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on

Climate Change and its Implications for Pakistan

held on
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at NIPA, Peshawar
During 41st MCMC

National Institute of Public Administration

National School of Public Policy


بسم الله الرحمن الرحيم

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Overall, the journal's focus on research, analysis, and practical solutions reflects a commitment to advancing knowledge and making a positive impact in the fields of international relations, Pakistan affairs, and faith & society. By providing a platform for diverse perspectives and experiences, the journal contributes to a more comprehensive understanding of complex issues and the development of effective policies and programs.

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- Five to six keywords should be provided;
- American English should be used;
- APA Manual of Style should be followed for Endnotes. In-text citations and bibliography are not required.;
- All the tables, charts, graphs and figures included in the manuscript should be in an editable, MS Word form.

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Khyber Journal of Public Policy

Volume: 3 Autumn, 2024 Issue: 4 (Special)

Special Issue: Climate Change and its Implications for Pakistan

(This special issue consists of the proceedings of a 2-Day Public Seminar held on September 29-30, 2024, on "Climate Change and its Implications for Pakistan," conducted at the conclusion of the Public Policy Simulation Exercise during the 41st Mid Career Management Course.)

Contents

Message of the Capt. (Retd) Usman Gul,

Director General National Institute of Public Administration, Peshawar on the eve of Special Issue of the Khyber Journal of Public Policy:

It is with immense pride and gratitude that I present this special issue of the Khyber Journal of Public Policy (KJPP), showcasing the exemplary research conducted by participants of the 41st Mid-Career Management Course (MCMC) during a week-long simulation exercise on "Climate Change and Its Implications for Pakistan." This special issue represents an invaluable effort, integrating diverse insights and research outcomes that underscore the urgent need for policy and action on climate adaptation and resilience.

During this simulation exercise the participants undertook a transformative journey, delving into the complex dynamics of climate change impacts on Pakistan's ecosystem, economy, and communities. Their work reflects a profound understanding of both the global context and local implications, addressing critical areas such as climate policy frameworks, ecosystem restoration, sustainable agriculture, renewable energy, carbon financing, adaptive infrastructure, and disaster resilience. The dedication displayed in exploring these diverse yet interlinked themes has yielded a rich compilation of insights that we proudly share in this issue.

This volume highlights not only the research acumen of the 41st MCMC participants but also the collaborative spirit that fuels policy innovation. Each article is a testament to the participants' commitment to creating a sustainable future and offers concrete recommendations for tackling climate challenges. The research topics discussed are a significant addition to the national discourse on climate policy, offering valuable perspectives on Pakistan's role in the global fight against climate change.

I extend my heartfelt appreciation to each participant, faculty member, and contributor who made this initiative a success. Your collective efforts have produced work that will serve as a foundational resource for policymakers, researchers, and practitioners alike.

Congratulations to all on this exceptional achievement.

Capt. (Retd) Usman Gul,
Director General
National Institute of Public
Administration, Peshawar

Preface

of the Special Issue of Khyber Journal of Public Policy

It gives us immense pleasure to present this Special Issue of the *Khyber Journal of Public Policy*, published by the National Institute of Public Administration (NIPA), Peshawar—a constituent unit of the National School of Public Policy. This edition is a comprehensive exploration of Pakistan's evolving climate policies, particularly focusing on Khyber Pakhtunkhwa (KP), in the context of national and international obligations. The issue seeks to address pressing challenges posed by climate change and explore innovative solutions for sustainable development and resilience building.

In recent years, climate change has emerged as a critical issue for Pakistan, particularly for provinces like KP, which are vulnerable to environmental degradation, natural disasters, and socioeconomic impacts. The articles presented in this issue are a culmination of rigorous research and policy analysis from experts in the field, providing insights into various dimensions of climate adaptation and mitigation strategies.

The contributions begin with a detailed analysis of the **National Climate Policy Framework and International Obligations**, presented by Mr. Aafaq Wazir, Mr. Zeeshan Khan, Mr. Saadullah Khan Mahsud, and Mr. Khalil Ahmed. This foundational piece lays out Pakistan's climate commitments and the role of international agreements in shaping the national response to global warming.

Moving to the provincial level, the **Climate Policy Framework of Khyber Pakhtunkhwa and International Obligations**, authored by Mr. Ashfaq Khan, Capt. (R) Bilal Shahid Rao, Mr. Fasih-ur-Rehman, and Ms. Shaista Azrar, examines KP's climate strategies and their alignment with global climate agendas.

A critical focus of this issue is the preservation of natural ecosystems, with articles like **Biodiversity, Ecosystem Restoration, and Reforestation to Combat Deforestation and Habitat Loss** by Muhammad Yousaf Iqbal, Zaid, and Bashir Ahmad, offering important perspectives on the importance of ecosystem health in addressing climate risks.

Climate change's implications for agriculture and food security are tackled in the article on **Climate Smart Agriculture, Food Security, and Sustainable Land and Water Management** by Mansoor Arshad, Mujeeb Ur Rahman, and Muhammad Iqbal, discussing innovative practices for sustainability in the agricultural sector.

The transition towards clean energy and sustainable technology is also critical in combating climate change. The article on **Energy Conservation, Renewable Resources, and Electric Vehicle Adoption** by Maqbool Hussain, Amjad Ali, and Ashraf Ali discusses the role of renewable energy and technology in reducing carbon footprints.

Innovative financing mechanisms are explored in **Carbon Financing, Carbon Credits, and Global Climate Resilience Investments** by Muhammad Awais Ishaque, Farid Ullah, and Manzoor Ahmad Afridi, offering insights into the economic strategies that could support climate resilience.

The broader implications of climate change for Pakistan are outlined in **Climate Change and its Implications for Pakistan** by Zahid Ullah Khan, Shahzad Javed, and Muhammad Nadeem Akhtar, a crucial piece that contextualizes the national impact of climate phenomena.

Urban planning and development in the context of climate adaptation are presented in **Climate-Adaptive Infrastructure and Environmentally Sustainable Urban Growth** by Syed Bilal Khisro, Bibi Fatima, and Muhammad Ishaq Khan, addressing the need for sustainable urbanization.

The issue also delves into the **Circular Economy and Sustainable Waste Management** with contributions from Amjad Meraj, Muhammad Ayaz Khan, and Syed Waseem Islam Kazmi, offering a forward-thinking approach to resource use and waste reduction.

Pakistan's vulnerability to natural disasters is analyzed in **Climate Risk Reduction, Disaster Preparedness, and Flood Resilience in Pakistan** by Muhammad Irfan Khan, Faqir Muhammad, and Mehnaz Bibi, which provides strategic insights into enhancing disaster resilience.

Lastly, the social dimensions of climate change are addressed in **Gender Inclusion and Cultural Engagement for Climate Mitigation** by Noor ul Huda Malick, Muhammad Nawaz, and Muhammad Ameer Khan, emphasizing the importance of inclusive approaches to climate action.

This Special Issue is a testament to the collaborative efforts of academics, practitioners, and policymakers committed to addressing one of the most pressing issues of our time. We hope the insights shared in these articles will contribute meaningfully to ongoing debates and inspire actionable solutions for a sustainable and climate-resilient Pakistan.

Dr. Muqeem ul Islam
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National Climate Policy Framework and International Obligations

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Abstract:

Governance plays a vital role in formulating climate change policies, especially in countries vulnerable to environmental hazards like Pakistan. Good governance requires a synergy between capable governments, civil society, and the private sector to create policies that improve disaster resilience and climate adaptation. Pakistan, although contributing less than 1% to global greenhouse gas emissions, ranks among the top 10 most affected countries by climate change. The recurrent climate-related disasters, such as the 2022 floods, demonstrate the urgent need for effective governance to mitigate climate risks. While Pakistan has aligned its national policies with international climate frameworks, challenges remain in policy implementation due to institutional, financial, and technical barriers. Strengthening governance, increasing domestic climate finance, and adopting innovative technologies are critical steps toward achieving resilience. Effective climate action requires a coordinated effort among all stakeholders to enhance Pakistan's capacity for climate adaptation and disaster preparedness.

Key words:

Governance, climate change, Pakistan, resilience, adaptation.

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Introduction

Governance is the exercise of political, economic, and administrative authority in the management of a country's affairs at all levels. It comprises formal and informal mechanisms, processes, and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations, and mediate their differences. While governance encompasses government and civil servants, it also includes all relevant stakeholders in a society, such as the private sector and civil society organizations, from households and local levels to provincial, national, and international levels.

Good governance for building feasible climate change policies that incorporate disaster and climate resilience occurs when capable, accountable, transparent, inclusive, and responsive governments work synergistically with civil society, the private sector, and at-risk populations. The aim is to formulate policies and action plans to create an enabling environment that improves society's ability to prepare for and respond to climate-related hazards, while building capacity to adapt to changes in the climate. However, governance is also affected by informal mechanisms, such as power dynamics, cultural and religious norms, and political ideologies, which can be powerful drivers in planning, formulating, and implementing policies.

Pakistan is among the top 10 countries most affected by climate change, despite contributing less than 1% to global greenhouse gas emissions. According to the Notre Dame-Global Adaptation Index (ND-GAIN), Pakistan is the 39th most vulnerable and the 27th least prepared nation globally to cope with the impacts of climate change. This is evident as the country has been intermittently hit by floods and other climate-related catastrophes in the past. A recent case is the June 2022 floods that caused an unprecedented disaster as heavy rains, combined with river, urban, and flash flooding, caused widespread devastation. The National Disaster Management Authority (NDMA) reported that around 33 million people, or one in seven Pakistanis, were affected by the floods. This situation presented a significant challenge for the Government of Pakistan, not only in resettling displaced populations but also in helping them adapt to drastically altered environments. Nearly 8 million people were forced to leave their homes, and over 1,700 lives were lost, with one-third of the victims being children. The unpredictable and volatile nature of climate-induced disasters was further highlighted by the fact that these floods came on the heels of a severe heatwave and drought. What was previously considered a once-in-1,000-year event was exacerbated by prolonged temperatures above 45°C, leading to crop failures, power outages, and wildfires (Hashmat et al., 2024). The following figure illustrates the categories of climate-related disasters Pakistan encountered over a fifteen-year period, with floods proving to be the most catastrophic, affecting 24.3 million people so far.

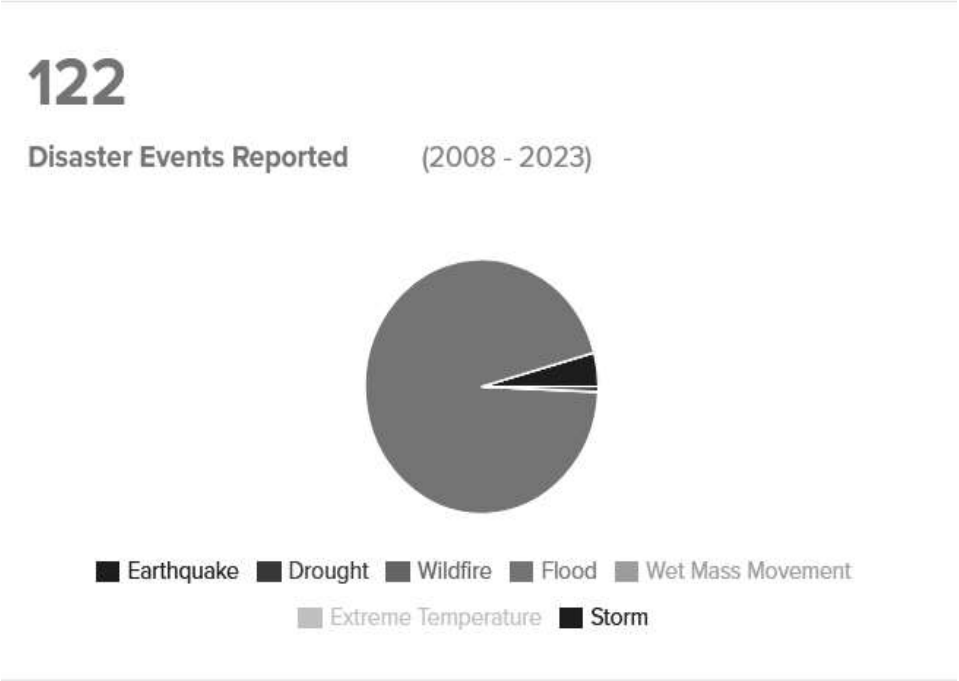

Figure 1. Affected population due to climate disasters (Pakistan)
Source: Internal Displacement Monitoring Centre (Pakistan)2023

In his book How to Avoid a Climate Disaster (2022), Bill Gates mentions that approximately 52 billion tons of greenhouse gases are emitted every year, contributing significantly to the degradation of the Earth's environment. In this context, Pakistan contributes only a minuscule percentage of 0.9% to global greenhouse gas (GHG) emissions, yet is one of the most susceptible countries (UNFCCC 2021).

To curtail the adverse effects of climate change and decarbonize the environment, a myriad of top international frameworks has been formulated, including the United Nations Framework Convention on Climate Change (UNFCCC) – 1992, the Kyoto Protocol – 1997, the Paris Agreement – 2015, the Conference of the Parties (COP, 26, 27 & 28), and the Sustainable Development Goals (SDGs). Pakistan has also developed several key policies and frameworks to address the growing challenges of climate change, including the Environmental Protection Act 1997, the National Climate Change Policy (NCCP) – 2012 (Revised in 2021), the National Disaster Risk Reduction Policy (NDRRP) – 2013, the Framework for Implementation of Climate Change Policy (2014-2030), the National Energy Efficiency & Conservation Act 2016, the Pakistan Climate Change Act – 2017, the Clean Green Pakistan Movement (CGPM) – 2018, the Ten Billion Tree Tsunami Programme (TBTTP) – 2019, and the National Adaptation Plan (NAP).

Problem Statement

Although Pakistan has devised several climate change-related policies and frameworks, significant challenges persist due to discrepancies between the country's national climate policies and international frameworks. These gaps, which include policy incoherence, inadequate institutional capacities, and limited financial resources, hinder Pakistan's ability to effectively meet global climate commitments.

A comprehensive examination of these policy mismatches is essential to ensure that national frameworks are robust enough to address the growing climate risks and are aligned with global standards for climate resilience and sustainability. Addressing this challenge is critical not only for enhancing Pakistan's climate adaptation and mitigation strategies but also for securing international support and maintaining credibility in global climate forums.

Scope

The study analyzes the workings of the Prime Minister's Task Force on the National Climate Policy Framework and International Obligations, established in 2008 by the Planning Commission of Pakistan, with the aim of aligning Pakistan's climate policies with global frameworks, including the Paris Agreement and Sustainable Development Goals (SDGs). The task force ensures that Pakistan meets its international climate obligations, as outlined in its Nationally Determined Contributions (NDC) under the Paris Agreement, and oversees the implementation of important national policies such as the National Climate Change Policy (2021) and the Climate Change Action Plan 2021-2025.

This study aims to evaluate Pakistan's current climate policy landscape, focusing on national and international regulatory frameworks, institutional structures, and their alignment with global best practices.

The study will analyze climate-related acts, laws, policies, and agreements of both Pakistan and international counterparts. It will also assess the effectiveness of Pakistan's national climate action, examine gaps in current policy implementation, and offer recommendations to strengthen institutional resilience and climate adaptation. The scope covers the Pakistan Climate Change Act 2017, the National Climate Change Policy 2021, and other key legislative frameworks, including the Pakistan Environmental Protection Act 1997 and the Nationally Determined Contributions (NDC).

Research Methodology

This research employs a qualitative methodology, rooted in an extensive review of secondary sources and data analysis. It includes a detailed examination of academic literature, government reports, interviews, social media analytics, and publications from international organizations pertinent to climate change. The following officials were interviewed:

1. Mr. Sami Ullah Wazir, DG Environmental Protection Agency, KP (KP Climate Change Policy and details of accomplishments of EPA, along with HR details, were obtained).
2. Mr. Zeeshan Abdullah, Additional Secretary, Climate Change, Forestry, Environment, and Wildlife Department (A brief prepared by the department for COP28 was obtained).
3. Mr. Adnan Farid, Additional Secretary P&D, and Mr. Sher Azam, Senior Chief of the Environment Section were interviewed, and documents such as the Supporting Climate Change concept note, a brief about the Climate Change Cell, P&D, and details of projects executed for achieving NDCs were obtained.

Analysis

Critical Analysis of National Policy Framework

Pakistan's national climate change policy framework, including the National Climate Change Policy (NCCP) 2012 and the Framework for Implementation (2014-2030), highlights the country's recognition of climate change's severe impacts, particularly on key sectors like agriculture, water, and energy. The policy framework emphasizes adaptation strategies such as building climate-resilient infrastructure, improving water resource management, and enhancing disaster preparedness. However, significant challenges hinder its effectiveness. Weak implementation mechanisms, limited financial resources, and institutional fragmentation, particularly between federal and provincial governments, have slowed progress. Pakistan's climate goals, as outlined in its Nationally Determined Contributions (NDCs), are heavily reliant on international financial assistance, which has been insufficient. Furthermore, the country's infrastructure remains vulnerable to climate risks, as evidenced by recent devastating floods. To improve, Pakistan needs to strengthen institutional capacities, mobilize both domestic and international climate financing, and encourage public-private partnerships to promote green technologies. Establishing robust monitoring and evaluation mechanisms is also essential to ensure policy effectiveness and accountability. Despite the challenges, Pakistan's engagement in global climate efforts, particularly under the Paris Agreement, reflects its commitment to addressing climate change, although significant improvements are needed to translate policies into action.

Evaluation of Federal-Level Policy Implementation Framework

The federal-level policy implementation framework in Pakistan plays a crucial role in translating national policies into actionable programs, particularly in areas such as climate change, development, and economic reform. However, despite strong policy frameworks, challenges in governance, resource allocation, and institutional coordination have hindered effective implementation. This evaluation explores the strengths and weaknesses of the federal-level policy implementation framework in Pakistan, focusing on key areas such as administrative capacity, resource mobilization, and coordination between federal and provincial governments.

Strengths of the Federal-Level Policy Implementation Framework

a. Comprehensive Policy Frameworks:

At the federal level, Pakistan has developed numerous comprehensive policies to address key national issues. For example, policies related to climate change, economic reform, education, and healthcare reflect clear objectives and strategic plans. These policies are often aligned with international agreements and standards, demonstrating Pakistan's commitment to global efforts such as the Sustainable Development Goals (SDGs).

b. Centralized Oversight and Coordination:

Federal institutions like the Ministry of Planning, Development, and Reform, and the Ministry of Climate Change provide centralized oversight and play a pivotal role in ensuring that national policies are harmonized and aligned with broader goals. These ministries are responsible for allocating resources, setting national priorities, and monitoring the progress of policy implementation.

c. International Cooperation and Funding:

The federal government has successfully engaged in international partnerships and secured funding from global financial institutions and development organizations, particularly in sectors such as energy, infrastructure, and climate change adaptation. This external support provides critical financial and technical resources that are often unavailable at the provincial level.

Issues and Challenges in Policy Implementation

a. Institutional Fragmentation and Governance Issues:

A major challenge in federal-level policy implementation is institutional fragmentation. Different ministries and departments often work in silos, resulting in inefficiencies and overlapping mandates. Coordination between federal ministries and provincial authorities remains weak, especially after the 18th Constitutional Amendment, which devolved several policy responsibilities to the provinces. This decentralization has led to governance issues, with provinces sometimes lacking the capacity or resources to implement federal policies effectively.

b. Limited Administrative Capacity and Technical Expertise:

Federal agencies often face capacity constraints, particularly in terms of human resources and technical expertise. In key sectors such as healthcare, education, and climate change, the federal government struggles to recruit and retain skilled personnel who can ensure effective policy execution. Moreover, bureaucratic inefficiencies and delays are common, further hindering implementation.

c. Inadequate Resource Mobilization:

While the federal government often formulates ambitious policies, their implementation is constrained by inadequate financial resources. National policies often depend on substantial domestic and international funding, which can be inconsistent or delayed. The federal budget allocates limited resources to development and social sectors, making it difficult to achieve policy targets in areas such as poverty reduction, infrastructure development, and environmental sustainability.

d. Monitoring and Accountability Mechanisms:

Pakistan's federal policy framework lacks robust monitoring and evaluation mechanisms to track the progress and effectiveness of policy implementation. This gap often leads to delays in identifying and addressing challenges, which reduces policy responsiveness and accountability. Although oversight agencies exist, their capacity to enforce compliance or address underperformance is limited.

Analysis of International Climate Obligations and Its Alignment with National Policy

International Climate Obligation	Alignment with National Policy
i. Kyoto Protocol (1997) In 2005, Pakistan signed the Kyoto Protocol but was not required to have binding emission reduction targets as it was considered a developing country. However, Pakistan has benefited from climate finance through mechanisms such as the Clean Development Mechanism (CDM) to support low-carbon development projects. Between 2005 and 2020, Pakistan hosted 74 CDM projects, potentially leading to a reduction of over 13 million tons of CO_2 equivalent per year (GoP, 2021).	The revised National Climate Change Policy (NCCP) in 2021 places a strong emphasis on building climate resilience, particularly through adaptation measures. However, there is limited focus on long-term mitigation, which is in line with Pakistan's status under the Kyoto Protocol. The Clean Development Mechanism (CDM) projects in Pakistan have supported green initiatives in renewable energy, such as small hydropower projects, aligning with national efforts to reduce dependency on fossil fuels (Ilyas et al., 2023).
ii. Paris Agreement (2015) Pakistan ratified the Paris Agreement in 2016 submitting its Nationally Determined Contributions (NDCs), which highlight a target of reducing GHG emission by 50% by 2030, conditional on international finance support. Recent studies show that Pakistan's emissions have increased over time, reaching approximately 490 million tons of CO_2 equivalent in 2021, with energy, agriculture, and industry being the largest contributors (GoP, 2021).	**Aligned with National Policy** The 2021 Updated NDCs reflect Pakistan's dual focus on adaptation and mitigation. Pakistan's Alternative and Renewable Energy Policy (AREP 2019) sets a goal to produce 30% of electricity from renewables by 2030. However, according to a 2022 review, the country still faces significant barriers to renewable energy adoption, such as financial constraints, political instability, and outdated infrastructure, slowing its transition to low-carbon energy production. Pakistan's energy sector contributed over 40% of total GHG emissions, highlighting the urgent need for decarbonizing energy. Despite the progress, achieving the 50% emission reduction target is contingent on securing around $100 billion in climate finance and capacity-building support by 2030 (Malik & Ullah, 2023).
iii. COP 27 (Sharm El Sheikh, 2022) At COP 27, Pakistan led efforts to establish a Loss and Damage Fund, aimed at compensating vulnerable countries for climate-induced damages. In the aftermath of the 2022 floods, which caused damages	**Aligned with National Policy** Pakistan's national policies are increasingly focused on disaster risk reduction and resilience-building, especially in agriculture and water management. The National Climate

of over $30 billion, Pakistan's advocacy for climate finance gained substantial international support. Pakistan's loss from climate change was estimated at 9.1% of GDP between 2000-2020, according to the Global Climate Risk Index 2021 (Eckstein et al., 2023).	Change Policy (NCCP) and National Disaster Risk Reduction Policy (2013) prioritize mitigation of extreme weather events (UNFCCC, COP 27).
iv. COP 28 (Dubai, 2023) At COP 28, Pakistan advocated for more robust climate financing and technical support. Recent research indicates that Pakistan requires an estimated $348 billion by 2030 to transition towards sustainable energy, adapt to climate change, and protect against future climate disasters.	**Aligned with National Policy** Pakistan's Alternative and Renewable Energy Policy (AREP 2019), which aims to generate 30% of energy from renewable sources by 2030, reflects the country's commitment to clean energy. However, a 2023 study found that Pakistan currently generates less than 5% of its electricity from renewables, which highlights a significant gap in policy implementation that needs addressing.
COP 29 (to be held at Baku, Azerbaijan from 11th to 22nd Nov, 2024) It has two pillars; namely Enhance Ambition and Enable Action. It will prioritise to focus on policies to lower temperature by 1.5 degrees, national adaptation plans, NDCs from all stakeholders, New Collective Qualified Goal and finalise Article 6 of Paris Agreement.	**Aligned with National Policy.** Since the COP will be focusing more on implementation and evaluation so the policies already aligned will be discussed and further progress will be ensure after evaluating the challenges in its achievement.
Sustainable Development Goals (SDGs) Pakistan has made progress toward the SDG 13: Climate Action, SDG14: Life Below Water Land, SDG:15 Life on Land with key areas including adaptation, disaster risk reduction, and early warning systems. The government's 2023 Voluntary National Review highlighted that 70% of Pakistan's SDG indicators are linked to climate and environmental outcomes, with over $7 billion allocated for SDG projects since 2016.	**Aligned with National Policy** Pakistan's integration of the SDGs into its Vision 2025 reflects alignment with international development goals. However, a 2022 study on SDG implementation noted that funding gaps and weak institutional coordination remain critical barriers to achieving the SDGs, particularly in rural areas affected by climate change. Achieving SDG 13 requires a significant increase in investment in climate-resilient infrastructure, particularly in water management and agriculture. The study indicated that Pakistan needs to close a $12.5 billion annual gap in SDG-related funding to stay on track by 2030 (Khan et al., 2023).

Legal and Institutional Framework Assessment

Legal Framework

Pakistan's existing legal and institutional framework for climate policy is a patchwork of policies and regulations aimed at addressing the multifaceted challenges of climate change, but it faces several significant challenges related to coherence, coordination, and implementation. The country's key climate strategy is the National Climate Change Policy (NCCP) 2012, which provides a broad framework for tackling climate change. However, the policy has struggled to achieve its goals due to weak institutional capacity, lack of inter-sectoral coordination, and inadequate financial resources. Additionally, the Framework for Implementation of Climate Change Policy (2014–2030) was introduced to prioritize actions, but tangible outcomes have been limited due to weak governance and political will (Mumtaz, M., 2018). At the institutional level, the Ministry of Climate Change is tasked with leading the implementation of national climate policies. Still, there are significant gaps in coordination between federal, provincial, and local authorities. Pakistan's devolution of powers under the 18th Amendment has further complicated the execution of climate policies across different governance levels, often leading to fragmented efforts (Iqbal et al., 2022). Furthermore, Pakistan has committed to international frameworks, such as the Paris Agreement, submitting its Nationally Determined Contributions (NDCs), which pledge to reduce greenhouse gas emissions. However, inadequate legal frameworks and a lack of integration between climate policy and broader economic development strategies have hindered progress (Mumtaz, M., 2018). The Kyoto Protocol also shaped Pakistan's approach to climate finance through the Clean Development Mechanism (CDM), but institutional inefficiencies have constrained the full realization of CDM benefits (Ahmad & Salman, 2012). In summary, while Pakistan has made strides in developing a legal and policy framework for climate action, significant barriers remain in ensuring these policies are effectively integrated into national development plans and implemented across all sectors.

A brief of the Pakistan Legal Framework is elaborated here as follows:

Important Features of Legal Framework
i. Pakistan Climate Change Act 2017 • Established the Pakistan Climate Change Council and the Pakistan Climate Change Authority to oversee the implementation of climate-related policies, coordinate across governmental levels, and manage international climate finance (Mumtaz.M, 2018). • Aims to integrate climate adaptation and mitigation strategies into national development planning.

ii. National Climate Change Policy (NCCP) 2012

- Provides a comprehensive framework to address climate change impacts on water, agriculture, health, and energy sectors.
- Focuses on disaster preparedness, biodiversity, and the transition to renewable energy, but its implementation has been slow due to lack of coordination and resources.

iii. Environmental Protection Act 1997

- Primarily focuses on pollution control but includes provisions for addressing climate-related environmental degradation, air and water quality. However, it doesn't provide a comprehensive mechanism for dealing with Climate Change. (Iqbal et al., 2022).
- Forms the legal basis for environmental impact assessments (EIAs), which are essential in climate-sensitive projects like infrastructure and energy development.

iv. Kyoto Protocol and Clean Development Mechanism (CDM)

- Pakistan has been involved in the CDM under the Kyoto Protocol, which facilitated projects to reduce greenhouse gas emissions and allowed for carbon credits trading (Iqbal et al., 2022).

v. Paris Agreement 2016

- Pakistan committed to reducing its emissions by 50% by 2030, conditional on international climate finance support (Mako et al., 2022).
- The country's Nationally Determined Contributions (NDCs) outline its strategies for achieving these targets, though progress remains limited due to institutional and financial constraints (GoP, 2017).

vi. National Disaster Risk Reduction Policy 2013

- Focuses on disaster risk management in the context of increasing climate change impacts such as floods and droughts
- Aligns with broader climate adaptation strategies, especially in vulnerable areas.

vii. 18th Constitutional Amendment (2010)

- Devolved environmental governance to the provincial level, complicating the coordination of national climate policies.
- Provinces now hold significant responsibility for implementing climate actions, which has led to uneven progress.

viii. National Energy Efficiency & Conservation Act 2016

- It aims to promote energy efficiency and reduce greenhouse gas emissions from the energy sector, a major source of Pakistan's emissions.
- Part of the broader effort to achieve sustainable energy targets under SDG-7 and SDG-13.

This framework, while extensive, faces challenges of coherence, coordination, and financial limitations, particularly in translating policies into actionable programs across provincial governments. Despite these legislative efforts, these laws do not fully integrate climate change as a priority within key economic sectors like energy, agriculture, and infrastructure. The fragmentation of laws across different sectors often results in a lack of cohesive implementation strategies at the national level (Khan et al., 2023).

Institutional Framework

The Ministry of Climate Change (MoCC) is the primary federal institution responsible for formulating and overseeing the implementation of climate policy. However, other ministries, such as the Ministry of Energy, the Ministry of Water Resources, and the Ministry of Planning, Development, and Reform, are also responsible for key economic sectors. The MoCC often lacks the authority to enforce climate-related policies across these ministries, leading to institutional fragmentation. For example, while the MoCC has designed comprehensive policies such as the National Climate Change Policy (2021) and the National Adaptation Plan (NAP), implementation is hindered by misalignments with economic planning documents such as Pakistan's Vision 2025 and Five-Year Development Plans. Additionally, an authority envisaged in the Climate Change Act of 2017, known as the Climate Change Authority, has yet to be established even after a lapse of seven years.

i. Integration with Economic and Multi-Sectoral Development Plans:

- Vision 2025 and Five-Year Development Plans: Pakistan's broader economic and development plans emphasize economic growth, poverty reduction, and industrial development. However, these plans have historically prioritized short-term economic growth over long-term sustainability, and the integration of climate policies is limited.

- A 2023 report by Hussain and Ahmed points out that while Vision 2025 mentions climate change, the goals are not aligned with actionable targets for carbon emissions reduction or adaptation. For instance, the energy sector's expansion plan within the Five-Year Plan focuses predominantly on coal and natural gas, with minimal inclusion of renewable energy targets, in contrast to the commitments made in Pakistan's Nationally Determined Contributions (NDCs) under the Paris Agreement.

COMPARATIVE ANALYSIS OF GLOBAL BEST PRACTICES

Overview of Pakistan's Climate Change Policy and Mitigation Strategies

Pakistan's climate change policy and mitigation strategies are articulated in several key documents, such as the National Climate Change Policy (2012), Nationally Determined Contributions (NDCs) under the Paris Agreement, and the National Adaptation Plan (NAP). However, there remain significant gaps in effective implementation, resource mobilization, and coordination with economic growth strategies. The National Climate Change Policy outlines objectives for reducing greenhouse gas (GHG) emissions, transitioning to renewable energy, and enhancing resilience to climate impacts. However, its Nationally Determined Contributions (NDCs) are relatively modest, aiming to reduce GHG emissions by 50% by 2030, conditional on receiving international financial support (GoP, 2021).

International Best Practices	**Best Practice adoption for Pakistan**
i. Renewable Energy Transition Germany's **Energiewende (Energy Transition)** is often cited as a model for decarbonizing energy systems. The country has rapidly expanded its renewable energy portfolio, with **47%** of its energy coming from renewables as of 2021. Germany's success lies in robust policy frameworks like feed-in tariffs, incentives for solar and wind installations, and substantial public-private investments (Helm. D, 2021).	• Pakistan could adopt feed-in tariffs and offer more attractive incentives for private sector investments in solar and wind energy. Germany's decentralized energy model can be replicated, especially in regions like Khyber Pakhtunkhwa, which have substantial hydroelectric potential.

ii. Climate Adaptation and Resilience Building The Netherlands' Delta Programme offers an excellent model for flood risk management and climate adaptation. By combining engineering solutions (dykes, levees, flood barriers) with nature-based solutions, the country has effectively protected itself from sea-level rise while enhancing ecological resilience. The program is anchored in a long-term, well-funded strategy and engages local communities (Aerts, J. et al., 2021).	• Pakistan, especially regions like Sindh and Punjab prone to flooding, can learn from the Netherlands by combining hard infrastructure (dams, levees) with nature-based solutions (mangrove restoration, wetlands creation). Long-term financing for adaptation should be prioritized through both national budgets and international funds like the **Green Climate Fund (GCF)**.
iii. Climate Governance and Institutional Capacity The UK Climate Change Act (2008) established legally binding carbon budgets and created the Committee on Climate Change, an independent body that advises the government on climate actions. The UK's success is rooted in strong legal frameworks, cross-ministerial coordination, and a centralized climate monitoring body that ensures accountability (CCC, 2021).	• Pakistan could benefit from establishing an independent Climate Change Commission that reports directly to the Prime Minister's Office. This body could oversee cross-sectoral coordination, track progress on NDC targets, and ensure accountability across ministries.

iv. Carbon Pricing and Market Mechanism Sweden's carbon tax has been hailed as one of the most effective tools in reducing emissions. Introduced in 1991, the carbon tax has helped Sweden reduce GHG emissions by 25% while growing its economy by 75%. Sweden's model also integrates financial incentives for companies that switch to low-carbon technologies (Hammar, H. et al. (2021).	• Introducing a carbon pricing mechanism could help Pakistan meet its emission reduction targets. A phased introduction of a carbon tax for high emission sectors such as cement and brick manufacturing could help generate revenue for green investments and provide incentives for emission reductions.

Institutional Framework Swot Analysis

SWOT Analysis	Details
Strengths	• **Existence of Dedicated Institutions**: Institutions like MoCC and PCCA with clear mandates for climate policies. • **Strong Policy Framework**: Key documents such as NCCP and NAP provide strategic roadmaps for climate action. • **International Support and Funding**: Success in securing international funding for climate projects. • **Climate Vulnerability Awareness**: Growing awareness among governments regarding climate vulnerability and integration into policies.
Weaknesses	• **Fragmented Institutional Coordination**: Lack of coordination among climate related bodies leading to inefficiencies. • **Inadequate Financial Resources for Implementation**: Limited budget for climate action affecting comprehensive programs • **Lack of Enforcement Mechanisms**: Weak enforcement of environmental regulations. • **Dependency on International Donors**: Reliance on donor support affects long-term sustainability of climate projects.

Opportunities	• **Green Economic Growth and Job Creation**: Potential to shift towards renewable energy and eco-tourism. • **Capacity Building and Institutional Strengthening**: International partnerships can enhance disaster management and climate adaptation. • **Leveraging International Climate Finance**: Increased focus on GCF and MDBs can enhance funding for climate initiatives. • **Technological Innovations in Climate Adaptation**: Potential to use advanced technologies for planning and response.
Threats	• **Political Instability and Policy Continuity**: Frequent political changes threaten climate policy sustainability. • **Rising Climate Risks and Disasters**: Increasing frequency of extreme weather events challenges institutional capacity. • **Economic Constraints and Competing Priorities**: Limited domestic funding due to economic challenges. • **Lack of Public Awareness and Community Engagement**: Low public awareness can hinder policy implementation.

Stakeholder Analysis

1. Positively Affecting

Key stakeholders responsible for shaping and implementing Pakistan's climate policies include the Ministry of Climate Change, the Pakistan Climate Change Authority, and international organizations like the UNFCCC. The Ministry of Climate Change plays a central role in setting the national climate agenda, drafting policies such as the National Climate Change Policy (2021), and overseeing their implementation. The Pakistan Climate Change Authority, established under the Pakistan Climate Change Act (2017), is tasked with ensuring that climate strategies are enacted across sectors and aligned with international obligations, such as the Paris Agreement (2015). Additionally, global bodies like the UNFCCC provide both financial and technical support, which is crucial for Pakistan's climate initiatives, particularly through mechanisms like the Green Climate Fund and the Adaptation Fund (Pakistan Climate Change Act, 2017).

2. Positively Being Affected

The primary beneficiaries of Pakistan's climate resilience strategies are vulnerable communities, particularly those in flood-prone areas, as well as sectors critical to the country's economy, such as agriculture and water management. Flood-prone communities along the Indus

River Basin benefit from initiatives like the Recharge Pakistan Program, which aims to restore wetlands and mitigate flood risks through nature-based solutions (National Climate Change Policy, 2021). In addition, Pakistan's Ten Billion Tree Tsunami initiative not only enhances forest cover but also improves local communities' resilience to climate-induced deforestation and desertification, contributing to better livelihood opportunities in rural areas. The agricultural sector, which accounts for around 22% of Pakistan's GDP, is also a direct beneficiary of climate adaptation programs focused on water conservation and sustainable farming practices (National Climate Change Policy, 2021).

3. Negatively Affecting

Despite positive intentions, inconsistent policy enforcement by provincial governments poses a significant challenge to climate action. Under the 18th Amendment (2010), provincial governments gained autonomy over environmental regulations, which has led to fragmented and uneven policy implementation across the country. While federal initiatives, such as the Pakistan Climate Change Authority, provide the legislative framework, provincial governments often lack the capacity, resources, or political will to fully enforce these policies. This inconsistency weakens national climate strategies and hampers the realization of Pakistan's commitments under international agreements like the Paris Agreement (2015) (Pakistan Climate Change Act, 2017).

4. Negatively Being Affected

Rural communities, particularly those in high-risk areas like Gilgit-Baltistan and Khyber Pakhtunkhwa, face increasing climate-related hazards such as Glacial Lake Outburst Floods (GLOFs) and droughts. These regions, already vulnerable due to geographic isolation and limited infrastructure, are further disadvantaged by inadequate disaster preparedness and a lack of resource allocation from both federal and provincial authorities (Pakistan Climate Change Act, 2017). Additionally, climate change exacerbates water scarcity in these regions, threatening both livelihoods and food security. The National Climate Change Policy (2021) recognizes these vulnerabilities, yet the lack of on-the-ground implementation, especially in rural areas, leaves these communities disproportionately affected by climate impacts (National Climate Change Policy, 2021).

PESTLE ANALYSIS OF THE ALIGNMENT FRAMEWORK

Political

The political landscape in Pakistan presents significant challenges to the effective coordination of climate policies, particularly due to provincial autonomy following the 18th Amendment (2010). This amendment transferred environmental governance powers to the provincial governments, leading to inconsistencies in policy enforcement and a fragmented approach to climate action. While the Pakistan Climate Change Act (2017) establishes the federal framework, its effectiveness is often hampered by provinces' limited capacity to implement climate initiatives uniformly (Pakistan Climate Change Act, 2017). This lack of coordination between federal and provincial authorities has slowed the execution of critical climate adaptation and mitigation projects, particularly in vulnerable regions such as Balochistan and Khyber Pakhtunkhwa.

Economic

Pakistan's climate actions are heavily dependent on international financial support. The Nationally Determined Contributions (2021) highlight the country's commitment to reducing greenhouse gas emissions by 50% by 2030, but this is contingent upon securing international funding (Nationally Determined Contributions, 2021). The economic strain of climate adaptation measures is particularly acute in sectors such as agriculture and energy, where the transition to sustainable practices requires significant investment. Pakistan has struggled to develop robust domestic financing mechanisms, such as carbon pricing or green bonds, which have proven effective in other countries like Sweden and Germany (National Climate Change Policy, 2021).

Social

Public awareness of climate change remains relatively low in Pakistan, especially in rural areas where communities are often directly impacted by climate-induced disasters such as floods and droughts. The National Climate Change Policy (2021) emphasizes the need for greater community participation and awareness, particularly in disaster-prone regions. However, the lack of comprehensive education and awareness programs has limited the public's engagement in climate action. Programs such as the Ten Billion Tree Tsunami have made some progress in involving local communities in afforestation efforts, but much more is needed to build a nationwide movement for climate resilience (National Climate Change Policy, 2021).

Technological

Pakistan faces significant technological gaps, particularly in the development and deployment of Monitoring, Reporting, and Verification (MRV) systems. These systems are critical for tracking emissions reductions and ensuring compliance with international climate commitments, such as the Paris Agreement (2015). The Pakistan Climate Change Act (2017) mandates the establishment of MRV systems, but inadequate data collection infrastructure and the lack of technological capacity at the provincial level hinder the effectiveness of these systems (Pakistan Climate Change Act, 2017). In contrast, countries like Norway and Germany have successfully implemented advanced MRV systems that enable real-time data collection and reporting, allowing them to meet their climate targets more efficiently.

Legal

The legal framework for climate action in Pakistan, primarily governed by the Pakistan Climate Change Act (2017) and the Pakistan Environmental Protection Act (1997), provides a strong foundation for addressing climate change. However, enforcement remains inconsistent across provinces. Provincial governments often lack the regulatory capacity or resources to enforce environmental laws effectively, resulting in gaps in compliance with national climate policies (Pakistan Environmental Protection Act, 1997). For example, environmental impact assessments, which are required for large infrastructure projects, are not always rigorously enforced, particularly in regions with limited governance infrastructure.

Environmental

Pakistan is highly vulnerable to climate-induced natural disasters, including floods, droughts, and Glacial Lake Outburst Floods (GLOFs) in the northern regions. The Pakistan Climate Change Action Plan (2021-2025) identifies increasing climate vulnerabilities as a significant challenge, particularly in rural and mountainous regions where communities lack access to disaster preparedness resources (Pakistan Climate Change Action Plan, 2021-2025). These environmental challenges are further compounded by deforestation, water scarcity, and soil degradation, which threaten the livelihoods of millions of Pakistanis.

Gap Analysis of Policies and Their Implementation

There is a significant gap between the formulation of climate policies and their effective implementation in Pakistan. This gap is particularly pronounced at the provincial level due to the decentralization of environmental governance brought about by the 18th Amendment (2010). While the National Climate Change Policy (2021) and the Pakistan Climate Change Act (2017) provide a robust framework for addressing climate challenges, the lack of coordination and capacity at the provincial level hinders consistent implementation across the country (Pakistan Climate Change Act, 2017). Provinces such as Balochistan and Khyber Pakhtunkhwa, which are most vulnerable to climate impacts, often lack the financial resources and technical expertise needed to implement climate adaptation and mitigation strategies.

Another critical gap lies in Pakistan's heavy reliance on international financial support. The Nationally Determined Contributions (2021) set ambitious targets for reducing greenhouse gas emissions by 50% by 2030, but these targets are contingent on receiving international funding. This financial dependency creates uncertainty and limits the sustainability of Pakistan's climate actions, as continued progress is subject to the availability of external aid (Nationally Determined Contributions, 2021). The reliance on global funds, such as the Green Climate Fund, while essential, exposes Pakistan to the volatility of international financial commitments, making long-term planning and project implementation challenging.

Furthermore, gaps in data collection and Monitoring, Reporting, and Verification (MRV) systems significantly hinder Pakistan's ability to accurately track emissions reductions and progress in climate adaptation. Although the Pakistan Climate Change Act (2017) mandates the establishment of MRV systems, these mechanisms are either underdeveloped or poorly coordinated at the provincial level. This lack of robust MRV systems not only impacts emissions tracking but also hampers Pakistan's ability to meet its international obligations under the Paris Agreement (2015). Provinces often lack the infrastructure needed for real-time data collection, making it difficult to compile accurate reports on climate action progress (Pakistan Climate Change Act, 2017).

Moreover, the Pakistan Environmental Protection Act (1997) mandates environmental assessments for projects that could potentially harm the environment. However, there are gaps in enforcement, particularly at the provincial level, where capacity constraints and a lack of regulatory oversight undermine the effectiveness of these assessments (Pakistan Environmental Protection Act, 1997). The inability to enforce these

regulations consistently across provinces adds another layer of complexity to the climate governance framework in Pakistan.

The gaps in policy implementation, financial dependency, and data collection systems pose significant challenges to Pakistan's climate goals. Addressing these gaps will require enhanced federal-provincial coordination, the development of domestic financial mechanisms, and the strengthening of MRV systems to ensure that climate actions are both sustainable and effective.

Figure: GAP ANALYSIS

Objective	Current State	Desired State	Gap identified	Gap Description
Provincial Implementation of Climate Policies	Inconsistent implementation due to decentralization post-**18th Amendment (2010).** Provinces lack capacity and resources.	Coordinated federal and provincial climate action, with strong capacity in all provinces.	Lack of coordination between federal and provincial governments, resource limitations in vulnerable provinces.	Provinces such as **Balochistan and Khyber Pakhtunkhwa** are unable to implement climate strategies effectively.
Financial Dependency on International Aid	Heavy reliance on international funding for climate initiatives, **NDC (2021)** targets contingent on external support.	Sustainable, domestically-funded climate actions with reduced dependence on international aid.	Reliance on global funds such as the **Green Climate Fund** creates uncertainty in long-term climate planning.	Financial dependency limits sustainability. making progress vulnerable to shifts in international financing commitments
Data Collection and MRV Systems	Inadequate Monitoring. **Reporting. and Verification (MRV)** systems. Provinces lack infrastructure for real-time data.	Robust, province-wide **MRV systems** capable of real-time data collection and emissions tracking	Lack of coordination and technological infrastructure at the provincial level.	Without accurate MRV systems, emissions tracking and progress on climate adaptation cannot be effectively monitored.
Enforcement of Environmental Regulations	**The Pakistan Environmental Protection Act (1997)** mandates assessments, but enforcement is inconsistent across provinces.	Consistent enforcement of environmental laws with strong regulatory oversight at the provincial level.	Capacity constraints and lack of regulatory oversight hinder effective enforcement of environmental regulations.	The provincial authorities lack the resources and capacity to enforce environmental assessments uniformly across projects.

Conclusion

Pakistan's climate obligations under international treaties such as the Paris Agreement, Kyoto Protocol, and the COP conferences align with its national climate policy framework. The National Climate Change Policy (NCCP) and Nationally Determined Contributions (NDCs) are evidence of this alignment, particularly in terms of focusing on adaptation, disaster risk reduction, and sustainable energy transition.

However, the gap between policy and implementation remains a challenge. Research indicates that while Pakistan is making strides in aligning its national strategies with international commitments, significant financial, technical, and institutional barriers persist. Political instability, limited financial resources, weak technological infrastructure, and fragmented legal frameworks pose significant barriers to effective climate action. Achieving Pakistan's climate goals will require a substantial increase in international climate finance, robust governance mechanisms, stronger institutional frameworks, and greater investment in renewable energy and climate-resilient infrastructure. By learning from international best practices and leveraging both domestic and international resources, Pakistan can strengthen its resilience against climate change and achieve its climate-related targets.

To address these issues, there needs to be:

- Stronger coordination mechanisms between the MoCC and key economic ministries.
- An integrated financial strategy, increasing domestic funding to mobilize and allocate climate finance more efficiently.
- Enhanced capacity-building at the provincial level to ensure that national climate policies are effectively translated into local action.

With actionable and pragmatic strategies, the country can enhance its capacity to mitigate the impacts of climate change while promoting sustainable development.

Recommendations

Strengthen Institutional Coordination and Governance

Recommendation

- Establish a Centralized Climate Coordination Body: To address the fragmented approach among federal, provincial, and local institutions, create a National Climate Action Council (NCAC) under the Ministry of Climate Change. This council would oversee coordination between ministries, provincial governments, and local agencies to ensure that climate-related policies are integrated across sectors like agriculture, water energy, and infrastructure Justification.
- Effective coordination ensures streamlined policy implementation and mitigates overlapping responsibilities, which have led to delays and inefficiencies.

Actionable Steps

- Set up regular climate action meetings that bring together key stakeholders from all levels of government.
- Empower the NCAC to create specific cross-sectoral working groups focusing on areas like flood management, agricultural resilience, and renewable energy.

Increase Domestic Climate Finance

Recommendation

- Create a National Climate Fund: To reduce reliance on international donors and make climate financing more sustainable, establish a domestic climate fund. This fund would be fueled by a mix of carbon taxation, environmental levies, and public-private partnerships.

Justification

- Over-reliance on external financing limits Pakistan's capacity for sustained climate action. A domestic fund would provide more control and long-term planning ability.

Actionable Steps

- Introduce a carbon tax on emissions from key industrial sectors like manufacturing and transport.
- Incentivize businesses to invest in climate-friendly projects through tax breaks and subsidies.

- Mobilize contributions from the private sector by introducing green bonds and creating opportunities for climate-focused public-private partnerships (PPPs).

Enhance Technological Innovation and Adoption

Recommendation:

- Invest in Climate-Smart Technology: Allocate funds to enhance technological capacity in key areas such as GIS-based disaster monitoring, early warning systems, and climate-resilient agriculture. Pakistan should collaborate with international tech firms and research institutions to introduce state-of-the-art climate prediction models.

Justification:

- Effective technology use is crucial for managing disasters, especially in flood-prone areas. Real-time monitoring improves decision-making and resource allocation during emergencies.

Actionable Steps:

- Develop an Integrated Early Warning System (IEWS) with real-time flood and drought forecasting, using GIS, drones, and satellite data.
- Establish innovation hubs that focus on climate-smart agriculture, energy efficiency, and renewable energy technologies.
- Build capacity through technical training programs for government agencies and local communities to adopt and implement these technologies.

Strengthen Legal Frameworks and Enforcement Recommendation:

- Improve Enforcement of Climate and Environmental Regulations: Strengthen the capacity of provincial Environmental Protection Agencies (EPAs) to enforce existing environmental laws, including the Pakistan Environmental Protection Act. Provide additional resources and funding to enable them to monitor industrial emissions, deforestation, and pollution effectively.

  Justification:

  - Weak enforcement has been a critical barrier to effective climate action. Strengthening regulatory bodies will ensure compliance and accountability for climate laws.

Actionable Steps:

- Allocate additional resources and technical expertise to EPAs to carry out inspections, monitor compliance, and enforce penalties.
- Increase the use of environmental fines for non-compliant industries, with funds funneled into the National Climate Fund.
- Standardize environmental assessments and ensure uniform enforcement across provinces to avoid discrepancies in regulatory practices.

Increase Public Engagement and Awareness Recommendation:

- Launch National Climate Awareness Campaigns: Develop large-scale awareness campaigns to educate the public on climate change, targeting vulnerable populations such as rural farmers and coastal communities. Emphasize the importance of local-level climate adaptation and mitigation strategies.

Justification:

- Public engagement is vital to the success of climate policies. Raising awareness and providing local communities with the knowledge and tools to act will foster community resilience.

Actionable Steps:

- Use multimedia platforms, including television, radio, social media, and community-based workshops, to disseminate climate information.
- Partner with local NGOs and community groups to mobilize rural and urban populations around adaptation strategies, such as flood management and water conservation.
- Introduce climate education programs in schools and universities to build a climate-conscious future generation.

Foster Research and Development (R&D) Recommendation:

- Increase Investment in Climate-Specific R&D: Encourage universities, research institutions, and private sector players to collaborate on developing context-specific climate adaptation solutions. Focus on key areas like water management, drought-resistant crops, and sustainable energy sources.

Justification:

- Pakistan lacks sufficient R&D in climate adaptation strategies tailored to its specific geographical and socio-economic challenges. Developing localized solutions will increase the effectiveness of climate policies.

Actionable Steps:

- Establish a National Climate Research Consortium that connects leading universities, private firms, and international experts to address Pakistan's climate challenges.

- Incentivize R&D by offering grants and scholarships for climate-related research projects in areas like agriculture, water management, and renewable energy.
- Collaborate with international climate research institutions to bring global expertise to Pakistan's unique climate issues.

Promote Renewable Energy Expansion Recommendation:

- Accelerate the Transition to Renewable Energy: Expand investments in solar, wind, and hydropower projects to reduce dependence on fossil fuels and cut greenhouse gas emissions. Prioritize public-private partnerships (PPPs) in the renewable energy sector to attract investment and enhance capacity.

Justification:

- Transitioning to renewable energy is essential for reducing emissions and strengthening energy security. Pakistan's natural resources—especially solar and hydropower—offer significant untapped potential.

Actionable Steps:

- Increase government investment in small-scale solar and wind farms that can be deployed in rural areas with limited access to electricity.
- Streamline the approval process for renewable energy projects, making it easier for businesses to invest in green energy.
- Implement financial incentives for households and businesses to adopt solar and wind energy systems, such as tax exemptions or subsidies for solar panels.

Improve Disaster Preparedness and Climate Resilience

Recommendation:

- Develop Climate-Resilient Infrastructure: Invest in climate-resilient infrastructure such as flood defenses, water storage systems, and disaster-proof housing in vulnerable regions like the Indus River basin and coastal areas.

Justification:

. Pakistan's vulnerability to extreme weather events—such as floods, droughts, and heatwaves—necessitates robust disaster preparedness and resilient infrastructure to protect vulnerable communities.

Actionable Steps:

- Construct flood embankments and improve drainage systems in flood-prone areas.
- Upgrade irrigation systems to conserve water and prevent losses during droughts.
- Create climate-resilient housing in areas prone to extreme weather events, particularly in coastal regions and floodplains.

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Climate Policy Framework of Khyber Pakhtunkhwa and International Obligations

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Abstract:

Climate change, a long-term shift in temperature and weather patterns, has been exacerbated by both natural and human activities since the 18th century. Pakistan, particularly Khyber Pakhtunkhwa (KP) province, is highly susceptible to climate-related disasters such as floods, glacier bursts, droughts, and heatwaves, which are expected to increase in the coming decades. To address these threats, the Khyber Pakhtunkhwa Environmental Protection Agency (EPA) established a Climate Change Cell in 2014 to study climate impacts and develop response strategies. KP became the first province in Pakistan to adopt a Provincial Climate Change Policy in 2017, which was further updated in 2022, along with a comprehensive action plan. The policy aims to guide adaptation and mitigation efforts, focusing on reducing greenhouse gas emissions and preparing vulnerable communities for climate-related risks. Despite these efforts, challenges such as weak institutional capacity, poor coordination, limited community engagement, and enforcement issues persist. Legal reforms, increased public awareness, and proactive measures are essential for achieving effective climate resilience in KP.

Key words:

Climate Change, Khyber Pakhtunkhwa, adaptation, mitigation, climate policy

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Introduction

Climate change refers to a long-term shift in temperature and weather patterns. Its causes can be natural or man-made. Since the 18th century, climate change has been affecting global temperatures. Currently, climate change is one of the most hotly debated topics, and certain protocols have been formulated to combat it. In this regard, Pakistan, being one of the worst-affected countries, has also been striving hard to minimize the effects of climate change and has formulated certain regulations. Climate change poses serious and significant threats to the ecosystems of Pakistan, especially in Khyber Pakhtunkhwa (KP) Province, but these challenges can be mitigated through transformative climate actions. According to scientific evidence, disasters related to climate change, such as riverine floods, storm water, glacier bursts, heat strokes, droughts, and other vector-borne diseases, are expected to increase in the coming decades.

The Khyber Pakhtunkhwa Environmental Protection Agency (EPA) Act was promulgated in 2014. A Climate Change Cell was established in the EPA in 2014 to study the impacts of climate change on different sectors of the province and to devise a coping strategy and action plan. The Cell steered the formulation of the first-ever Climate Change Policy of the province. KP is the first province in the country to have formulated and approved a Provincial Climate Change Policy in 2017, and the Chief Minister's Environmental Protection Council (EPC) was established in 2017 to supervise and steer climate change initiatives in the province. The Provincial Climate Change Policy was updated in 2022 along with the Action Plan, 2022. The KP Climate Policy 2022 is a policy document setting the goals regarding climate change, while the KP Climate Change Action Plan 2022 is the implementation document.

The policy also focuses on the province of KP's susceptibility to climate change, and the steps that need to be taken, i.e., adaptation and mitigation in different sectors of the economy, as well as climate change awareness in the province. Adaptation to climate change involves measures to either prevent natural and human systems from becoming vulnerable or to prepare for changes in climate, whereas mitigation focuses on reducing greenhouse gas (GHG) emissions through technological advancements or by curtailing activities that result in GHG emissions.

Problem Statement

Khyber Pakhtunkhwa is highly vulnerable to climate change, experiencing severe climate-related events such as glacial lake outburst floods (GLOFs), floods, and droughts. Despite efforts through the Khyber Pakhtunkhwa Environmental Protection Act of 2014 and the Climate Change Policy of 2022, gaps persist in effectively implementing these frameworks and aligning them with national and international climate obligations. This study aims to critically assess KP's legal framework on climate change, its alignment with other sectoral policies, and identify gaps to recommend actionable improvements.

Research Methodology

The data for this study was collected from both primary and secondary sources. Primary data includes interviews with public officials at the Environmental Protection Agency (EPA) Peshawar, the Department of Environment Peshawar, the Department of Forestry Peshawar, and the Planning and Development Department Peshawar. Secondary sources include the Khyber Pakhtunkhwa Environmental Protection Act of 2014, the Khyber Pakhtunkhwa Climate Change Policy of 2022, and the Khyber Pakhtunkhwa Climate Change Action Plan of 2022, among others. Articles published in various renowned journals have also been analyzed. Comparative analysis, PESTLE analysis, gap analysis, and SWOT analysis have been conducted to propose practical and pragmatic policy and institutional remedial measures.

Literature Review

KP is a province with a wide range of geography, from mountains to fertile plains, and it has its own set of problems. It hosts a large percentage of Pakistan's glaciers, which, although a crucial freshwater supply, are quickly melting due to the increase in temperatures (Rasul, 2021). Research has shown that rising temperatures, changing precipitation patterns, and increased glacial melt are major threats to both the environment and economy of Pakistan (Abbas & Shah, 2020). According to the Asian Development Bank (2021), if current trends persist, Pakistan's temperature could rise by 3°C by the century's end, which would have serious consequences for agriculture, water resources, and public health. In KP, the rise in temperatures is accelerating glacier melt, a vital component of the Indus River system. This has resulted in more frequent flooding in the short term and poses a risk of severe water shortages in the future (Rasul, 2021). Beyond water-related issues, KP's agricultural sector, a crucial part of its economy, is also at risk. A study by Ahmad, Majeed, and Alam (2020) revealed that fluctuations in temperature and rainfall have already caused a decline in crop yields and increased food insecurity in the province. The growing occurrence of extreme weather events, such as flash floods and droughts, is disrupting agricultural cycles, diminishing income for farming

communities, and worsening poverty in rural areas (Siddiqui, 2020). Additionally, the region's biodiversity, forests, and ecosystems are threatened as changing climate conditions alter habitats and raise the risk of forest fires (Qureshi & Syed, 2021).

The government of KP has acknowledged the pressing need to tackle climate change, as demonstrated by the establishment of the Chief Minister's Environmental Implementation Committee on Climate Policy in 2017. This council marks a crucial advancement in incorporating climate resilience into the province's governance and development strategies (Government of KPK, 2020). It has been instrumental in developing the province's climate change strategy, which encompasses reforestation, water management, and projects focused on climate-resilient infrastructure. Nonetheless, despite KP's ambitious initiatives, several obstacles persist. Qureshi and Batool (2018) argue that the province lacks the necessary institutional capacity and technical know-how to effectively execute its climate policies. Additionally, there are concerns about the sustainability of projects like the Billion Tree Tsunami (BTT), as critics have raised concerns about monitoring, community engagement, and the long-term upkeep of forest areas (Naseer & Saleem, 2019). The task force's efforts are further hindered by financial limitations, with the province heavily dependent on federal assistance and international funding to support climate-related initiatives (Sajjad & Naeem, 2021).

Pakistan, as a participant in international environmental agreements like the Paris Agreement, has pledged to lower its GHG emissions and improve its climate resilience. Although Pakistan contributes a small fraction to global emissions, less than 1%, its susceptibility to climate change demands robust adaptation and mitigation strategies (Munir & Azam, 2020). A significant aspect where international obligations are shaping provincial policy is the emphasis on sustainable forestry and agriculture, which are essential for lowering emissions and boosting climate resilience. However, research indicates that turning international climate agreements into practical provincial policies is challenging due to limited financial resources and local capacity (Irfan, 2019; Qureshi & Batool, 2018).

Despite advancements in KP, a major hurdle is the lack of coordination between provincial and federal climate policies. Sarwar and Zafar (2019) note that the absence of a cohesive national climate strategy that includes provincial viewpoints has resulted in disjointed efforts, leaving provinces like KP struggling to obtain the necessary resources for climate adaptation and mitigation. Additionally, the provincial government's dependence on external funding has raised concerns about the long-term viability of its climate initiatives (Sajjad & Naeem, 2021). Another issue is the insufficient integration of climate considerations into broader development plans. Although KP has initiated steps to tackle climate change through efforts like the Chief Minister's Task Force, climate adaptation has not been fully incorporated into provincial infrastructure, health, and education policies (Hussain et al., 2022).

Analysis of KP Climate Change Policy 2022

The KP Climate Change Policy, updated in 2022, provides comprehensive guidelines for addressing the climate-related challenges faced by the province. The policy represents a significant step forward in provincial-level climate governance, aligning itself with Pakistan's updated National Climate Change Policy (NCCP) of 2021. The KP policy emphasizes both adaptation and mitigation strategies across various sectors, including agriculture, water resources, forestry, biodiversity, and energy.

One of the major strengths of the KP Climate Change Policy is its comprehensive scope, covering nearly all relevant sectors of the provincial economy. The policy addresses agriculture, livestock, water resources, energy, and biodiversity, recognizing the interconnection of these sectors with climate change. By doing so, it ensures that climate actions are integrated into broader development frameworks, rather than treated in isolation.

Another strength lies in its alignment with national and international climate frameworks. The KP policy mirrors the priorities laid out in the NCCP (2021) and contributes to Pakistan's Nationally Determined Contributions (NDCs) under the Paris Agreement. By aligning with international commitments like the Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action), the policy enhances the credibility of provincial efforts on the global stage.

Institutionally, the KP policy promotes coordination among provincial departments and encourages cross-sectoral collaboration. The establishment of the Provincial Climate Change Policy Implementation Committee (PCCPIC) represents a positive step in improving interdepartmental cooperation. The policy also underscores the role of the EPA in managing climate actions, with the EPA playing a central role in coordinating with other provincial departments.

Despite its strengths, the KP Climate Change Policy has some weaknesses, particularly its broad, non-specific nature. One major issue is the lack of quantitative targets. While the policy outlines ambitious goals for reducing GHG emissions and increasing climate resilience, it does not provide specific, measurable targets to guide implementation.

Another weakness is the general nature of the policy recommendations. While it offers high-level guidance for climate action, it often lacks specificity regarding how these actions should be implemented. For instance, the policy advocates for enhancing climate resilience in agriculture but does not specify which crops should be prioritized or which regions are most vulnerable.

Additionally, the policy's heavy reliance on external funding sources presents a significant challenge. The KP Climate Change Policy explicitly acknowledges that its successful implementation is contingent upon securing international financial support from donors such as the United

Nations Framework Convention on Climate Change (UNFCCC) and the Global Environment Facility (GEF).

Alignment of KP's Legal framework with International Climate Obligations

Kyoto Protocol (1997):

The purpose of the Kyoto Protocol was to reduce emissions; however, it was not binding on Pakistan as a developing country.

Paris Agreement (2015):

Pakistan submitted its updated NDC in 2021, committing to reduce its greenhouse gas emissions by 50% by 2030, contingent on receiving international financial support (with 15% unconditional reductions and 35% conditional on external support). The focus is on climate adaptation, clean energy development, reforestation, and improving resilience to climate impacts. It emphasizes adaptation measures to cope with floods, droughts, and extreme weather events. Pakistan is required to regularly report its progress on climate actions and contribute to the global effort to limit the temperature rise to well below 2°C, with efforts to limit it to 1.5°C.

COP 27 (2022) and COP 28 (2023):

Pakistan played a pivotal role in COP 27 by advocating for a loss and damage fund for developing countries, one of the main outcomes of the conference. This fund aims to provide financial assistance to countries suffering from the adverse effects of climate change. At COP 27, Pakistan emphasized the need for funding to address both loss and damage and adaptation efforts. COP 28 is expected to follow up on these negotiations, particularly around operationalizing the loss and damage fund, and Pakistan will continue to push for adequate financial and technological support to meet its climate adaptation and mitigation goals.

Sustainable Development Goals (SDGs):

Pakistan is actively working towards achieving the 17 SDGs, particularly those related to climate.

- **SDG 7 (Affordable and Clean Energy):** Pakistan aims to increase the share of renewable energy sources, particularly hydro, wind, and solar, to provide affordable and sustainable energy.
- **SDG 13 (Climate Action):** Pakistan's climate action plan involves strengthening resilience to climate-related hazards, promoting sustainable agricultural practices, and building climate-smart infrastructure.
- **SDG 6 (Clean Water and Sanitation):** Given its vulnerability to water scarcity and flooding, Pakistan is focusing on water management and climate-resilient infrastructure.
- **SDG 15 (Life on Land):** This includes efforts for reforestation (e.g., the Billion Tree Tsunami project) and protecting ecosystems, in alignment with climate and environmental goals.

Pakistan's Vision 2025 integrates many of the SDGs, aligning them with national policies to reduce poverty, improve health and education, and ensure environmental sustainability.

Analysis

Gap Analysis of legal frameworks of difference sectors in KP with respect to KP climate change legal framework

Current Situation	Gap/Deficiency	Desired Situation
Agriculture -The KP Agriculture Act 2014 does not explicitly address climate change directory but emphasis has been placed on sustainable practices. - very little research on climate-resilient crops. -Weak Enforcement & Monitoring	- Lack of legal mandate for climate smart agriculture covering drought-resistant crops, water-efficient techniques. - Outdated laws No proper mechanism for enforcement of sustainable agricultural practices related to climate adaptation.	- Inclusion of climate smart agriculture practice and laws. - Introduction of innovative provision for promotion of resilient crops - inclusion of relevant provision for water efficient irrigation practices. Improved enforcement frameworks for ensuring climate-adaptive farming.

Irrigation Department - existing polices focusing on traditional water management techniques. - Little efforts in flood control and small dam's construction. - poor Cross-sectoral Coordination	- Absence of legal provisions for climate-resilient water management (e.g., flood management, efficient irrigation). - absence of integration for water resource management (glacial melt, floods).	- Up to Date legal frameworks inclusive of climate-resilient water management techniques. -proper incorporation of climate data in water resource management (e.g., glacier monitoring). -Establishment of legal mechanisms for intra-department coordination (water, agriculture, and forestry).
Forest Department - Project-based legal framework (Billion Tree Tsunami) for afforestation. - sustainable forest management lacking climate specificity. - Lack of continuous Monitoring & Sustainability	- lack of sustainable and long-term approach for afforestation - poor legal framework for community engagement and long-term forest management. - Little legal provisions for long-term monitoring and sustainability of afforestation projects.	- Shift from project-based forestry legislation for long-term forest management laws with climate resilience mandates. - Strengthen community involvement through legally binding provisions. - Introduction of legal provisions for continuous monitoring, sustainability, and community engagement.
Disaster Management (Relief) Department - Legal framework is more about reactive approach - limit inclusion of climate-related risks, but limited scope.	- Limited integration of climate risks and lack of proactive disaster risk reduction measures. - No legal mandate for early warning systems for climate-related calamities - Weak coordination between climate change	- need for revision of disaster management laws by integrating climate change risks and mandating of proactive measure. - Implementation of legal mandates regarding early warning systems and

- Weak Coordination with Climate Policy	frameworks and disaster management.	disaster-resilient infrastructure. - Strengthening of legal coordination between disaster management and rest of the climate-sensitive departments e.g. water and agriculture.
Energy Department Focus on Renewable energy lacking legal mandates for implementation. - support for hydropower but minimal support for solar and wind energy - No Decarbonization Goals	- no legislation regarding de-carbonization to promote renewable energy development (solar, wind) and reduce emissions. - no legal incentives for energy efficiency. - Lack of legal framework for decarbonization or emission reduction goals.	- Enactment of legal mandates for renewable energy generation and setting of provincial targets for emissions control. - Introducing of legal frameworks for promotion of energy efficiency in industries and buildings. - Alignment of energy laws with climate goals to reduce GHG emissions.
Environmental Protection Agency - The KP Environmental Protection Act 2014 promotes environmental conservation but lacks climate-specific regulations. - General provisions about pollution control lacking focusing on climate-focused. - Poor Monitoring & Reporting	- absence of legal regulations for industries for reduction their carbon footprint. - Poor enforcement mechanism for climate-related environmental standards. - absence of mechanism GHG emissions and monitoring	- Strengthening the EPA's legal mandate for inclusion of specific climate change regulations (e.g., emission reduction targets for industries). - need for improved enforcement mechanisms. - need for introduction of legal frameworks requiring systematic monitoring and reporting of GHG emissions.

Transport Department -More Focus on vehicular emissions lacking climate-specific directives. - Limited promotion of sustainable transportation.	- absence of legal framework for promotion of low-emission vehicles or electric vehicle infrastructure. - absence of provisions for promoting public transport and reducing vehicular emissions.	- need for Updating of transport laws to regulate the promotion of electric vehicles (EVs) and develop EV infrastructure. - need for inclusion of legal provisions for enhancing public transportation and non-motorized transport options.

Comparative analysis of climate legal frameworks KP, Punjab, and Kerala (India) based on key legal aspects:

Key Legal Aspects	**KP**	**Punjab**	**Kerala (India)**
Climate-Specific Legislation	Limited, reactive	Moderate	Comprehensive
Integration in Sectoral Policies	Minimal integration	Some integration	Strong integration across sectors
Enforcement Mechanisms	Weak	Moderate	Strong and well-established
Community Participation	Limited	Moderate	Strong, legally mandated
Cross-Sectoral Coordination	Poor	Moderate	Strong, well-coordinated
Climate-Resilient Infrastructure	Developing	Moderate	Well-developed
Renewable Energy Focus	Growing, but slow	Active	Strong, established
Public Awareness Initiatives	Developing	Moderate	Comprehensive

Khyber Pakhtunkhwa (KP)

KP has been gradually focusing on renewable energy (hydropower) and afforestation through the Billion Tree Tsunami (BTT). However, climate-specific legislation is not fully developed, and there is limited integration of climate action into sectoral policies (e.g., agriculture, water management). Additionally, enforcement mechanisms and community participation are relatively weak. Cross-sectoral coordination is minimal, which impacts the overall effectiveness of climate strategies.

Punjab

Punjab has made progress in integrating climate resilience into urban infrastructure, energy, and industrial policies. Enforcement mechanisms are stronger than in KP but still require further strengthening. However, community participation and cross-sectoral coordination need improvement to ensure comprehensive climate adaptation.

Kerala(India)

Kerala stands out with a comprehensive legal framework that includes strong enforcement mechanisms, climate-specific legislation, and well-developed public awareness initiatives. It also emphasizes community participation, ensuring that local governments are actively involved in climate adaptation. However, Kerala's challenge lies in balancing economic growth with its strong climate mandates, as implementation at the local level can sometimes face resource constraints. This comparison highlights how Kerala's more decentralized and legally robust framework can serve as a model for KP and Punjab, particularly in terms of enforcement, community involvement, and cross-sectoral integration.

PESTLE Analysis of KP's Legal Framework on Climate Change

Political

There is a lack of strong political will at both the provincial and national levels to combat climate change. The KP government has demonstrated a commitment to aligning its climate actions with national and international frameworks, which is critical for securing political support for climate projects. Only two meetings of the council have been held so far.

Economic

The policy's reliance on external funding presents a significant economic challenge. While international donors can provide valuable resources, there is a need for the province to develop a more sustainable financial strategy. This could include mobilizing domestic resources and attracting private sector investment through public-private partnerships.

Social

Public awareness of climate change remains limited, particularly in rural areas. The policy acknowledges the importance of raising public awareness, but more needs to be done to engage local communities in the implementation of climate actions. This is particularly important for ensuring that vulnerable populations, such as farmers and indigenous communities, are included in the decision-making process.

Technological

The lack of access to advanced climate technologies presents a significant challenge. While the policy recognizes the need for climate-smart technologies, it does not provide a clear strategy for acquiring or scaling up these technologies. The province would benefit from leveraging international climate finance mechanisms to invest in technologies such as early warning systems, precision farming, and renewable energy solutions.

Legal

The policy's legal framework is relatively weak in terms of enforcement. While the EPA has the mandate to oversee climate actions, it often lacks the regulatory authority to enforce compliance. Strengthening the legal framework would help ensure that climate goals are met and that provincial departments are held accountable for their actions.

Environmental

The province is highly vulnerable to climate-related disasters, including floods, droughts, and glacial lake outburst floods (GLOFs). These events pose a significant threat to the province's economy, development, and livelihoods. The policy emphasizes the need for climate resilience, but more needs to be done to build adaptive capacity in vulnerable sectors such as agriculture and water resources.

SWOT Analysis of the EPA

Strengths

- **Existing Legal Framework:** The KP Environmental Protection Act 2014 provides a basic legal framework for environmental conservation and pollution control.
- **Close Alignment with National and International Policies:** The EPA's activities are closely aligned with Pakistan's national commitments under international climate agreements like the Paris Agreement and SDGs.
- **Emphasis on Environmental Monitoring:** The EPA has determined environmental standards and conducts environmental assessments, particularly for industrial pollution and resource management.

Weaknesses

- **Poor Enforcement Mechanisms:** The enforcement mechanisms of the EPA are weak, and there are insufficient penalties for violations of environmental regulations to deter noncompliance.
- **Limited Focus on Climate Change:** There is no explicit provision for climate change in the EPA; rather, there is more emphasis on general

environmental conservation and pollution control rather than GHG emissions and climate resilience.

- **Lack of Resources:** There is a lack of sufficient funding, technology, and personnel to implement and enforce robust climate-related policies and environmental monitoring programs.
- **Poor Public Engagement:** Low community involvement and low public awareness regarding climate change hinder effective environmental governance.

Opportunities

- **Climate-Specific Legislation:** The EPA can introduce specific regulations for climate and strengthen its mandate to focus on climate adaptation and mitigation, such as regulating carbon emissions and promoting sustainable industry practices.
- **International Climate Finance:** The EPA can strive to secure international funding (e.g., Green Climate Fund) to increase capacity for climate resilience projects.
- **Technological Innovation:** There are opportunities for modern environmental monitoring technologies (e.g., satellite imaging, remote sensors) to enhance environmental oversight and enforcement.

Threats

- **Political Instability:** Lukewarm responses from political elites and a lack of long-term commitment to climate and environmental issues can hinder the EPA's efforts.
- **Overlapping Jurisdiction:** Issues between federal and provincial environmental authorities can lead to confusion and inefficiencies in the implementation of climate policies.
- **Fast Urbanization and Industrial Growth:** Increasing industrial activity and urban sprawl without adequate environmental safeguards can exacerbate pollution and environmental degradation.

Issues and Challenges

Lack of Strong Legislative Backing

KP lacks a comprehensive Climate Change Act or specific provincial legislation that enforces climate policy across sectors. Most of the actions remain policy-driven rather than mandated by law. The absence of legally binding commitments makes it difficult to enforce mitigation and adaptation measures, leading to inconsistent implementation across departments and sectors.

Centralized Governance, Coordination Issues, and Limited Integration Across Sectors

The KP institutional framework for climate governance is relatively centralized, with decisions often made at the provincial level. This can create bottlenecks in implementation, especially at the district and local levels where adaptation and disaster management efforts are most needed. The lack of effective coordination between provincial and district authority's hampers localized climate action. Climate change adaptation, disaster resilience, and sector-specific initiatives (e.g., in agriculture or water management) require stronger integration with local governance bodies.

Weak Institutional Capacity

Although KP provincial departments like forestry, agriculture, and energy are tasked with addressing climate change, they often lack the technical expertise, human resources, and financial support to execute comprehensive climate strategies. This results in a gap between policy formulation and actual implementation, with climate action plans remaining largely aspirational rather than operational.

Inadequate Legal Framework for Disaster Risk Management

Given that KP is highly vulnerable to climate-induced disasters such as floods, landslides, and glacier melting, its disaster management framework lacks a strong legal and institutional link with climate change policies. Legal gaps in integrating disaster risk reduction with climate change policies make the province more vulnerable to future climate risks.

Resource Allocation and Funding Issues

KP's climate change policy requires substantial financial resources that are currently insufficient. Many of the climate change-related projects, including afforestation (e.g., Billion Tree Tsunami) and renewable energy initiatives, rely heavily on external funding or sporadic government allocations, leading to financial instability.

Poor Monitoring and Enforcement

KP in general, and the EPA in particular, lack clear mechanisms for monitoring, evaluation, and enforcement of climate-related policies and action plans. As a result, climate projects can be implemented inconsistently across the province, with little accountability for achieving the desired outcomes or for measuring the effectiveness of mitigation and adaptation efforts.

Insufficient Focus on Climate-Resilient Infrastructure

KP's infrastructure development, particularly in urban areas, does not adequately integrate climate resilience measures. The lack of climate-resilient infrastructure increases the risk of flooding, heat stress, and other climate-related impacts in urban and peri-urban areas, especially with rapid urbanization.

Inadequate Use of Climate Data and Research

The legal and institutional framework in KP does not adequately emphasize the use of climate science, data, and research in policy formulation and implementation. This lack of data-driven policymaking reduces the effectiveness of KP's climate strategies, as decisions are often made without a solid understanding of localized climate impacts, vulnerabilities, and risks.

Challenges in Implementing Renewable Energy Policies

Although KP's Climate Change Policy 2022 emphasizes renewable energy development, particularly hydropower, the legal and institutional mechanisms for promoting energy diversification (e.g., solar and wind energy) are underdeveloped. Hydropower projects face environmental and social challenges, such as displacing communities and affecting water flow, while other renewable sectors like solar and wind are underutilized, slowing progress towards energy transition and emission reduction goals.

Conclusion

- The KP climate change legal framework is aligned with national and international law on climate change.
- There are coordination issues between provincial and national climate change authorities.
- There are opportunities for legal reforms and climate-specific legislation.
- The EPA, being the flagbearer organization, has weak capacity.
- There are enforcement and implementation issues.
- There is limited cross-sector coordination.
- There is poor community engagement and public awareness.
- The departmental approach is more reactive than proactive.
- There is a low priority for the environmental protection council's proceedings.

Recommendations

Logical Framework Matrix

S#.	Proposed Action	KPIs	Means of Verification	Timeline
1.	Strengthened Legal Frameworks for Climate Action (EPA)	-Change in EPA Act by incorporating three new sections (1) overriding effect (2) introduction of climate change mandatory provisions. (3) climate specific master planning of all districts	- Approved copy of the act signed by the Governor	3-6 Months
2	Master Planning of the entire KP districts starting from 6 districts by consultants	Climate disaster prone 6 districts to be piloted for the master plan (Swat, Chitral, Upper Dir, Nowshehra, Charsada, Mansehra)	-Copies of master plan duly signed by the concerned DC and approved by EPA	1-2-year
3	Revised Legal Framework of Forest Department	- introduction of new section after incorporating climate change mandatory provision and tree plantation (Project like BTT)	- Approved copy of the act signed by the Governor	3-6 Months
4	CM Environmental Protection Counsil	-issuance of meeting Calander along with tasks for the year in advance -In absence of CM to be chaired by Minister for forest and climate change	-Minutes of the meeting duly signed -Notification authorizing climate minister -Notification regarding meeting calendar	Regular In a month Regular

5	Revised legal frameworks of following Departments Agriculture Disaster management Irrigation transport	- introduction of one new section in law of each department about climate change	-Approved copies of the laws/Regulations duly signed by the Competition Authorities	9 Months
6	Early Warning Systems and Disaster-Resilient Infrastructure	-6 Pilot districts	- installed early warning system in each district.	1 year
7	Expanded Reforestation and Biodiversity Protection through legislation	-400,000Hectares of forest cover added. - Number of community-based forest projects. Copies of Law	-Forest department reports. -Satellite imagery.	3-4 years
8.	Legal cover to P&D Climate Cell	-introduction of mandatory provision in P&D Law regarding climate cell	-Approved by Cabinet	3 months

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Biodiversity, Ecosystem Restoration and Reforestation to Combat Deforestation and Habitat Loss

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Abstract:

This report critically reviews the legal, institutional, and policy frameworks guiding biodiversity conservation, ecosystem restoration, and afforestation in Khyber Pakhtunkhwa province, Pakistan. It evaluates the effectiveness of these efforts in aligning with international commitments, such as the Paris Agreement and the Convention on Biological Diversity, while identifying obstacles to implementing KP's Climate Change Policy 2022. Utilizing situational and SWOT analyses, the report assesses the performance of KP's Forest and Wildlife Departments in their conservation initiatives. Additionally, it examines global best practices to formulate recommendations for improving the province's environmental management. These recommendations emphasize the need for stronger legislation, enhanced enforcement mechanisms through technology, and increased community involvement. Ultimately, the goal is for KP to achieve its long-term environmental objectives while addressing climate change impacts and protecting its unique ecosystems. The report concludes with a call for more robust legal frameworks, better coordination among provincial departments, and increased international support.

Key words:

Biodiversity, Conservation, Afforestation, Climate Change, Khyber Pakhtunkhwa

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Introduction

Climate change is a significant threat to humanity in the 21st century, profoundly impacting daily life and the environment. In response, countries across the globe have committed to addressing the issue. In addition to many other serious concerns, shifting weather patterns and the increasing frequency of natural disasters pose substantial risks to ecosystems and biodiversity. Furthermore, carbon emissions are identified as a major contributor to these changes (United Nations, n.d.). Forests are vital sources of carbon storage, essential for maintaining environmental balance. More than 1.6 billion people depend on forests for food and fuel, and around 70 million, including many Indigenous communities, live within these ecosystems. Forests supply crucial resources like oxygen, shelter, employment, water, nourishment, and fuel (WWF, n.d.).

Climate change poses significant threats to biodiversity and ecosystems. Afforestation and ecosystem restoration are crucial strategies for mitigating these effects: afforestation sequesters carbon and creates habitats, while restoration enhances ecosystem health and resilience. Together, these efforts support biodiversity, which is vital for maintaining the functionality and resilience of ecosystems in the face of climate change. This interconnected relationship underscores the importance of integrated environmental management for sustainable futures.

Global initiatives have set targets to combat climate change, conserve biodiversity, and expand forest cover. Pakistan actively engages in these global climate frameworks and has made significant progress in strengthening its legal and institutional structures. The country has developed comprehensive policies and action plans that involve provincial participation to effectively achieve these targets.

Khyber Pakhtunkhwa (KP) is a crucial stakeholder in Pakistan's forestry landscape, accounting for over 40% of the country's forest cover (Khurshid, 2024). In line with national policies, the KP government launched the Green Growth Initiative in 2014 to enhance forest coverage and promote sustainable resource management through biodiversity conservation and ecosystem restoration. This initiative seeks to protect the environment while benefiting local communities that depend on these resources.

In response to international and national calls to address climate change and recognizing the high vulnerability of Khyber Pakhtunkhwa (KP), the provincial government developed a Provincial Climate Change Policy in consultation with relevant departments. This policy, first established in September 2017 and updated in July 2022, is designed to be specific and aligned with the National Climate Change Policy of Pakistan (2021). It proposes two key approaches—adaptation and mitigation—targeting the most affected sectors. The policy outlines essential legislation, performance measures, and an institutional framework.

Statement of Problem

Over the past decade, the Khyber Pakhtunkhwa (KP) government has made notable progress in afforestation, ecosystem restoration, and biodiversity conservation. These efforts demonstrate KP's dedication to environmental sustainability and addressing climate change. As the province continues to develop policy guidelines and implement projects in this area, it is crucial to critically assess the legal framework and performance of the relevant departments overseeing these activities. This is especially important in the context of international climate change agreements and Pakistan's national climate policy. The study aims to evaluate how well KP's legal and institutional frameworks, along with its achievements, align with global environmental standards, national policies, and set objectives.

Scope of Study

This study will focus on the performance of the KP government in afforestation, ecosystem restoration, and biodiversity conservation, in light of the targets set and guidelines issued in the KP Climate Change Policy of 2022. It will provide a brief overview of the international and national legal landscape in the fields of biodiversity, ecosystem restoration, and afforestation. The analysis will focus on the KP government's current legal and institutional framework, along with an examination of its performance against the targets set in the policy.

Literature Review

International Legal Framework

Pakistan has signed multiple international conventions and treaties focused on climate change, environmental sustainability, and biodiversity conservation, aligning itself with global climate efforts.

- **Intergovernmental Panel on Climate Change (IPCC)**: Established by the United Nations in 1988, the IPCC assesses and synthesizes the latest scientific research on climate change, its impacts, and potential adaptation and mitigation strategies. One of its key functions is issuing Assessment Reports (AR) that comprise the latest knowledge on climate change, along with the impact of policies and guidelines.
- **United Nations Framework Convention on Climate Change (UNFCCC, 1992)**: Pakistan ratified the UNFCCC in 1994, committing to climate change mitigation, adaptation, and reporting responsibilities under global frameworks. The COP, or Conference of the Parties, is the main decision-making body of the UNFCCC, serving as a platform for countries to negotiate and assess progress in combating climate change.
- **Paris Agreement (2015)**: The Paris Agreement is an international treaty aimed at addressing climate change and its impacts. Adopted in

December 2015 at the COP21 conference in Paris, it brought together nearly all countries to work towards limiting global warming to well below 2 degrees Celsius while pursuing efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels.

- **Convention on Biological Diversity (CBD, 1992)**: This international treaty aims to conserve biological diversity, promote the sustainable use of its components, and ensure fair and equitable sharing of benefits arising from genetic resources. Pakistan ratified the CBD, committing to the conservation and sustainable use of biodiversity. This treaty has influenced national and provincial biodiversity policies, especially in the conservation of wildlife, forests, and ecosystems, linking these efforts with climate change adaptation.
- **United Nations Convention to Combat Desertification (UNCCD, 1994)**: The UNCCD focuses on mitigating desertification and drought and encourages the restoration and maintenance of land productivity.
- **Sustainable Development Goals (SDGs, 2015)**: The SDGs are a set of 17 global goals established by the United Nations in 2015 as part of the 2030 Agenda for Sustainable Development. These goals aim to address a range of social, economic, and environmental challenges, promoting prosperity while protecting the planet.

    - **SDG 13: Climate Action –** Focused on taking urgent actions to combat climate change.
    - **SDG 15: Life on Land –** Emphasizes the protection, restoration, and sustainable use of terrestrial ecosystems, managing forests, and halting biodiversity loss.

National Legal Framework

Pakistan Environmental Protection Act, 1997: The Pakistan Environmental Protection Act (PEPA), 1997 governs the protection of natural resources and environmental quality across the country. This foundational law influences national and provincial environmental governance by mandating pollution control, resource management, and biodiversity conservation.

National Climate Change Policy (NCCP, 2012; Revised 2022): The NCCP 2012 provided the foundation for national climate strategies, focusing on mitigation and adaptation across sectors like water, agriculture, and forestry. The revised NCCP 2022 aligns with the Paris Agreement and incorporates recommendations from the IPCC AR6. This policy directs provinces, including KP, to implement climate-resilient strategies and enhance their natural carbon sinks.

Nationally Determined Contributions (NDCs): Pakistan's NDCs, issued under the Paris Agreement, outline the country's climate mitigation and adaptation strategies, emphasizing the need for international support. The updated NDC (2021) focuses on reducing emissions by 20% by 2030, with specific goals related to afforestation, clean energy, and biodiversity conservation.

Khyber Pakhtunkhwa Legal Framework

KP Forest Ordinance, 2002 (Amended 2022): The Khyber Pakhtunkhwa Forest Ordinance, 2002, serves as the key legal framework for forest conservation and management. In 2022, the ordinance was amended to strengthen regulations, increase penalties for deforestation, and incorporate modern sustainable forest management practices. The act was aligned with national and provincial climate change policies and also included merged districts in its scope. These amendments support KP's contribution to Pakistan's NDC targets, focusing on afforestation and reforestation as essential climate mitigation strategies.

Khyber Pakhtunkhwa Environmental Protection Act (EPA), 2014: The KP Environmental Protection Act (EPA), 2014 provides the legal framework for environmental management in the province. It includes provisions for pollution control, environmental quality standards, and the promotion of sustainable natural resource use. The law also supports afforestation and biodiversity conservation initiatives that are essential for mitigating climate impacts.

KP Wildlife and Biodiversity (Protection, Preservation, Conservation and Management) Act, 2015: This act provides comprehensive regulations for wildlife protection and biodiversity conservation in KP. The law aligns KP's wildlife policies with the Convention on Biological Diversity (CBD) and supports biodiversity conservation as a critical aspect of climate adaptation. It oversees the establishment of wildlife sanctuaries and protected areas, as well as the preservation of endangered species.

KP Climate Change Policy, 2022: KP's Climate Change Policy of 2022 is a comprehensive plan aimed at building climate resilience in vulnerable sectors such as water, forestry, biodiversity, and agriculture. The policy integrates recommendations from national climate policies and the Paris Agreement, focusing on both mitigation and adaptation. It emphasizes enhancing carbon sinks through large-scale afforestation and promoting biodiversity conservation to reduce the province's vulnerability to climate impacts. The policy outlines a total of 342 strategies, with 195 for adaptation and 147 for mitigation.

KP Action Plan on Climate Change: The KP Action Plan on Climate Change provides specific strategies for implementing mitigation and adaptation measures in line with Pakistan's NDC commitments. It includes action points on afforestation, sustainable forest management, climate-smart agriculture, and disaster risk reduction. The plan strengthens institutional capacity to respond to climate change and ensures alignment with national and international climate policies.

KP Multilateral Environment Agreement: The Khyber Pakhtunkhwa (KP) Multilateral Environmental Agreement (MEA) is a framework that outlines the province's commitment to adhering to various international environmental agreements. This initiative is essential for addressing environmental challenges while promoting sustainable development. The agreement emphasizes integrating international environmental standards into local policies and regulations, ensuring that provincial practices align with global best practices.

Methodology

This study is based on primary and secondary data obtained through personal interviews, access to official reports and data, and consulting online sources. Data obtained will be analyzed using situational and SWOT analysis methods to draw conclusions and prepare recommendations.

Situational Analysis

Afforestation Policy Guidelines and Targets:

- **Afforestation and Reforestation Initiatives**:
    - Expand forest cover by 25% by 2030 through large-scale afforestation and reforestation projects, such as the Ten Billion Tree Tsunami project.
    - Restore 350,000 hectares of degraded forest land across KP to improve carbon sequestration and reduce soil erosion.
    - Urban and peri-urban forestry: Promote tree plantation drives in cities and peri-urban areas to improve air quality and create green spaces (Urban Forestry Policy).
    - Community-based forestry management: Strengthen community participation in afforestation projects, ensuring sustainable forest resource use and protection against illegal logging.
    - **Carbon Sequestration Goals**: Enhance the capacity of forests to act as carbon sinks, contributing to the 20% greenhouse gas emission reduction target outlined in Pakistan's NDCs, conditional on international support.

- **Forest Monitoring and Management**: Strengthen forest monitoring systems using satellite imagery and GIS technology to track deforestation rates and assess the health of afforested areas.

Biodiversity Conservation Policy Guidelines and Targets:

- **Protected Areas and Wildlife Sanctuaries**:
  - Expand the network of protected areas to cover at least 15% of the province's land by 2030. This includes the establishment of new national parks, wildlife sanctuaries, and nature reserves to protect biodiversity hotspots.
  - Implement measures under the KP Wildlife and Biodiversity Act 2015 to safeguard endangered species and critical habitats.
- **Biodiversity Corridors**:
  - Establish and maintain biodiversity corridors to connect fragmented ecosystems, allowing for species migration and adaptation to climate change.
  - Special focus on creating corridors for species endangered by habitat loss due to deforestation and climate change, ensuring genetic diversity and reducing extinction risks.
- **Conservation of Endangered Species**:
  - Strengthen efforts to protect endangered species like the snow leopard, markhor, and other native fauna through habitat restoration, anti-poaching laws, and public awareness campaigns.

Ecosystem Restoration Policy Guidelines and Targets:

- **Restoration of Degraded Ecosystems:**
  - Restore degraded rangelands and wetlands to improve ecosystem services, such as water retention, flood control, and biodiversity support. Specific focus on the restoration of ecosystems vulnerable to climate impacts, such as drylands and mountainous regions.
  - Rehabilitate riverine ecosystems and watershed areas to prevent soil degradation and improve water availability, particularly in areas prone to droughts and flash floods.
- **Sustainable Land Use and Agriculture:**
  - Promote sustainable agriculture and forestry practices to combat land degradation and desertification. Encourage agroforestry and the planting of native tree species alongside crops to enhance soil fertility and water retention.

- **Community-Based Ecosystem Management:**
  - Engage local communities in ecosystem-based adaptation (EBA) approaches, ensuring that local populations benefit from ecosystem restoration projects and take active roles in managing natural resources.
- **Climate-Resilient Infrastructure**:
  - Incorporate ecosystem-based approaches in infrastructure development to reduce environmental impact and protect vulnerable ecosystems. This includes designing climate-resilient roads, dams, and housing projects in line with environmental conservation guidelines.

Performance Against Targets

The KP Government, through its various departments and agencies such as the Forest Department, Wildlife Department, and the Environmental Protection Agency (EPA), has undertaken several significant initiatives to address the challenges of climate change, biodiversity loss, and environmental degradation.

Performance of Forest Department

1. The Green Growth Initiative (GGI) was launched in 2014, under which the flagship, globally recognized Billion Tree Afforestation Project (BTAP) has been successfully implemented, resulting in the raising of 1.208 billion plants.
2. Previously, the Khyber Pakhtunkhwa Forest Department also implemented several projects, including the Kalam Integrated Development Project (KIDP), Siran Forest Development Project, Malakand Social Forestry Project, Kagan Intensive Forest Management Project, Social Forestry Project, and Tarbela Watershed Management Program for the restoration of forest landscapes, strengthening the livelihoods of rural communities, and enhancing the lifespan of strategic reservoirs.
3. The Ten Billion Tree Tsunami Program (10-BTTP) was started in 2019, under which 0.708 billion plants have been raised (2019-2024).
4. To implement the REDD+ Program, the KP Government has achieved the following targets under Reducing Emission from Deforestation:
   a. Prepared Subnational REDD+ Strategy and Action Plan (2022-31).
   b. Developed Benefit Sharing Mechanism for different categories of forests.
   c. Prepared Forest Reference Emission Level for KP.
   d. Conducted Carbon Stock Assessment in all forest areas of KP.
   e. Developed Biomass and Carbon Tables for major tree species.

5. A Letter of Agreement (LoA) has been signed with the Survey of Pakistan for the demarcation of state forests in the province; this activity is ongoing.
6. Demonstrated ecotourism activities under the Sustainable Forest Management Project in the Northern Forest Region-II (2017-21), thus reducing community dependence on forests by providing alternative livelihood options.
7. The Billion Tree Afforestation Support Project (BTASP) was initiated in 2019-27 through the financial and technical support of German Cooperation to provide sustainability to the natural assets developed under the BTAP and 10-BTTP.

Performance of Wildlife Department

Protected Areas and Biospheres

The KP Government has significantly expanded its network of protected areas, including national parks, biosphere reserves, and wildlife sanctuaries. The creation and management of these areas are central to the province's efforts to conserve biodiversity, restore ecosystems, and meet the 15% protected land target by 2030 set in the KP Climate Change Policy.

- **Chitral Gol National Park**:

- Located in the Chitral district, this park is part of the Man and Biosphere (MAB) Reserve model under UNESCO. The park covers an area of approximately 77.5 km² and plays a crucial role in conserving the endangered snow leopard and markhor populations, alongside other local fauna.
- The MAB model, applied here, integrates community-based management approaches, balancing biodiversity conservation with sustainable resource use by local communities.

- **Ayubia National Park (Gallies Biosphere Reserve)**:

- This national park is another successful application of the UNESCO MAB model. It spans over 3,312 hectares in the Gallies Forest Division and is known for its rich biodiversity, including leopards, black bears, and a variety of bird species.

- **New Protected Areas**

KP has designated new wildlife sanctuaries and national parks, such as Nizampur National Park and Shandur-Hundrup National Park, contributing to the expansion of protected lands. By August 2024, approximately 16.75% of KP's total land area was declared protected under various conservation categories.

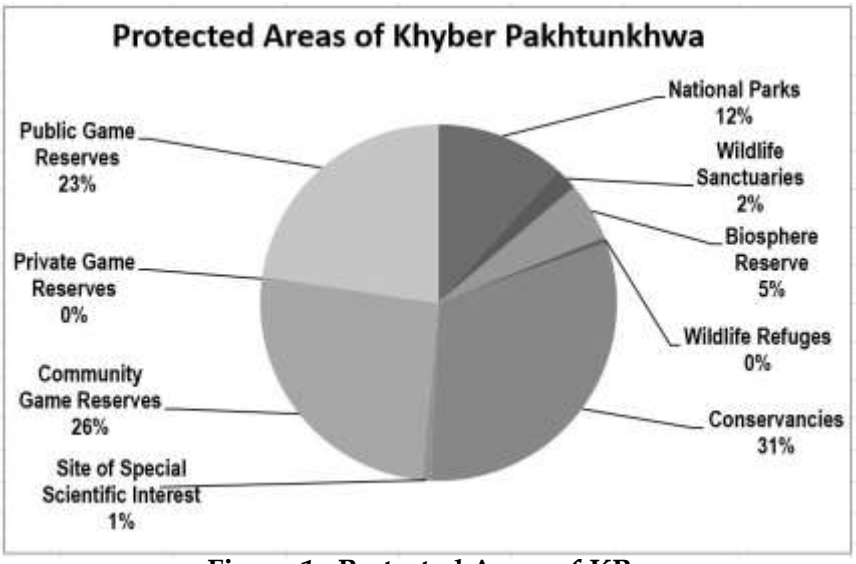

Figure 1: Protected Areas of KP

Zoos and Wildlife Sanctuaries

- **Peshawar Zoo**:
  - Opened in 2018, Peshawar Zoo is a key initiative by the KP government aimed at wildlife education, conservation, and rehabilitation. The zoo has become an important center for raising awareness about the protection of endangered species in the province.
- **Wildlife Sanctuaries**:
  - The KP government has declared several areas as wildlife sanctuaries, such as the Dhodial Pheasantry and Broghil Wildlife Sanctuary. These sanctuaries aim to protect bird species and high-altitude fauna, providing crucial habitats for species under threat from habitat loss and climate change.

National Parks and Wildlife Sanctuaries

The KP Wildlife Department has been instrumental in the creation and management of several national parks and wildlife sanctuaries aimed at conserving critical habitats and endangered species.

- **Nizampur National Park:**
  - A newly declared protected area in the Nowshera district, focusing on the conservation of flora and fauna native to the semi-arid ecosystem.
  - The Park aims to protect the Indian gazelle and other threatened species while restoring the region's ecological balance.

- **Shandur-Hundrup National Park**:
  - This Park, declared in 2021, covers a vast area of the high-altitude Shandur Plateau, famous for its annual Shandur Polo Festival. The park's objectives include biodiversity conservation and the promotion of eco-tourism as a sustainable livelihood option for local communities.
- **Margalla Hills National Park Extension**:
  - KP has been instrumental in the expansion of Margalla Hills National Park, which borders Islamabad, extending protection to additional forested areas within KP.

Urban Forestry Initiatives

- **Peshawar Urban Forestry Program**:
  - In line with the KP Climate Change Policy 2022, the Peshawar Urban Forestry Program was initiated to address urban heat islands, improve air quality, and create green spaces in densely populated areas. The program aims to plant 5 million trees in and around the provincial capital by 2025.
  - The focus is on planting climate-resilient species and developing green belts along major roads, parks, and other public spaces.
- **Urban Greening in Other Cities**:
  - Urban forestry initiatives are being expanded to other major cities like Abbottabad, Mardan, and Swat, with local communities and municipal bodies involved in afforestation activities. The KP government aims to increase urban green cover by 10% by 2030.

Environmental Protection Agency (EPA)

The KP EPA is tasked with enforcing the KP Environmental Protection Act (2014), which regulates activities that impact the environment, including integrated tourism zones and new construction in protected areas.

Performance Against Targets

- Despite progress, illegal logging and land-use conflicts remain challenges in certain areas, and 11,000 acres of forest have been lost (APP, 2024). Furthermore, enforcement in newly merged districts is also a significant hurdle and needs to be strengthened.
- The implementation of biodiversity corridors is behind schedule, limiting species migration and habitat connectivity.
- Wetland and rangeland restoration projects have seen limited progress due to resource constraints and competing land-use demands.

Best Practices Around the World

Uttarakhand is a state in Northern India that successfully implemented a reforestation project supported by the Japan International Cooperation Agency, where local communities were intensively involved with the main objective of sustainable forest management. Below is a comparison of the KP BTAP project with the Uttarakhand project:

Criteria	Uttarakhand Forest Resource Management Project	Khyber Pakhtunkhwa Billion Tree Afforestation Project (KP BTAP)
Objectives	Promote sustainable forest management, enhance biodiversity, improve community livelihoods, rehabilitate degraded areas	Afforestation to combat climate change, restore ecosystems, increase forest cover by planting one billion trees
Methodologies	Community-based forest management, participatory planning, direct seeding, nursery planting	Mix of direct seeding, planting nursery-grown seedlings, community engagement in afforestation
Species Selection	Prioritizes native species for biodiversity and ecosystem resilience	Emphasizes diverse native species for ecosystem restoration and carbon sequestration
Community Involvement	Strong emphasis on empowering local communities through training and direct participation	Actively engages local communities in planting and maintenance, fostering ownership
Funding and Resources	Funded through state and central government sources, with support from international organizations	Primarily funded by the provincial government, with additional international donor support
Monitoring and Evaluation	Participatory monitoring methods involving local communities	Structured monitoring framework using technology for tracking survival rates and biodiversity
Policy and Regulatory Context	Operates within India's comprehensive forest laws, promoting conservation and community rights	Aligned with Pakistan's national climate policies and commitments under international agreements
Legal Framework	Governed by: - Forest (Conservation) Act, 1980 - Wildlife Protection Act,	Supported by: - Khyber Pakhtunkhwa Forest Ordinance, 2002 - Environmental Protection

	1972 - Forest Rights Act, 2006	Act, 2014
Ecological Context	Focuses on hilly terrain with diverse ecosystems, addressing soil erosion and habitat degradation	Targets various ecological zones, emphasizing restoration of degraded lands and biodiversity enhancement
Socioeconomic Impact	Improves livelihoods for forest-dependent communities through sustainable practices and alternative income sources	Aims to provide economic benefits through job creation in tree planting and maintenance
Challenges and Barriers	Faces issues related to land tenure, human-wildlife conflict, and bureaucratic hurdles	Encounters climate variability, ensuring long-term maintenance of planted areas, and land use pressures

Case Study: Markhor Trophy Hunting and Biodiversity in Khyber Pakhtunkhwa (KP), Pakistan

The markhor (*Capra falconeri*) is a wild goat species native to the mountainous regions of Central Asia, particularly Pakistan, where it is recognized as the national animal. Markhor populations have faced significant threats due to habitat loss, poaching, and competition with livestock, leading to its classification as "Near Threatened" by the International Union for Conservation of Nature (IUCN, 2021).

Trophy Hunting as a Conservation Tool

In the late 1990s, the Government of Pakistan, in collaboration with various NGOs and international organizations, initiated a regulated trophy hunting program aimed at conserving the markhor population. This program highlights several key aspects:

1. **Population Management:** The program allows a limited number of markhor to be harvested each year, contributing to population stabilization. Sustainable quotas are set based on scientific assessments.
2. **Economic Incentives:** Fees from trophy hunting licenses can be substantial, generating revenue that is reinvested in conservation efforts and local community development. In KP, fees for a single markhor hunting license can reach up to $60,000 (GOP, 2017).
3. **Community Involvement:** Local communities receive a share of the hunting revenues, providing them with a vested interest in conserving markhor populations and their habitats. Community-based wildlife management models have proven effective in ensuring local engagement.

Success Stories

1. **Population Recovery:** Studies have indicated that the trophy hunting program has contributed to the recovery of markhor populations. For example, the markhor population in the Chitral region increased from about 2,000 in the late 1990s to approximately 4,500 by 2018 (Mishra et al., 2018).
2. **Economic Benefits:** The revenue generated from trophy hunting has funded local initiatives, including education and healthcare services. This has helped improve the quality of life for residents, who see direct benefits from wildlife conservation.
3. **Biodiversity Conservation:** Protecting markhor habitats has also benefited other wildlife species, promoting overall ecosystem health. Conservation efforts in the region have led to the preservation of critical habitats that support diverse flora and fauna.

Despite its successes, the trophy hunting program faces several challenges

1. **Regulation and Enforcement:** Ensuring compliance with hunting regulations is crucial. Illegal hunting and poaching remain significant threats, requiring robust monitoring and enforcement mechanisms.
2. **Balancing Local Needs:** Conflicts can arise between conservation objectives and local land use needs, particularly regarding grazing rights and agricultural land. Addressing these conflicts is essential for sustainable management.
3. **Public Perception:** Trophy hunting can be controversial, with opposition from some conservationists and the public. Raising awareness about its benefits and the importance of sustainable practices is vital for garnering support.

SWOT Analysis of Forest, Wildlife and EPA of KP

Strengths

Forest Department	Wild Life Department	EPA
Legal Frame Work Skilled Staff and Training: GIS monitoring, and forest law enforcement Legal Team. Financial Resources for Reforestation Community based Organizations Research Center	Legal Framework Human Resource Breeding Facility Research Center Logistics and Infrastructure Veterinary Hospitals and Labs	Legal Framework National and Internal support Relevant Knowledge and Expertise

Weakness

Forest Department	Wild Life Department	EPA
Infrastructure Deficiencies: The available infrastructure for forest rangers and officers, particularly in field formations. Lack of Operational Funds: Limited Technological Integration Insufficient • Infrastructure, • Human Resource and • Logistics in newly merged Districts	Deficient in requisite HR Shortage of Operational Budget Non-integration of Technology for monitoring Insufficient • Data repository • Infrastructure, • Human Resource and • Logistics	Technological Gaps Human Resource Shortage Operational Funding Organizational capacity Non-prioritize sector

Opportunities

Forest	Wild Life	EPA
International Donors National and international Policies/Legal Framework Collaborations with NGO, Institutes and Other governments Best practices around the world Job creation Eco Tourism	International Donors National and international Policies/Legal Framework Collaborations with NGO, Institutes and Other governments Best practices around the world Job creation Eco Tourism	International Donors National and international Policies/Legal Framework Collaborations with NGO, Institutes and Other governments Best practices around the world Improved Health Carbon Credits Conservation of

Local communities Social Media Carbon Credits Revenue Generation Non-Timber Forest Products Agro-Farming	Local communities Social Media Revenue Generation Integrated Tourism Zones	natural Resources

Threats

Forest	Wild Life	EPA
Class-Based Social Fabric **Law and Order Issues** Timber Mafia Population Expansion Farming Expanding Housing Societies Integrated Tourism Zones Non-consistent Policies Smuggling Litigation with Communities	**Class-Based Social Fabric** **Law and Order Issues** Timber Mafia Population Expansion Illegal Hunting Road ecology Integrated Tourism Zones Non-consistent Policies Smuggling	Infra structure growth Population growth Urban Sprawl Increased automobiles Fundings

Issues and Challenges

1. Legal

- **Inadequate Legal Mechanisms**: While KP has made considerable progress with laws like the KP Forest Ordinance 2002 (amended in 2022) and the Wildlife Act 2015, the legal framework still lacks provisions for carbon emission trading and climate finance mechanisms, which are essential for aligning with global climate agreements such as the Paris Agreement.
- **Gaps in Enforcement**: The laws enacted are not always effectively enforced due to resource constraints, especially in the merged districts, where the extension of the KP Forest Act 2002 is hindered by law-and-order issues as well as social fabric.
- **Human Resource Deficiency:** Departments like the Environmental Protection Agency (EPA) and Wildlife Department face serious shortages of qualified staff, hindering efficient monitoring of greenhouse gas (GHG) emissions, biodiversity conservation, and environmental assessments.
- **Limited Technological Integration:** The lack of AI-based monitoring systems and computerized forest surveillance reduces the effectiveness of forest protection efforts, leading to issues like illegal logging, wildlife poaching, and forest fires going undetected.

2. Institutional

- **Weak Coordination**: Despite various departments (Forest, Wildlife, EPA) working toward common goals under the KP Climate Change Policy 2022, there is a lack of coordination and integrated action, which affects overall performance in achieving afforestation, biodiversity conservation, and ecosystem restoration.
- **Insufficient Operational Funding**: Departments face budgetary constraints that limit their capacity to enforce environmental laws, conduct field operations, and implement flagship projects like urban forestry and community-managed forestry.
- **Law and Order Challenges**: In regions like the merged districts, implementing forest protection laws is challenging due to security concerns and local resistance from powerful elites within the social fabric.
- **Weak Coordination**: Weak coordination among the tourism department and environmental agencies has resulted in unregulated development that threatens local biodiversity.
- **Unregulated Tourism Expansion**: The overarching legal framework for ITZs (Integrated Tourism Zones) has led to

unregulated tourism expansion, threatening local ecosystems and habitats.

- **Inadequate GHG Monitoring**: The KP government lacks adequate GHG monitoring and has yet to fully develop mechanisms to capitalize on carbon credits or engage in carbon offset projects.
- **Public Awareness Campaigns**: Public awareness campaigns are sporadic and lack focus on portraying offenders of deforestation and wildlife poaching negatively.

Conclusion

The KP government has made significant strides in promoting afforestation, biodiversity conservation, and ecosystem restoration through initiatives like the Billion Tree Tsunami and the KP Climate Change Policy 2022. However, institutional and legal frameworks face significant challenges that inhibit the attainment of projected targets. These include enforcement weaknesses, inadequate funding, technology gaps, and human resource shortages. The government's approach needs a more integrated and coordinated response, especially in emerging fields like carbon management and sustainable tourism.

Recommendations

Objective	Challenges	Recommendations	Projected Targets and Timeline
Strengthen Legal Framework	Insufficient legislation on **carbon finance** and **sustainable tourism**	Introduce **legislation on carbon credits**, **emission trading systems**, and **Integrated Tourism Zones (ITZs)** regulations	Legal framework aligned with **NDCs** and **SDGs** goals Hiring of Consultants 3 Months Coordination with Federal departments 3 Months Coordination with IPCC and Stake Holders 6 Months Legislation and Policy making 4 Months
Improve Enforcement Capacity	**Weak enforcement** of forest and wildlife laws in **merged districts**	Increase **human resource allocation**, ensure strong monitoring through technology, and enhance coordination between departments	Hiring of HR 3 Months Introduction of Technology : Procurement and Capacity Building 6 Months
Enhance Technological Integration	**Lack of AI-based and computer systems** for monitoring	Deploy **drones**, **AI-based forest monitoring**, and **satellite technology** for real-time oversight of forests and biodiversity	Collaborate with International Organizations for funding 6 months Procurement of Equipment and training of Staff 6 months.
Increase Funding for Field Operations	Insufficient funds for **field patrols**, equipment, and afforestation	Establish **special climate funds** and attract **international climate finance.** Introduce Gradual tourism, hunting and entertainment fee by developing niche business in the field.	Hiring of Consultants 3 months Capacity Building 2 months Collaboration with NGOs and Communities. 6 Months Implementation within 1 year

Promote Community-Based Conservation	Lack of **community involvement** in conservation	Expand **community-managed forestry** programs, increase local **engagement through collaborations with stake holders.**	Increase Game Reserves by engagement of local communities by promoting awareness.
Develop Integrated Tourism Zones (ITZs)	**Unchecked tourism** threatening ecosystems	Enforce **ecological regulations through Forest department as the power lies with EPA, Tourism and Forest.**	Preparation of amendment in EPA act 2 week Vetting from Law Department 1 week Approval of Cabinet 1 week Approval from Parliament and Governor 1 month.

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Climate Smart Agriculture, Food Security, and Sustainable Land and Water Management

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Abstract:

This simulation exercise examines the intersection of climate change, food security, and sustainable land and water management in Pakistan. Despite contributing minimally to global greenhouse gas emissions, Pakistan faces significant climate-induced challenges, including extreme weather events, water scarcity, and land degradation, severely impacting its agricultural sector, which accounts for over 20% of GDP and employs nearly 38% of the labor force. Current national policies for Climate-Smart Agriculture (CSA) and food security are inadequate. The report identifies key institutional gaps and emphasizes the need for better integration of global best practices, highlighting modern technologies like IoT and AI for optimizing resource use. Comparative case studies from India and Bangladesh illustrate effective strategies for mitigating climate risks. The report also stresses the importance of sustainable land and water management (SLWM) and proposes strategic recommendations, including precision agriculture, urban planning reforms, and public-private partnerships, to enhance Pakistan's resilience to climate change and ensure agricultural sustainability.

Key words:

climate change, food security, sustainable management, agriculture, resilience

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Introduction

Pakistan, despite its minimal contribution to global greenhouse gas emissions, stands as one of the most vulnerable nations to the impacts of climate change (UN Report, 2020). Extreme weather events, water scarcity, and the melting of glaciers disproportionately affect the country's most impoverished and marginalized communities (Khan & Ali, 2019). In response, the Government of Pakistan has developed climate change adaptation policies to address these challenges. However, an assessment of these policies is essential to identify areas for improvement and enhance the country's resilience to climate change (Ahmed, 2022).

Globally, climate change driven by both natural variability and human activities such as greenhouse gas emissions, deforestation, and industrialization presents far-reaching consequences for ecosystems, weather patterns, and societies (IPCC, 2021). Pakistan's challenges are exacerbated by these anthropogenic factors, further stressing the need for effective adaptation and mitigation strategies (UNEP, 2018).

Between 1997 and 2023, Pakistan experienced an average of 523 lives lost annually due to extreme weather events. According to the Pakistan Meteorological Department (PMD), the country faced 145 extreme weather events by 2024. Over the past 50 years, Pakistan's average temperature has increased by 0.6°C, with projections indicating a potential rise of 3°C to 5°C by 2100 (IPCC, 2023). The 2022 Karachi heatwave alone resulted in 1,300 deaths, underscoring the risks posed by urban heat islands. Flooding between 2010 and 2023 displaced large populations, particularly the 2022 floods that affected 33 million people and caused $15 billion in damages (World Bank, 2024). Additionally, the World Bank estimates Pakistan's annual climate adaptation costs to range between $8 billion and $15 billion (World Bank, 2024).

One of the most pressing impacts of climate change is the growing uncertainty in water availability, with projections indicating a decrease in freshwater by 12–20% (IPCC, 2014). This will directly affect agricultural productivity, potentially leading to a 30% decline in crop yields in South Asia by 2050 (UN Report, 2021). Additionally, health risks such as skin cancer, heart disease, and vector-borne diseases like dengue and malaria are expected to rise (WHO, 2019). The consequences extend to massive migration, loss of culture, biodiversity loss, and ecosystem disruptions, particularly harming marginalized groups like women and children (Ali & Hussain, 2020; Ahmed, 2022).

To combat these issues, smart agriculture has emerged as a promising solution. By incorporating modern technologies such as IoT, AI, and data analytics, smart agriculture enhances farming efficiency, productivity, and sustainability. This approach is particularly relevant for Pakistan as it helps

optimize resource use, reduce environmental impacts, and build resilience against climate change (Smith et al., 2020). Techniques such as precision farming, automated irrigation, and climate-resilient crop varieties can significantly support farmers in adapting to changing climate conditions.

In parallel, addressing food security, defined as ensuring the availability, accessibility, and stability of nutritious food, is becoming more challenging in the context of climate change. The impacts of erratic weather, shifting growing seasons, and water scarcity directly threaten global and regional food systems (Brown & Taylor, 2019).

Sustainable Land and Water Management (SLWM) is a critical component of both food security and climate resilience. By promoting practices that safeguard land and water resources, SLWM helps maintain ecosystem health, reduce environmental degradation, and enhance resilience to climate-induced stresses like soil degradation and water shortages (Green & White, 2022). Together, these efforts in smart agriculture and SLWM are key to ensuring a sustainable future in the face of climate change.

Statement of Problem

Pakistan, an agricultural country, faces significant challenges from climate change, water scarcity, and land degradation, threatening food security and livelihoods. Current policies and frameworks for climate-smart agriculture (CSA), food security, and sustainable resource management are not effective in addressing the prevailing issues in Pakistan. To address these issues, there is an urgent need to align policies, strengthen institutional capacity, and adopt global best practices to ensure sustainable agricultural productivity and resource management.

Scope of the Study

- Comprehensive analysis of legal, institutional, and infrastructural frameworks in Climate Smart Agriculture, Food Security, and Sustainable Land and Water Management in Pakistan.
- It will also be an endeavor to understand the implementation of strategies.
- Analyze the challenges and issues faced by Khyber Pakhtunkhwa specifically and Pakistan in general.
- The study will be an endeavor to recommend practical policy options for achieving the desired goals of Climate Smart Agriculture, Food Security, and Sustainable Land and Water Management in Pakistan.

Research Methodology

This research has used a qualitative method of analysis using secondary data available online. The concerned departments were consulted for data collection. Acts, policies, rules, and regulations were reviewed. Newspapers,

articles, journals, etc., have been accessed for secondary data. SWOT, GAP, and PESTLE analyses are carried out as techniques for analysis.

Situational Analysis

The agriculture sector constitutes the largest sector of our economy in terms of involving not only more than 38 percent of our labor force but also contributing more than 20 percent, on average, to national GDP (Finance, n.d.). However, the agricultural sector, despite the availability of substantial infrastructure and human resources, has failed to ensure food security in the country. The country ranks 4th in cotton production in the world, 5th in sugarcane, 9th in wheat, 5th largest producer of milk, and 3rd largest in buffalo hides/skins, etc. However, every year, the nation faces acute shortages, especially in wheat and sugarcane, impacting real-time food security in the country (FAO, 2024).

The reasons for this lag are many, including climate change and natural disasters, massive urbanization, but the most important factors are the lack of modern technology and climate-smart agriculture practices.

Situational Analysis Related to Climate Smart Agriculture (CSA) and Sustainable Land and Water Management

Pakistan's agricultural sector faces significant challenges, including rapid urbanization, inefficient land use, and poor water management, all of which threaten food security. Approximately 20% to 40% of agricultural land has been converted into residential areas due to the unchecked expansion of housing societies (Zahoor, 2023). This trend, driven by population growth and unplanned urbanization, has reduced the availability of fertile land for farming and strained agricultural productivity. Despite the country's agricultural potential, the lack of a holistic approach to land preservation has resulted in underutilized resources and a declining ability to meet food production demands. Compounding this issue is water mismanagement. Although Pakistan possesses abundant water resources through the Indus Basin Irrigation System, approximately 40 million acre-feet (MAF) of water is wasted annually (IRSA, 2024). The basin is crucial, contributing over 25% of Pakistan's GDP and supporting 90% of food production; yet inefficiencies in water use remain a major challenge.

The rapid conversion of agricultural land and inefficient water management highlight the urgent need for Climate Smart Agriculture (CSA) practices. CSA focuses on optimizing the use of natural resources, such as land and water, through sustainable techniques. By incorporating practices like precision irrigation, climate-resilient crop varieties, and conservation agriculture, CSA can mitigate the impacts of urbanization and environmental degradation. A sound urban policy, combined with CSA strategies, could promote efficient land use, preserve agricultural productivity, and ensure better water management. This would not only

improve food security but also help Pakistan adapt to the pressures of climate change and urban expansion.

The absence of proactive legislation on urban planning and agricultural management has exacerbated the food security crisis. Effective CSA approaches, such as sustainable land and water management, could address the growing demand for food production while reducing environmental degradation. In particular, CSA's focus on enhancing resource efficiency and resilience is vital for balancing the needs of urban development with sustainable agricultural production.

Legal and Institutional Framework

Federal Policies and Institutions

Sr. #	Policies/Acts/Rules	Madates
1	National Climate Change Policy 2012	Provides a framework to address the impacts of climate change on key sectors, including agriculture, food security, and natural resource management (4.1,4.2,4.6.5,10)
2	National Climate Change Act of 2017	providing a legal framework for coordination and implementation of climate policies, including Climate-Smart Agriculture (CSA), food security, and sustainable land and water management(4.1,4.2,4.6.5,10)
3	National Agriculture and Food Security Strategy 2016-2025	The strategy includes key provisions related to Climate-Smart Agriculture (CSA), food security, and sustainable land and water management(6.1,6.1.3,6.2,6.4(chapter 6)
4	National Sustainable Agriculture Policy	to promote sustainable agricultural practices, improve food security, and ensure the sustainable management of land and water resources(1.2,1.6,2.3,2.6)
5	National Water Policy 2018	addressing water management challenges chapter.4(4.2), chapter.6(6.2), chapter. (7,8,16,20)
6	Ministry of National Food Security and Research	Responsible for national agricultural policy.
7	Indus River System Authority	Manages water resources in the Indus basin
8	Ministry of climate change and environmental coordination	To steer Pakistan towards climate resilience development

Provincial Policies and Institutions

Sr. #	Acts/rules	Mandates
1	Khyber Pakhtunkhwa Agricultural Produce Markets Act	Regulates the marketing of agricultural produce.
2	Khyber Pakhtunkhwa Agriculture Policy	Aims to enhance agricultural productivity and promote sustainable practices.
3	Khyber Pakhtunkhwa Land Use Regulation	Provides guidelines for land use planning and zoning.
4	Agriculture Department of KP	Responsible for implementing agricultural policies and providing support to farmers.
5	Provincial Irrigation Department	Manages irrigation systems and water distribution
6	Khyber Pakhtunkhwa Environmental Protection Agency (KPEPA)	Addresses environmental issues related to agriculture and water resources
7	The Khyber Pakhtunkhwa Water Act 2020	Addresses the impact of climate change regarding droughts on water resources (chapter iv, v, viii)
8	The Integrated Water Resource Management (IWRM) Strategy for Khyber Pakhtunkhwa (	Focusing on several aspects related to water management Chapter, Strategic frame work, (4.1,4.2)
9	The Canal and Drainage Act of 1873	Regulates irrigation, drainage and canal construction and maintenances. (chapter, ii, iii ,v)

Gaps in Provincial Polices/Acts and Institutions

S.No	Acts/rules	Gaps
1.	**Climate Change Policy KP 2022**	• Non redressal of the specific needs of smallholder farmers, • No risk insurance mechanisms for farmers to cope with climate-induced losses, such as droughts, floods, and crop failures.
2.	**The Khyber Pakhtunkhwa Water Act 2020**	• Absence of framework for building resilience in water infrastructure or ecosystems

		• Non emphasize on Strategies for adaptation, such as improving water storage systems or encouraging water-efficient technologies • Poor engagement mechanism to engage communities in water conservation through education campaigns or incentives to encourage sustainable water use.
3.	**The Integrated Water Resource Management (IWRM) Strategy for Khyber Pakhtunkhwa**	• Poor managing and monitoring mechanism for ensuring Groundwater Depletion • No Recharge Mechanisms strategy for replenishing groundwater sources (e.g., rainwater harvesting) • Insensitive to rapid Urbanization Pressures • Inadequate Attention to Watershed Management
4.	**The Canal and Drainage Act of 1873**	• Lacks specific guidelines on water conservation and efficient water use • No mention of technologies such as drip irrigation, sprinkler systems, or modern practices aimed at reducing water wastage • More focus on surface water and poor integration of Groundwater Management • Weak engagement of relevant Stakeholder in water governance • Absence of robust framework to deal with flood management & the rehabilitation of drainage systems
5.	**KP Irrigation Department**	• Rules and regulations of water under KP water Act 2020 are not framed yet

Review of Legal and Institutional Frameworks

Supportive Aspects (Policies)

- **Policies Promoting Modern Techniques:** Existing agricultural policies at the federal and provincial levels encourage the adoption of modern farming techniques, including CSA practices.
- **Incentives for Innovation:** There are initiatives aimed at providing incentives for farmers who adopt sustainable practices.

Hindering Aspects

- **Outdated Regulations:** Some existing agricultural laws and regulations are outdated and may not support innovative CSA practices.
- **Lack of Awareness:** Farmers often lack knowledge about CSA techniques, and there is insufficient training provided by agricultural institutions.

Supportive Aspects (Water Resources)

- **Water Conservation Policies:** Policies exist to promote efficient water use and management, which aligns with CSA principles.
- **Irrigation Improvement Initiatives:** There are efforts to modernize irrigation systems, which can enhance water efficiency.

Hindering Aspects

- **Fragmented Management:** Poor coordination between various water management authorities leads to inefficiencies and hinders the implementation of integrated water resource management (IWRM) that supports CSA.
- **Regulatory Gaps:** Existing regulations may not adequately address the challenges posed by climate change, leading to a lack of frameworks for sustainable water management.

Supportive Aspects (Land Management)

- **Land Use Regulations:** The introduction of land use planning can support sustainable agricultural practices by promoting agroecological methods.
- **Tenure Security Initiatives:** Some policies aim to enhance land tenure security, encouraging farmers to invest in sustainable practices.

Hindering Aspects

- **Insecure Land Tenure:** Inadequate land tenure security can discourage farmers from adopting long-term CSA practices, as they may fear losing access to the land.
- **Bureaucratic Barriers:** Complicated land registration processes can deter investment in sustainable land use.

Specific Challenges in Khyber Pakhtunkhwa (KP)

- **Historical Context:** KP's history of conflict has disrupted agricultural practices and institutional capacity, making it difficult to implement CSA initiatives effectively.
- **Limited Resources:** Many institutions in KP face budgetary constraints, hindering their ability to support CSA and sustainable resource management initiatives.
- **Awareness and Capacity Issues:** Farmers in KP may lack knowledge about CSA practices, and there is often insufficient training available through provincial institutions.

Comparative Analysis

India's Climate-Smart Agriculture Initiatives

India has been proactive in implementing climate-smart agriculture (CSA) strategies to address the vulnerabilities of its agricultural sector to climate change.

1. The National Innovations in Climate Resilient Agriculture (NICRA) program, launched by the Indian Council of Agricultural Research (ICAR), is a flagship initiative that promotes the adoption of climate-resilient crops, water-saving technologies, and efficient soil management practices.
2. The Climate Resilient Agriculture Initiative in Andhra Pradesh focuses on sustainable agricultural practices such as zero-tillage, biofertilizers, and the use of drought- and flood-tolerant crops.
3. Watershed programs, particularly in drought-prone areas of Madhya Pradesh and Maharashtra, enhance water management through rainwater harvesting and agroforestry. These programs reflect the country's commitment to increasing agricultural productivity while ensuring long-term environmental sustainability in the face of climate challenges.
4. The Bihar Climate Resilient Agriculture Initiative aims to reduce the vulnerability of smallholder farmers in Bihar through climate-smart practices.

Bangladesh's Climate-Smart Agriculture Initiatives

Bangladesh, being highly vulnerable to climate change, has integrated climate-smart agriculture to improve the resilience of its farming communities.

1. The Climate-Smart Agriculture and Water Management (CSAWM) program focuses on promoting climate-resilient rice varieties, better irrigation techniques, and water conservation methods, particularly in flood-prone regions.
2. CARE Bangladesh's Climate Resilient Agriculture Project promotes the cultivation of saline-tolerant crops, innovative soil management techniques, and rainwater harvesting systems.
3. The Haor Basin initiative allows farmers to grow vegetables in waterlogged conditions, addressing the threat of flash floods.

Comparative Analysis of Best Practices in Climate Smart Agriculture (CSA), Food Security, and Sustainable Land and Water Management in India, Bangladesh, and Pakistan, Specifically Khyber Pakhtunkhwa in Table Form:

Category	India	Bangladesh	Pakistan
Climate Smart Agriculture (CSA)	**Practices:** - Organic Farming (National Program for Organic Production) - Integrated Pest Management (IPM) - Agroforestry	**Practices:** - Floating Gardens (flood-prone areas) - Rice-Fish Farming Systems - Community-Based Adaptation	**Practices:** - High-Value Crop Cultivation - Water-Conserving Techniques (drip irrigation, rainwater harvesting) - Farmer Training Programs
	Effectiveness: - Improved soil health, yields, and resilience to climate change	**Effectiveness:** - Significant food security and resilience improvement	**Effectiveness:** - Limited uptake of CSA due to lack of awareness and resources
	Strengths: - Strong policy support for organic farming and IPM	**Strengths:** - Innovative local practices and community engagement	**Strengths:** - Potential for high-value crops and water-saving irrigation methods

	Weaknesses: - N/A	**Weaknesses:** - N/A	**Weaknesses:** - Slow CSA adoption and limited government support
Food Security	**Practices:** - Public Distribution System (PDS) - National Food Security Act	**Practices:** - Safety Net Programs (cash transfers, food assistance) - National Food Policy	**Practices:** - Provincial Food Security Policy - Community Engagement in food production
	Effectiveness: - Reduced food insecurity but implementation challenges	**Effectiveness:** - Improved food security, with malnutrition challenges	**Effectiveness:** - High food insecurity due to economic challenges and natural disasters
	Strengths: - Robust food distribution systems and legal frameworks	**Strengths:** - Targeted safety nets and comprehensive food policy	**Strengths:** - Community-driven approaches have potential for greater impact
	Weaknesses: - N/A	**Weaknesses:** - Malnutrition remains a challenge	**Weaknesses:** - Ineffective policy implementation and sectoral coordination
Sustainable Land and Water Management	**Practices:** - Integrated Watershed Management - Rainfed Farming Technologies (drought-resistant crops, conservation agriculture)	**Practices:** - Integrated Coastal Zone Management - Participatory Irrigation Management	**Practices:** - Watershed Management Initiatives - Community-Led Irrigation Projects

	Effectiveness: - Improved soil health, water retention, and resilience to climate change	**Effectiveness:** - Significant advancements in managing water resources in coastal areas	**Effectiveness:** - Nascent initiatives, hindered by funding, coordination, and capacity challenges
	Strengths: - Strong focus on integrated watershed management and community involvement	**Strengths:** - Innovative strategies in coastal areas and community-driven irrigation management	**Strengths:** - Opportunities for community-led water management initiatives
	Weaknesses: - N/A	**Weaknesses:** - N/A	**Weaknesses:** - Limited implementation of comprehensive water and land management strategies
Recommendations for KP	- Policy Reforms: Update laws and policies to support CSA and sustainable resource management - Capacity Building: Training and resources for farmers		- Community Engagement: Encourage local participation in decision-making to ensure context-specific and effective interventions

PESTLE Analysis

PESTLE analysis of the federal and Khyber Pakhtunkhwa (KP) levels concerning climate smart agriculture (CSA), food security, and sustainable land and water management, covering the political, economic, social, technological, legal, and environmental factors.

Factor	Federal Level	Khyber Pakhtunkhwa (KP) Level
Political	- Federal policies are increasingly focusing on food security and climate change. - Bureaucratic hurdles can slow down policy implementation. - Political instability may hinder long-term agricultural and water management strategies.	- Local government structure can support grassroots initiatives. - Political dynamics may affect funding and prioritization of agricultural projects. - Inter-departmental coordination can be challenging.
Economic	- Agriculture remains a key sector for economic development and employment. - Limited budget allocations can constrain agricultural and water management initiatives. - International funding and partnerships are critical for resource mobilization.	- KP's economy is largely agrarian, heavily reliant on agriculture. - Economic challenges such as unemployment may affect farmers' ability to adopt new practices. - Potential for local markets to support sustainable agricultural products.
Social	- Increasing public awareness and concern about food security and climate change. - Cultural resistance to changing traditional farming practices may hinder adoption of CSA. - Diverse population with varying needs for food security and agricultural practices.	- Strong community ties can facilitate local engagement in agricultural initiatives. - Limited access to education and awareness about CSA practices among rural populations. - Vulnerable populations are more affected by food insecurity and climate impacts.

Technological	- Growing emphasis on adopting modern agricultural technologies, including precision farming and irrigation systems. - Lack of infrastructure for technology transfer can hinder progress. - Opportunities for research collaboration with universities and international organizations.	- Limited access to modern technology and innovation in rural areas. - Training and capacity building for farmers on new technologies are often insufficient. - Community-based solutions leveraging local knowledge can enhance technology adoption.
Legal	- Frameworks for food security and agricultural development are present but need updating and enforcement. - Regulatory hurdles can impede the implementation of sustainable practices. - Land tenure issues can affect investment in sustainable land use.	- Local laws and regulations may not always align with federal policies. - Bureaucratic inefficiencies may complicate the execution of legal frameworks. - Community land rights issues can deter investment in sustainable practices.
Environmental	- Increasing focus on environmental sustainability in agricultural policies. - Climate change poses significant threats to agriculture, necessitating urgent action. - Federal programs for reforestation and sustainable land management are gaining traction.	- KP faces unique environmental challenges, such as water scarcity and land degradation. - Vulnerability to climate change impacts on agricultural productivity. - Local initiatives may focus on conservation but require more support and resources.

Institutional SWOT Analysis

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis provides a framework for assessing Pakistan's agricultural institutions and their capacity to promote climate-smart agriculture and sustainable land and water management.

Strengths:

- **Established Institutions:** Pakistan has several key agricultural institutions, such as the Ministry of National Food Security and Research (MNFSR), which has a national mandate to develop agricultural policy. Provincial agricultural departments also have the capacity to adapt policies to meet local needs (Zaman & Shah, 2018).
- **Diverse Agricultural Sector:** Pakistan's diverse agricultural sector, which includes crops ranging from wheat to cotton and sugarcane, provides opportunities for experimenting with different climate-smart practices. For instance, water-saving irrigation techniques and agroforestry have the potential to be adopted across various regions, depending on local conditions (Saeed & Hussain, 2020).

Weaknesses:

- **Fragmentation Between Federal and Provincial Governments:** One of the main challenges facing Pakistan's agricultural institutions is the lack of coordination between federal and provincial governments. The devolution of powers under the 18th Amendment has led to inconsistencies in the implementation and enforcement of climate-smart practices across provinces (Rehman & Ali, 2021).
- **Underfunded Extension Services:** Agricultural extension services, which are responsible for providing farmers with information and training on climate-smart practices, are severely underfunded and understaffed. As a result, many farmers, particularly those in remote rural areas, do not have access to the knowledge and resources they need to adopt sustainable practices (Saeed & Hussain, 2020).

Opportunities:

- **Emerging Technologies:** Precision agriculture, drone-based monitoring, and other emerging technologies offer significant opportunities to improve the productivity and resilience of Pakistan's agricultural sector. By leveraging these technologies, Pakistan can improve resource efficiency and reduce the environmental impact of farming (Khan, 2019).
- **Access to Global Climate Finance:** Global climate finance mechanisms, such as the Green Climate Fund, offer opportunities for Pakistan to access funding for large-scale climate adaptation projects.

These funds could be used to support the adoption of climate-smart agricultural practices, such as no-till farming, agroforestry, and precision irrigation (Ahmad & Farooq, 2020).

Threats:

- **Vulnerability to Climate Change:** Pakistan's agricultural sector is highly vulnerable to climate change. Rising temperatures, erratic rainfall patterns, and increasing incidents of floods and droughts threaten food security and rural livelihoods. Without significant investments in climate adaptation, the sector will struggle to cope with these growing risks (Rehman & Ali, 2021).
- **Political Instability:** Political instability and shifting government priorities pose a threat to the long-term sustainability of climate-smart agricultural policies. Frequent changes in leadership may delay the implementation of critical reforms and adaptation projects (Saeed & Hussain, 2020).

Issues and Challenges

Inadequate Legal Framework:

The absence of a national legislative framework on food security, its vision, objectives, and implementation strategies is the biggest challenge to achieving the goal of food self-sufficiency and security in the country. Although there are many laws in Pakistan that ensure various aspects of the food chain, their focus is mainly on food chain management and marketing. Due to a poorly developed legislative framework, various foodborne infectious diseases have prevailed in the Pakistani community (MoNFSR, 2024).

Rising Population:

Pakistan's high population growth is attributed to limited access to family planning services, lower literacy rates, and rapid urbanization. The rising population is already burdening food security by taxing resources and infrastructure, thereby increasing hunger and malnutrition. The demand for food products is rising alongside population growth, which saw a three-fold increase from 1972 to 2017, while agricultural production exhibited nominal growth patterns.

Rapid Urbanization:

Pakistan continues to urbanize rapidly, driven by increasing population and subsequent demand for housing and industrial development. This urban expansion into agricultural lands has caused many problems for the agricultural sector; however, no laws are in place to stop this practice. If measures are not taken to secure the future of the agricultural sector, Pakistan faces a threat to food security and a significant decline in exports (Imperial Institute of Policy Studies, 2021).

Land Utilization Practices:

Pakistan faces an acute dilemma not only regarding the efficient utilization of available land for increased productivity but also in managing urban sprawl and encroachment on agricultural spaces. There are no national or provincial land utilization plans or enforcement mechanisms in place to protect land against the ever-increasing number of housing societies.

Diversifying Diet Patterns:

Despite the increase in food availability and per capita income, the average calorie intake per adult equivalent in Pakistan is still less than the 2,350 Kcal benchmark. It is estimated that thirty percent of children under age 5 are underweight, forty-five percent are stunted, eleven percent are wasted, and thirty percent are underweight. This overall scenario may increase vulnerability to poverty, widespread disease burdens, and lower productivity (Haider, 2017).

Water Availability for Agriculture:

Pakistan is facing problems related to food security due to an irrigation water crisis for crop production. Food security encompasses not only the sufficiency of available food but also ensures people's full access to food sustainably. Although resources and natural geography for irrigation are available, the absence of on-farm irrigation infrastructure, excessive reliance on water-intensive crops, and lack of water conservation practices, along with flooding irrigation methods instead of drip or sprinkler systems, lead to resource wastage.

Unsustainable Agricultural Practices:

The incidence of food poverty is higher in rural areas (35%) than in urban areas (26%). In Pakistan, irrigated agriculture is vital for future food security because it produces more than 90% of total grain production (Qureshi, 2012). With decreasing amounts of available water, the challenge of sustaining irrigated agriculture is increasing daily.

Increased Soil Erosion:

Soil health, along with water supply, is the most valuable resource for humans, as human life depends on the soil's generosity. Soil degradation poses a threat to food security, as it reduces yield, forces farmers to use more inputs, and may eventually lead to soil abandonment. Unfortunately, the importance of preserving soil health appears to be overlooked by policymakers, especially in light of the ever-increasing incidences of floods and climate change impacts.

Climate Change:

Increasing minimum and maximum temperatures and irregular rainfall patterns due to global warming are major climatic factors affecting food security in Pakistan by reducing wheat production. Floods have become a regular phenomenon in the country, severely impacting the agricultural landscape. However, respective institutions have failed to mitigate the impact on agricultural practices, leading to poverty and food insecurity.

Inefficient Food Distribution Systems:

The supply chain for food distribution in Pakistan is often fragmented and inefficient, involving multiple intermediaries, which increases costs and reduces the quality of food reaching consumers. Lack of coordination among stakeholders exacerbates these challenges. This inequitable food distribution system impedes food access and availability, reducing opportunities for the disadvantaged in society.

Limited Access to Credit:

Despite agriculture being a vital sector, a significant portion of farmers, especially small and marginal ones, struggle to access formal credit. Estimates suggest that only 10-15% of credit needs are met by formal sources. This limited access forces farmers to turn to informal lenders who charge exorbitant interest rates, trapping them in cycles of debt.

Lack of Storage Facilities:

Many farmers rely on traditional methods like on-farm storage in open sheds or pits, leading to significant post-harvest losses of up to 40% due to factors like pests, rodents, moisture damage, and spoilage.

Value Addition in Export Commodities:

The country has some of the best varieties of fruits and vegetables. However, their contribution to exports is minimal due to the absence of standard processing and storage facilities. Most of these export commodities get wasted during transportation and conveyance, even within the country.

Housing Societies and Agriculture:

The ever-increasing presence of housing societies encroaching on agricultural lands is detrimental to the food security regime in the country. In the absence of a regulatory framework, the growth and strength of these societies incentivize farmers to sell their lands for readily available cash instead of investing in agricultural production.

Technological Gaps:

Unlike other advanced countries, where the availability of fertile land is limited by geography, they have achieved great feats through extensive use of technology for maximizing production, reducing water usage, and ensuring the conservation of soil and nature. Pakistan has failed to develop a special program for using technology in precision farming, water management, crop rotation, and consequently, productivity.

Conclusion

Pakistan faces significant challenges in addressing the impacts of climate change on its agricultural sector. However, by strengthening policy coherence, improving institutional capacity, and promoting technological innovation, the country can enhance its resilience to climate change and ensure sustainable agricultural development. The recommendations and action plan outlined in this report provide a roadmap for integrating climate-smart agriculture, food security, and sustainable land and water management into national and provincial frameworks, paving the way for long-term sustainability and resilience.

Urbanization, especially the construction of housing societies on urban agricultural lands, has disrupted existing food supply chains in urban areas, leading to food insecurity. The population bulge, massive pressure on cities to provide amenities to the public, and inefficient use of land available for agriculture impact the production cycle in the country. Ancient agricultural practices, the absence of modern farm machinery, a lack of capacity building for farmers, and impractical, non-consensus-based policy decisions impede progress toward achieving food security in the country.

A lack of coherence between federal and provincial structures, insufficient incentives for innovation, the absence of linkages between producers and agricultural industries, and capacity issues affecting farmers' social behavior for more productive crops point to systemic problems in the agricultural sector. Productivity is directly proportional to food security, and the state must prioritize the agricultural sector as a main area of investment to foster growth and development.

The future of Pakistan's agricultural sector hinges on its ability to adapt to the realities of climate change. While the country has taken some steps toward promoting sustainable practices through initiatives like the National Climate Change Policy, much more needs to be done to build resilience against climate risks. By strengthening its legal and institutional frameworks, investing in research and innovation, and learning from global best practices, Pakistan can create a more sustainable and resilient agricultural sector that ensures long-term food security and economic growth.

Recommendations

Agriculture is the locomotive of rural development in Pakistan. The agricultural sector is the main source of foreign exchange earnings in the country. The export of cotton, cotton-based products, and rice accounts for about 65% of total export earnings. Despite its critical importance to growth, exports, and food security, the agricultural sector faces many challenges that lower its yield. These impediments include the use of obsolete farming technology, outdated infrastructure, a lack of irrigation facilities, and water salinity. The following policy measures must be implemented by the government to address the various challenges farmers face in Pakistan's agricultural sector.

Legislative Framework

A detailed study of some regional countries reveals that they have framed practical and need-based national legal frameworks. These frameworks aim to assign responsibilities to national and provincial governments for regulating agricultural markets in the truest sense, supporting research and innovation, and protecting farmers from exploitative market forces. The government must formulate a national food security act with a clear vision and enforcement mechanism, aligning the interests of all relevant stakeholders.

Urban Planning/Control Laws

The national and provincial governments should take immediate steps to control the two most important contributors to food insecurity in Pakistan: population explosion and massive urbanization. Population control must be the top priority for both federal and provincial structures, and programs such as family planning, EPI, and Nashunuma should be linked for lasting impact. National and provincial laws on land use, along with enforcement bodies, should be established immediately to curb the surge of illegal societies, prevent haphazard urban growth, and improve the performance of civic agencies responsible for providing amenities.

Provision of Microcredit to Farmers

Microcredit can significantly benefit farmers with small landholdings by providing necessary support to maximize productivity. However, the microcredit system faces fundamental issues, such as lengthy processing times for lending. Additionally, due to inflationary pressures, the standard amount of credit may fall short of farmers' requirements, which is discouraging. Higher interest rates also deter farmers. This can be addressed through regulations by the State Bank that provide micro-lending on a fast-track basis with minimal interest. Another important intervention could be a subsidy on loan interest to lower barriers for farmers seeking credit.

Climate-Smart Agriculture Practices

One of the most critical aspects of our policy intervention should be the adoption of climate-smart agricultural practices. Pakistan has experienced massive disruptions in agricultural production cycles due to floods and climate change impacts on crop patterns and water use. The government, through its engagement in COPs and domestic legislation, has prioritized climate response mechanisms, with a special focus on conserving cultivable soil and forest cover. The government can protect farming communities from potential devastation by using the Climate Investment Fund and resilience strategies to mitigate the consequences of climate change and floods.

Technology as a Revolutionary Tool for Transforming Agriculture

Technology can be a revolutionary tool in transforming agriculture in Pakistan and ensuring food security. It assists stakeholders at all levels—farmers, markets, government, and support organizations—in knowledge sharing, machinery use, crop patterns, and, most importantly, precision farming and sustainability. The government must invest in technology transfer and dissemination, along with attracting private sector investment through public-private partnerships. Agriculture IT wings should be established in farm services centers to create an interface between farmers and government agencies for troubleshooting issues.

Strengthening Policy Coherence

There is an urgent need for a more coherent national strategy that aligns federal and provincial efforts. A central coordinating body should be established to ensure that provincial initiatives align with national climate goals. This body would also be responsible for ensuring that resources are allocated efficiently and that climate-smart policies are consistently enforced across regions.

Building Institutional Capacity

Agricultural extension services should be strengthened to ensure that farmers have access to the information and resources they need to adopt climate-smart practices. This could include increasing funding for extension services, providing training programs for agricultural officers, and expanding the use of digital platforms to reach remote rural communities.

Introducing Financial Incentives

Financial incentives, such as subsidies for water-efficient irrigation systems or tax breaks for farmers who adopt drought-resistant crops, would encourage widespread adoption of sustainable practices. These incentives could be targeted at smallholder farmers, who are often the most vulnerable to climate risks but lack the capital to invest in new technologies.

Promoting Public-Private Partnerships

Collaboration between the government and the private sector can drive innovation in agriculture. Public-private partnerships could be used to introduce new technologies, such as precision agriculture tools, to farmers. The private sector could also play a role in providing training and technical support to farmers who adopt these technologies.

Logical Framework Matrix

Log frame for short Term Initiatives

S#	Initiatives/Actions	Institutions	Time	Fund Allocated	Objectives
1	Framing of Rules and Regulations under Water Act 2020	Irrigation Department KP	6 months	nil	Efficient utilization of water
2	Framing of Housing Schemes Regulation	Local Govt. and Rural Development Department	6 months	nil	Land sustainably would be ensured
4	Revision of KP Water Act 2020	Irrigation Department KP	2 months	nil	Water management
5	Revision of Integrated Water Resource Management Strategy KP	Irrigation Department Kp	6 months	nil	Water management
6	Revision of Canal and Drainage water Act 1873	Irrigation Department KP	6 months	nil	Water Management and Flood Control ensuring Food security and Health of Soil
7	Revision of Climate Change Policy KP 2022	Environment Protection Agency	1 months	nil	Climate smart agriculture

Log frame for Long Term Initiatives

S#	Initiatives/Actions	Institutions	Time	Fund Allocated	Objectives
1	District Land Use Plans and Master Plans Of all Districts in KP	Urban Planning Unit Working under Planning & Development Department	3 years	Rs.800 Million	Land sustainability And Urbanization Control
2	Precision Irrigation (Drip irrigation, Sprinkler irrigation, Centre pivot irrigation, soil moisture sensors)	Irrigation Department Kp	5-6 years	Rs.1000 Million	Water management And Climate Smart Agriculture by enhancing crops productivity
3	Introduction of Climate Resilient Crops Verities for Farmers	Agriculture Department	6-7 years	Rs.500 Million	Climate Smart Agriculture
4	Strengthen Policy Coherence	MNFSR, Provincial Agriculture Departments	12 months		Conduct training programs for farmers and officials
5	Improve Institutional Coordination	MNFSR, MoCC, Provincial Governments	12 months		Pilot precision agriculture projects
6	Enhance Capacity Building	MNFSR, Provincial Governments, Research Institutions	Ongoing	1000 million (50/50% sharing model)	Develop proposals for international climate funds

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Energy Conservation, Renewable Resources and Electric Vehicle Adoption

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Abstract:

Pakistan is facing a severe energy crisis driven by urbanization, population growth, and industrialization. As of 2024, the country's power generation heavily relies on fossil fuels, resulting in high production costs and economic instability. This study examines three critical areas to address this crisis: energy conservation, renewable energy sources, and electric vehicle (EV) adoption. Energy conservation initiatives led by the National Energy Efficiency & Conservation Authority (NEECA) are essential for reducing consumption, but challenges like limited enforcement and public awareness hinder progress. Renewable energy policies aim to boost the share of renewables, yet slow project implementation and bureaucratic hurdles remain significant obstacles. EV adoption, supported by the National Electric Vehicle Policy (NEVP), is vital for reducing greenhouse gas emissions, although high initial costs and insufficient charging infrastructure pose challenges. By analyzing global best practices and conducting SWOT analyses, this study identifies gaps and provides recommendations to enhance energy conservation, streamline renewable projects, and promote EV adoption for a sustainable energy future in Pakistan.

Key words:

Energy Crisis, Renewable Energy, Electric Vehicles (EVs), Energy Conservation, Sustainable Development

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Introduction

Pakistan is grappling with a severe, longstanding energy crisis. The demand for energy has surged over the years due to urbanization, population growth, and industrialization. However, Pakistan's traditional sources of energy generation have remained inadequate to cope with the rising demand. As of 2024, Pakistan's installed power generation capacity is 42,131 MW, with 59% derived from thermal sources, 25% from hydropower, 9% from nuclear, and 7% from renewable sources (Bhutto, 2024). For electricity generation, Pakistan relies heavily on fossil fuels and imported energy sources. Thermal power plants, which constitute over 59% of the country's electricity generation capacity, have entangled Pakistan in high production costs and price volatility driven by fluctuations in global oil and gas markets (Bhutto, 2024). This reliance on imported energy sources has adverse effects, as increases in the prices of oil, liquefied natural gas, and coal in international markets result in rising electricity generation costs. In recent years, the prices of these commodities have dramatically increased, causing a sharp depletion in Pakistan's foreign exchange reserves. Consequently, the average generation cost has risen substantially. Moreover, this heavy reliance on imported fossil fuels is a major cause of the trade deficit and has put significant strain on the economy. Additionally, Pakistan has increased its use of coal to meet energy demands. Though this is a cost-effective solution in the short term, it poses severe environmental and health risks, raising concerns about long-term sustainability and climate impact. Furthermore, the energy infrastructure in Pakistan is outdated and insufficient to meet growing demand. The power sector's inefficiencies are exacerbated by chronic underinvestment in transmission and distribution infrastructure, leading to significant technical and commercial losses; nearly 16% of electricity is lost due to transmission inefficiencies and theft. This has contributed to a circular debt exceeding Rs. 2.8 trillion, worsening the financial burden on the government and escalating electricity costs for consumers. Frequent power outages and transmission losses are common, affecting both residential and industrial consumers.

Electricity prices have surged by 155% since 2021, driven by the government's strategies to secure loans from the International Monetary Fund (IMF). The average tariff now stands at $0.23 per unit, significantly higher than in other developing economies, prompting industries and households to seek alternative energy sources. For instance, farmers are increasingly adopting off-grid solar systems, while businesses are installing rooftop solar panels to mitigate the impact of soaring grid electricity prices (Bhutto, 2024).

Pakistan is also under pressure to address its energy demands amid climate change. The country is particularly vulnerable to climate impacts, especially in sectors reliant on predictable water flows, such as hydropower. In response to this challenge, the government aims to reduce emissions by 50% by 2030, primarily through promoting renewable energy sources and energy conservation measures[6].

Problem Statement

Pakistan's energy crisis has been aggravated by the inefficient use of energy, limited use of renewable energy resources, and public disinterest in electric vehicles, which has a broader impact on climate change. However, Pakistan has great potential to address these issues. Therefore, the situation warrants an extensive analysis to identify the loopholes in the existing policy and regulatory framework in order to provide a viable solution.

Scope of the Study

This study focuses on the energy sector and its impact on climate change, exploring various aspects such as energy conservation, renewable resources, and the adoption of electric vehicles. It aims to analyze the prevailing policies, regulatory framework, and implementation. The study also explores the potential for energy conservation, renewable energy sources like solar, wind, and hydropower, highlighting the challenges in policy implementation, financial constraints, and infrastructure. The aim is to provide a comprehensive understanding of the efforts, issues, and challenges in achieving a sustainable energy future for Pakistan, leading to a positive impact on the overall climate.

Research methodology

This research employs a mixed methods approach to gather comprehensive data. The methodologies utilized include:

- **Mixed Methods**: A combination of qualitative and quantitative research techniques.
- **Secondary Data Analysis**: Utilization of existing qualitative and quantitative data, including acts, regulations, policies, and projects relevant to the energy sector.
- **Interviews**: Conducted via Zoom with key stakeholders, including the CEO of PEDO, the Additional Director General of NEPRA, and the Section Officer for Climate Change.
- **Literature Review**: Examination of surveys, scholarly articles, journals, and relevant websites to support the analysis.

This multi-faceted approach ensures a robust understanding of the energy landscape and its implications for climate change in Pakistan.

[6] https://neeca.gov.pk/Detail/MmE3ZWE0ZWQtMDY4Yy00ZGUzLWFjYTMtZWRhOTg3YTQzYTY4

Literature Review

Energy Conservation

Energy conservation refers to the set of measures and steps required to reduce energy consumption by using available energy more efficiently and minimizing energy waste[7]. This goal can be achieved through various methods, a few of which are listed below:

- **Efficient Energy Use**: Efficiency in energy use can be achieved by employing technology that requires less energy to perform the same task. For instance, using LED bulbs instead of incandescent bulbs results in lower energy consumption, as incandescent bulbs lose 80-90% of their energy as heat, making them only 10-20% efficient. Similarly, other energy-efficient home appliances can be used to reduce energy consumption (National Energy Efficiency and Conservation Policy, 2023).
- **Behavioral Changes**: Individuals can play a vital role by modifying their habits to reduce energy use, such as turning off lights when not in use and using public transportation instead of driving personal vehicles.
- **Energy Audits**: Surveys can be conducted to identify areas where energy is prone to waste, and this waste can be mitigated by implementing measures to improve efficiency.
- **Off-Peak Scheduling**: The public may be sensitized to use appliances during off-peak hours when energy demand is lower and costs are reduced, as communicated through messages printed on electricity bills.

By adopting these measures and practices, individuals can not only reduce their utility bills but also contribute to lowering greenhouse gas emissions and conserving natural resources (National Energy Efficiency and Conservation Act, 2016).

Policies on Energy Conservation

The National Energy Efficiency and Conservation Policy, 2023: The surge in energy prices and the increasing demand for energy, along with depleting energy resources, necessitate that Pakistan look for measures to enhance energy efficiency and conservation. Improving energy efficiency and conservation is one of the easiest and least costly pathways to enhance a country's energy sector sustainability. Saving one unit of energy is always cheaper than producing one unit. These measures also produce co-benefits such as industrial competitiveness, reduction in the energy import bill, transition to clean energy, and wider access to energy.

The National Energy Efficiency and Conservation Act of 2016 aims to strengthen the energy efficiency and conservation agenda in the country.

[7] https://neeca.gov.pk/Detail/MmE3ZWE0ZWQtMDY4Yy00ZGUzLWFjYTMtZWRhOTg3YTQzYTY4

Moreover, there is an increasing demand to develop effective regulatory measures complemented by appropriate by-laws, regulations, policies, programs, and technical, economic, and fiscal interventions for an effective governance framework for energy efficiency and conservation in Pakistan. The National Energy Efficiency and Conservation Policy 2023 (NEECA Policy 2023) outlines several measures for the industry, transport, and building sectors to enhance energy efficiency and conservation in Pakistan. Here are some key measures for each sector:

1. **Industry Sector**:

    - Energy Audits and Assessments: Conducting regular energy audits to identify areas for improvement.
    - Minimum Energy Performance Standards (MEPS): Implementing MEPS for industrial equipment and processes.
    - Energy Management Systems: Encouraging the adoption of energy management systems and practices.
    - Incentives for Energy Efficiency: Providing financial incentives and support for industries to adopt energy-efficient technologies.

2. **Transport Sector**:

    - Fuel Efficiency Standards: Establishing fuel efficiency standards for vehicles.
    - Public Transport Enhancement: Promoting the use of public transport to reduce energy consumption.
    - Electric Vehicles (EVs): Encouraging the adoption of electric vehicles through incentives and infrastructure development.
    - Traffic Management: Implementing better traffic management systems to reduce fuel waste.

3. **Building Sector**:

    - Building Codes and Standards: Enforcing energy-efficient building codes and standards.
    - Energy Labeling: Introducing energy labeling for buildings to inform buyers and tenants about energy performance.
    - Retrofitting Existing Buildings: Promoting the retrofitting of existing buildings to improve energy efficiency.
    - Awareness and Training: Conducting awareness campaigns and training programs for builders, architects, and homeowners.

These measures aim to create a sustainable and energy-efficient environment across these critical sectors.

SWOT Analysis of the National Energy Efficiency and Conservation Authority (NEECA)

Strengths

- **Comprehensive Vision and Goals:** Clear vision and goals for energy efficiency and conservation.
- **Guiding Principles:** Strong emphasis on sustainability, conservation, and evidence-based approaches.
- **Strategic Sectors:** Focus on key sectors like industry, buildings, transport, energy, and agriculture.

Weaknesses

- **Institutional and Regulatory Gaps:** Identified gaps in institutional and regulatory frameworks.
- **Economic and Financial Gaps:** Challenges in financing and economic incentives for energy efficiency.
- **Technical and Operational Gaps:** Need for improved technical and operational capabilities.

Opportunities

- **Policy Measures and Deliverables:** Potential for impactful policy measures and deliverables.
- **Innovation and R&D:** Opportunities for innovation, research, and development in energy efficiency.
- **International Partnerships:** Strengthening coordination with international partners.

Threats

- **Informational Gaps:** Lack of adequate information and data for effective implementation.
- **Surveillance and Enforcement:** Challenges in monitoring, reporting, and verification.
- **Coordination Challenges:** Need for better coordination mechanisms with provincial governments and stakeholders.

Best Practices

South Asian countries have implemented various best practices in energy conservation that can serve as valuable examples for Pakistan. Here are some notable practices from different countries in the region:

India

- **Energy Conservation Building Code (ECBC):** This code sets minimum energy performance standards for new commercial buildings.
- **National Solar Mission:** Promotes the use of solar energy through subsidies and incentives, aiming to increase solar power capacity.

Sri Lanka

- **Green Building Certification:** Encourages the construction of energy-efficient buildings through a certification program.

Nepal

- **Renewable Energy Subsidy Policy:** Provides subsidies for the installation of renewable energy systems, such as solar and biogas.

Comparison with Pakistan (GAP Analysis)

Pakistan has also made strides in energy conservation, but there are areas where it can learn from its neighbors:

- **Energy Efficiency Standards:** Pakistan can benefit from adopting more stringent energy efficiency standards and codes, similar to India's ECBC.
- **Renewable Energy Subsidy Policy:** Pakistan can also provide subsidies for the installation of renewable energy systems.
- **Green Building Certification:** Pakistan can encourage the construction of energy-efficient buildings through a certification program by the concerned authority.
- **Public Awareness and Training:** Increasing public awareness and training programs, as seen in Sri Lanka and Bangladesh, can help promote energy conservation practices.

Renewable Energy Sources

Renewable energy is the type of energy derived from natural sources that are replenished at a higher rate than they are consumed. Examples of renewable energy sources include solar, hydropower, and wind. These sources are constantly being replenished and are plentiful all around us.

In contrast to fossil fuels, renewable sources do not cause harmful greenhouse gas emissions. Generating renewable energy creates far lower emissions than burning fossil fuels. The transition from non-renewable energy sources to renewable energy is essential for addressing the climate crisis.

Renewable energy in Pakistan is an emerging sector with significant potential. Currently, around 7% of Pakistan's total installed power generation capacity comes from renewable sources such as wind, solar, and hydropower. The country has set ambitious targets to increase this share to 20% by 2025 and to 30% by 2030. Hydroelectricity remains the dominant source of renewable energy; however, there is growing interest in solar and wind power. For instance, the Quaid-e-Azam Solar Park in Bahawalpur is one of the largest solar power projects in the country. Wind power projects are also being developed in regions like Jhimpir and Gharo. Expanding renewable energy is crucial for Pakistan to achieve energy security, reduce carbon emissions, and provide affordable electricity to its population. The government, along with international partners, is investing in various projects to harness the country's renewable energy potential.

Policy on Renewable Energy

Pakistan has delineated a policy to promote the development and integration of renewable energy sources. The Alternative and Renewable Energy Policy 2019 represents a significant shift toward sustainable energy development. This policy aims to increase the share of renewable energy in Pakistan's energy mix to 20% by 2025 and 30% by 2030. It focuses on promoting solar, wind, and small hydropower projects through competitive bidding and other incentives.

The Alternative and Renewable Energy Policy 2019 (ARE Policy 2019) aims to increase the share of renewable energy in the national energy mix to 20% by 2025 and 30% by 2030. It emphasizes competitive pricing, transparency, and the fast-track development of renewable energy projects. One of its key features is the promotion of decentralized energy solutions, such as net metering and off-grid systems, to enhance energy access in remote areas. Additionally, the policy provides various financial incentives to attract private sector investment and encourages the use of indigenous resources.

Despite its ambitious goals, the policy faces challenges, such as the need for infrastructure upgrades and effective implementation. Overall, the ARE Policy 2019 is a comprehensive framework designed to foster a sustainable and resilient energy future for Pakistan.

The policy reflects Pakistan's commitment to transitioning toward a more sustainable and resilient energy future. By leveraging its abundant renewable resources, the country aims to enhance energy security, reduce carbon emissions, and provide affordable electricity to its population.

SWOT Analysis of the National Electric Power Regulatory Authority (NEPRA)

Strengths

- **Comprehensive Legal Framework:** NEPRA operates under a well-defined legal framework, including the Regulation of Generation, Transmission, and Distribution of Electric Power Act, 1997, and its subsequent amendments.
- **Regulatory Authority:** NEPRA has the authority to regulate tariffs, licensing, and performance standards, ensuring a structured and fair energy market.
- **Focus on Renewable Energy:** Policies like the NEPRA (Alternative & Renewable Energy) Distributed Generation and Net Metering Regulations, 2015, promote renewable energy adoption.
- Net Metering Reference Guide for DISCOs

Weaknesses

- **Complex Regulatory Processes:** The extensive regulatory requirements can sometimes be cumbersome, potentially slowing down project approvals and implementation.
- **Enforcement Challenges:** Ensuring compliance with regulations across all stakeholders can be difficult, leading to inconsistencies in enforcement.

Opportunities

- **Market Liberalization:** Recent amendments aim to introduce competition and market forces in the power sector, which could lead to more efficient and cost-effective energy solutions.
- **International Collaboration:** Opportunities to strengthen coordination with international partners can bring in expertise and funding for energy projects.
- **Technological Advancements:** Embracing new technologies in energy generation and distribution can enhance efficiency and sustainability.

Threats

- **Political and Economic Instability:** Fluctuations in political and economic conditions can impact policy implementation and project funding.
- **Regulatory Overlap:** Potential overlaps with other regulatory bodies can create confusion and hinder effective governance.
- **Resistance to Change:** Stakeholders accustomed to the existing system may resist reforms aimed at introducing competition and market-based approaches.

Best Practices

In South Asia, several countries have made significant strides in adopting renewable energy practices, each with unique approaches and successes.

India

India has been a leader in the region, with substantial investments in solar and wind energy. The country has implemented large-scale solar parks, such as the Bhadla Solar Park, and has ambitious targets to increase its renewable energy capacity to 450 GW by 2030. India also promotes decentralized renewable energy solutions, like rooftop solar installations, to enhance energy access in rural areas.

Bangladesh

Bangladesh has focused on solar home systems (SHS) to provide electricity to off-grid rural areas and has successfully installed millions of SHS, significantly improving energy access. Additionally, Bangladesh is exploring wind energy potential along its coastal regions.

Sri Lanka

Sri Lanka has capitalized on its wind and hydro resources. The country aims to achieve 70% renewable energy in its electricity mix by 2030. Sri Lanka's wind farms, such as the Mannar Wind Farm, are key contributors to this goal.

Comparison with Pakistan (GAP Analysis)

Pakistan has a diverse mix of renewable energy resources, including hydro, wind, nuclear, and solar. The country aims to increase its renewable energy share to 30% by 2030. Key projects include the Quaid-e-Azam Solar Park and various wind farms in the Jhimpir and Gharo regions. However, Pakistan faces challenges such as policy implementation, financial constraints, and infrastructure development.

While Pakistan's renewable energy targets are ambitious, the country can learn from its neighbors by:

- **Enhancing Policy Frameworks:** Adopting clear and consistent policies like India's National Solar Mission.
- **Promoting Decentralized Solutions:** Implementing programs similar to Bangladesh's SHS to improve rural energy access.
- **Investing in Wind and Hydro:** Leveraging its wind corridors and hydro potential, akin to Sri Lanka and Nepal.

By adopting these best practices, Pakistan can accelerate its transition to a more sustainable and resilient energy future.

Hydro Power Projects

Name of Project	**Production Capacity (MW)**	**Cost of Project (USD)**	**Donors**	**Dealing Organization**
Dasu Hydropower Project	4,320	4.6 billion	World Bank, Local Banks	WAPDA
Diamer-Bhasha Dam	4,500	14 billion	Government of Pakistan, China	WAPDA
Tarbela Dam Extension-V	1,530	823 million	World Bank, AIIB	WAPDA
Mohmand Dam	800	2.6 billion	Government of Pakistan, Saudi Fund for Development	WAPDA
Neelum-Jhelum	969	5.1 billion	Government of Pakistan, China Exim Bank	WAPDA
Keyal Khwar	128	94 Million	KFW Germany & European Investment Bank	WAPDA
KurramTangi	83.4	108 Million	Turkey/Pakistan	WAPDA
Karot	720	1.7 Billion	China/Pakistan	Private Sector
Suki Kinari	870	1.9 Billion	China/Pakistan	Private Sector
Dasu (Stage-I)	2,160	4.2 Billion	World Bank	WAPDA
Mangla refurbishment and up-gradation	310	1.5 Billion	World bank	WAPDA

Mini Hydro Power Projects

Currently, 356 mini hydro power projects are underway, which will produce 32.5 MW of electricity at a cost of Rs. 5,250.19 million. Forty-four of these projects have been dropped due to various reasons, including site feasibility, land acquisition issues, and political interference. Hydropower Resources Book 2022

Adoption of Electric Vehicles

The shift towards electric vehicles (EVs) in Pakistan is framed as a critical step for reducing energy consumption and protecting the environment. The government aims for EVs to constitute 30% of the total vehicle population by 2030, aligning with broader renewable energy goals. This transition is vital as Pakistan seeks to decrease its dependence on fossil fuels and improve air quality, particularly in urban areas beset by severe pollution.

The adoption of EVs is expected to play a dual role: reducing reliance on imported oil and lowering greenhouse gas emissions. Despite contributing only 0.8% to global emissions, Pakistan is highly affected by climate change and environmental degradation. Thus, promoting EVs supports national energy policies and aligns with international environmental commitments.

To facilitate this transition, substantial investment in EV infrastructure, including charging stations, is essential. Competitive electricity rates for charging, compared to traditional fuels, will incentivize consumers. Furthermore, training programs for skilled professionals in the EV sector are critical for supporting local manufacturing and technological advancement. Embracing electric mobility underscores the synergy between energy consumption, environmental protection, and economic growth in Pakistan's future energy landscape. WRI Insights on EV Adoption

Policy on EV Adoption

The National Electric Vehicle Policy (NEVP) 2019 of Pakistan aims to promote the adoption of electric vehicles (EVs) to reduce greenhouse gas emissions and reliance on fossil fuels. Pakistan is demonstrating its commitment to becoming a key player in the EV revolution and is determined to achieve a remarkable 90% transformation by 2040. The driving force behind Pakistan's initiative to adopt this policy is the vision of a greener nation, aimed at reducing the environmental impact of transportation.

As the world embraces electric mobility, Pakistan is not just aiming for a 30% electric vehicle (EV) penetration by 2030; it is setting the stage for a competitive presence in the global EV market.

The "EV Charging Infrastructure Regulations 2024" by the National Energy Efficiency and Conservation Authority (NEECA) in Pakistan outlines the rules for establishing Electric Vehicle (EV) Charging Infrastructure across the country. The document aims to promote electric vehicles and standardize charging station installation. Key highlights include:

- **Purpose and Scope:** The regulations facilitate the development of EV charging stations, focusing on ensuring convenience, cost-effectiveness, and standardized charging solutions for both short- and long-term needs.
- **Charging Levels:** The regulations define five levels of EV charging, ranging from slow (Level 1, 220-240V) to ultra-fast (Level 5, over 350KW). The higher levels are intended for motorways and commercial spaces due to their power demands and costs.
- **Infrastructure Requirements:** New or reconstructed parking areas must allocate a percentage of spaces for EV charging. Additionally, safety protocols, equipment standards, and signage are mandated for all charging stations. Accessibility requirements also ensure a certain number of charging points are available for persons with disabilities.
- **Site Selection and Installation:** Sites for EV charging stations need to meet specific standards, including protection against physical damage, appropriate equipment clearance, and adherence to national and international safety codes. Maintenance and periodic inspection are mandatory to ensure proper functioning.
- **Battery Swapping Stations:** These facilities, where EV batteries can be swapped for fully charged ones, must comply with relevant technical standards. Tariffs for these stations will be determined by NEPRA in consultation with NEECA. NEPRA will establish a pricing structure for public EV charging stations based on power capacity and location. The stations can follow different tariff models, including flat rates or time-based charges.
- **Safety Provisions:** Extensive safety regulations are provided to prevent hazards such as electrical shocks and overloading. Proper grounding, protection against reverse power flow, and shock prevention mechanisms must be incorporated.
- **Registration and Fees:** EV charging stations must register with NEECA. The registration and annual fees vary based on the charging level, and penalties for non-compliance can include fines and revocation of the registration. NEECA EV Regulations

In 2024, Pakistan is making significant strides in developing its EV charging infrastructure. Here are some key points from the latest regulations and initiatives:

- **National Energy Efficiency and Conservation Authority (NEECA):** NEECA is responsible for setting standards and regulations for EV charging infrastructure. This includes ensuring that charging stations are efficient, safe, and accessible.
- **Government Investment:** The government has launched a Rs. 4 billion package to support the development of EV charging infrastructure. This initiative aims to establish charging stations in key urban centers and along major highways.
- **Collaboration with Oil Marketing Companies (OMCs):** The government is working with OMCs and the National Highway Authority (NHA) to deploy sufficient charging stations, including fast-charging facilities.
- **Tariff Structure:** The National Electric Power Regulatory Authority (NEPRA) is involved in setting preferential tariffs for EV charging stations to make them more economically viable.
- **Battery Swap Systems:** There are also plans to introduce battery swap systems, which can significantly reduce the time required for EVs to recharge.

These measures are part of Pakistan's broader strategy to promote EV adoption and reduce its carbon footprint. The focus is on creating a robust and reliable charging network to support the growing number of EVs on the road. This regulatory framework aims to ensure the safe, efficient, and wide-scale deployment of EV charging infrastructure in Pakistan.

SWOT Analysis of the Ministry of Climate Change

SWOT analysis of the Ministry of Climate Change's National Electric Vehicle Policy (NEVP) 2019 for Pakistan:

Strengths

- **Environmental Benefits:** Significant reduction in greenhouse gas emissions and air pollution, addressing 43% of airborne emissions from the transport sector.
- **Economic Savings:** Reduction in the oil import bill, which is a major economic burden for Pakistan.
- **Job Creation:** Potential to create new green businesses and job opportunities in the EV sector.
- **Government Support:** Strong backing from the government with incentives, subsidies, and tax breaks for EV manufacturers and buyers.

Weaknesses

- **High Initial Costs:** High costs of EVs and charging infrastructure, which may deter initial adoption.
- **Infrastructure Development:** Need for extensive development of charging infrastructure across the country.
- **Technological Dependence:** Reliance on imported technology and components for EVs.

Opportunities

- **Market Growth:** Growing global and local market for EVs, with potential for exports.
- **Technological Advancements:** Rapid advancements in battery technology and decreasing costs.
- **International Collaboration:** Opportunities for collaboration with international organizations and countries leading in EV technology.

Threats

- **Economic Instability:** Economic challenges and fluctuations that could impact funding and investment in EV infrastructure.
- **Policy Continuity:** Risk of policy changes with government transitions that could affect long-term goals.
- **Competition:** Competition from conventional fuel vehicles and hybrid technologies.

https://en.wikipedia.org/wiki/Ministry_of_Climate_Change_(Pakistan)

Best Practices

- **India:** The FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) scheme provides subsidies for EV purchases and infrastructure development. The GST on EVs has been reduced to 5%, and there are additional incentives for local manufacturing.
- **Thailand:** The 3030 EV Production Policy aims for 30% of domestic vehicle production to be electric by 2030. Incentives include tax reductions and subsidies for both consumers and manufacturers.
- **Indonesia:** Plans to ban the sale of fossil fuel motorcycles by 2040 and cars by 2050. The government offers tax incentives and supports local EV manufacturing.

Charging Infrastructure

- **India:** Significant investments in charging infrastructure are underway, with plans to install charging stations every 25 km on highways. Public-private partnerships are encouraged to expand the network.
- **Thailand:** The focus is on developing a comprehensive charging network, including fast chargers in urban areas and along major routes.
- **Indonesia:** Collaboration with the private sector is key to building charging stations and integrating them with renewable energy sources.

Comparison with Pakistan (GAP Analysis)

- The National Electric Vehicle Policy (NEVP) offers incentives for local EV manufacturing, including reduced customs duties and tax benefits. The policy aims for 30% of all passenger vehicle and heavy-duty truck sales to be electric by 2030.
- While Pakistan's incentives are similar to those in India and Thailand, the scale and implementation are still developing. India and Thailand have more established frameworks and higher adoption rates.

Charging Infrastructure

- **Pakistan:** Investment in charging infrastructure is ongoing, with plans to set up stations in urban centers and along highways. Collaboration with oil marketing companies and the National Highway Authority is crucial.
- India's charging infrastructure is more advanced, with extensive networks already in place. Thailand and Indonesia are also ahead in terms of infrastructure development.

While Pakistan is making strides in EV adoption, it can learn from the best practices in South Asia, particularly from India, Thailand, and Indonesia. Key areas for improvement include expanding charging infrastructure, enhancing local manufacturing capabilities, and implementing robust government policies and incentives.

Energy Policies

There are eight key energy-related policies in Pakistan listed below:

1. The National Energy Efficiency and Conservation Act (2016)
2. National Alternative and Renewable Energy Policy (2019)
3. National Electric Vehicle Policy (2020-25)
4. National Energy Conservation Policy (2006)
5. Net Metering Regulations (2015)
6. KP Hydropower Policy (2016)
7. KP Solar Energy Program (2019)
8. KP Energy Development Strategy (2017)

SWOT Analysis of Existing Energy Policies

This situational analysis examines the Strengths, Weaknesses, Opportunities, and Threats (SWOT) of the above-mentioned energy-related policies in Pakistan.

Strengths

- **Legal Framework for Energy Efficiency:** The National Energy Efficiency and Conservation Act (2016) is one of the most comprehensive legal frameworks that establish energy conservation as a national priority. The creation of the National Energy Efficiency and Conservation Authority (NEECA) enables a centralized approach to reducing energy consumption across sectors. This policy has significantly promoted the adoption of energy-efficient technologies, especially in the industrial and residential sectors.
- **Focus on Renewable Energy Expansion:** The National Alternative and Renewable Energy Policy (2019) represents a crucial step in diversifying Pakistan's energy mix. The government's target of achieving 30% renewable energy by 2030 signals a commitment to reducing reliance on fossil fuels and mitigating climate change impacts. The policy is particularly strong in promoting public-private partnerships (PPP) and encouraging foreign direct investment in renewable energy projects.
- **Advancement in Electric Vehicle Transition:** The National Electric Vehicle (EV) Policy (2020-25) demonstrates a forward-thinking approach to addressing environmental and fuel import concerns. The policy offers significant incentives for manufacturers and consumers alike, from tax reductions to subsidies, making EV adoption more feasible for the general population. The policy also integrates plans for developing charging infrastructure, a key element in the success of EVs.

- **Empowerment of Provinces:** Khyber Pakhtunkhwa (KP) has demonstrated leadership with its Hydropower Policy (2016) and Solar Energy Program (2019). The hydropower policy capitalizes on KP's abundant water resources to develop sustainable energy, while the solar energy program aims to increase access to energy, particularly in off-grid areas. These policies reflect a province-specific approach that allows for local resource management and more tailored solutions for energy challenges. KP Energy Development
- **Consumer-Driven Renewable Energy:** The Net Metering Regulations (2015) are a strong example of a policy empowering consumers to contribute to the energy supply. By allowing households and businesses with solar or wind systems to sell surplus electricity to the grid, this policy encourages small-scale renewable energy generation. It effectively engages citizens and promotes self-sufficiency while reducing the burden on the national grid. Net Metering Reference Guide

Weaknesses

- **Fragmented Implementation of Energy Efficiency:** While the National Energy Efficiency and Conservation Act (2016) provides a solid framework, its implementation has been fragmented. Many industries and sectors remain non-compliant due to weak enforcement mechanisms. Furthermore, the energy auditing process lacks the necessary infrastructure and human capital for effective execution, delaying the full realization of the policy's potential.
- **Financial and Regulatory Barriers in Renewable Energy:** The National Alternative and Renewable Energy Policy (2019), although ambitious, faces significant financial constraints. Investment in large-scale renewable energy projects, particularly for wind and solar, requires considerable capital, which remains a challenge in Pakistan's current economic situation. Regulatory hurdles, including lengthy approval processes and complex bureaucracy, further slow down renewable energy development.
- **Slow EV Adoption:** Despite the promising incentives in the National Electric Vehicle Policy (2020-25), Pakistan's infrastructure for EVs remains underdeveloped. The policy's success heavily depends on the timely rollout of charging stations, which has been slower than anticipated. Additionally, the initial cost of EVs remains a significant barrier for average consumers, limiting widespread adoption.
- **Outdated Focus in Conservation Policy:** The National Energy Conservation Policy (2006) was progressive when introduced but has since become outdated. Its focus on conventional energy-saving techniques, such as retrofitting buildings and promoting efficient lighting, does not fully align with more modern approaches like

smart grids, energy storage, and the digitization of energy systems. The policy also lacks strong enforcement mechanisms and has seen little success in mobilizing public-private partnerships for energy conservation projects.

- **Limited Reach of Net Metering:** While the Net Metering Regulations (2015) encourage renewable energy generation, uptake has been limited to more affluent consumers who can afford the initial investment in solar panels or wind systems. The high upfront costs and lack of adequate financing schemes deter broader adoption, particularly in rural areas where energy poverty remains high.

Opportunities

- **Leveraging International Funding:** There are significant opportunities for Pakistan to leverage international climate finance and green energy funds to support its renewable energy transition. The National Alternative and Renewable Energy Policy (2019) and KP's Solar Energy Program (2019) can both benefit from partnerships with international donors and multilateral organizations committed to sustainable development.
- **Job Creation through Energy Programs:** The expansion of the solar and hydropower sectors in KP presents immense potential for job creation. The development of new infrastructure, including solar installations, hydropower plants, and related services, could create thousands of jobs in both urban and rural areas, thus contributing to Pakistan's broader socio-economic goals.
- **Technological Advancements in EV and Renewable Energy:** Emerging technologies, such as battery storage and smart grid systems, offer opportunities to integrate more renewable energy into Pakistan's national grid. The National Electric Vehicle Policy could be further strengthened by research and development partnerships that drive down the costs of EVs and improve battery performance, making EVs more affordable and efficient.
- **Decentralized Energy Solutions:** Policies like the KP Solar Energy Program and Net Metering Regulations present significant opportunities for decentralizing energy production. By promoting off-grid solar systems, these programs could help alleviate energy shortages in remote areas, reduce transmission losses, and increase the overall reliability of electricity supply in Pakistan.

Threats

- **Economic Instability:** The biggest threat to the successful implementation of these energy policies is Pakistan's ongoing economic instability. Rising debt, inflation, and a shrinking fiscal space limit the government's ability to fund new energy projects, offer subsidies, and create an enabling environment for renewable energy investments.
- **Political Uncertainty and Governance Issues:** Political instability and governance challenges continue to hamper long-term planning and the continuity of energy policies. Frequent changes in leadership can disrupt ongoing projects, delay policy implementation, and lead to inconsistent regulatory enforcement, particularly in energy conservation and renewable energy development.
- **Climate Change Impacts:** While many of these policies aim to mitigate climate change, the increased frequency of natural disasters, such as floods and droughts, poses a direct threat to energy infrastructure. Hydropower projects, for instance, could face operational disruptions due to irregular water flows, while solar installations are vulnerable to extreme weather conditions.
- **Energy Demand Outpacing Supply:** Despite the introduction of several energy policies, demand for energy continues to outpace supply. With a growing population and industrial demand, Pakistan risks falling further behind unless it significantly accelerates the implementation of these policies and expands energy production capacities.

Identification of Issues and Challenges

Energy conservation, renewable energy sources, and electric vehicle (EV) adoption are crucial for a sustainable future, but they come with several issues and challenges, some of which are listed below.

Energy Conservation

- **Behavioral Barriers:** People often resist changing their habits, even when it could save energy. This includes simple actions like turning off lights or using energy-efficient appliances.
- **Economic Constraints:** Upfront costs for energy-efficient technologies can be high, making them less accessible for some households and businesses.
- **Policy and Regulation:** Inconsistent policies and a lack of incentives can hinder energy conservation efforts. Effective regulations and incentives are needed to encourage energy-saving practices.

Renewable Energy Resources

- **Interruption:** Renewable sources like solar and wind are not always available, leading to reliability issues. Energy storage solutions, like batteries, are essential but still expensive and not widely implemented.
- **Infrastructure:** Transitioning to renewable energy requires significant changes to existing infrastructure, which can be costly and time-consuming.
- **Environmental Impact:** While renewable energy is cleaner, the production and disposal of technologies like solar panels and wind turbines can have environmental impacts.

Electric Vehicle Adoption

- **High Costs:** EVs are generally more expensive than traditional vehicles, primarily due to the cost of batteries.
- **Charging Infrastructure:** There is a lack of widespread charging stations, leading to "range anxiety," where drivers fear running out of power before finding a charging point.
- **Battery Technology:** Current batteries have limitations in terms of range, charging time, and lifespan. Advances in battery technology are needed to make EVs more practical.
- **Grid Capacity:** Increased EV adoption will put additional strain on the electrical grid, requiring upgrades to handle the higher demand.

Addressing these challenges requires coordinated efforts from governments, industries, and consumers. Policies that provide incentives for energy conservation, investments in renewable energy infrastructure, and advancements in battery technology are crucial steps toward a sustainable future.

Conclusion

Pakistan's journey towards a sustainable energy future remains challenging. A holistic approach, integrating energy conservation, renewable energy expansion, and electric vehicle (EV) adoption, is vital for establishing a stable and efficient power sector. Achieving this requires substantial investments, comprehensive policy reforms, efficient governance, and long-term planning to ensure energy security and economic growth in the face of global energy and climate challenges.

To cope with the challenges of energy generation and to address concerns about climate vulnerability, Pakistan has significant potential for utilizing renewable sources for energy generation. These renewable sources include solar, wind, and hydropower, among others. However, the transition to renewable energy is slow due to financial constraints, a lack of technical expertise, and policy implementation issues. Addressing Pakistan's energy sector challenges requires comprehensive reforms, including improving governance, diversifying energy sources, and investing in renewable energy infrastructure. While the path to a sustainable energy future is filled with obstacles, strategic planning and effective policy implementation can pave the way for long-term energy security and economic stability.

Efforts include promoting energy-efficient appliances, industry practices, and public awareness. Despite the potential for solar, wind, hydropower, and biomass, renewable energy adoption is slow due to policy, financial, and infrastructure challenges. Electric vehicle adoption is also in the early stages, hindered by high costs, a lack of charging infrastructure, and limited awareness. Continued policy reform, public awareness, and infrastructure development are essential for a sustainable energy future.

Recommendations

Strengthening of Regulatory Framework for All Policies: To achieve the desired goals, it is essential to ensure coherence among the various policies prevailing at both the federal and provincial levels. There must be a single authority responsible for the formulation and implementation of a comprehensive policy covering the overall subject of power.

- **Action Plan:** Involve representatives from all energy-consuming sectors, policymakers, and community leaders to develop a consensus (Long-Term).

  Regularization of Sectors: Rules are required to be established and meticulously observed for streamlining the standards and codes for sectors that consume the most energy, such as industry, transport, and buildings.

  Action Plan: Specialized committees comprising industry experts, policymakers, and community representatives should be formed and involved in the formulation of sector-specific standards and codes for industry, transport, and buildings (Long-Term).

  Behavioral Change: It is necessary to initiate widespread public awareness campaigns to educate citizens on the importance of energy conservation, the environmental and economic benefits of renewable energy, and the advantages of adopting electric vehicles.

  Action Plan: Utilize social media, electronic media, and print media; conduct seminars and workshops in educational institutions and other public venues. Branding the public awareness message at public places will be key to fostering behavioral changes that support energy efficiency (Immediate, Medium, and Long Term).

  Improvement in Procedural Mechanism: Establish clear deadlines for each stage of the approval process to ensure efficiency. Clearly define responsibilities for each step in the approval process to prevent confusion and ensure accountability.

- **Action Plan:**

  - Introduce software tools to remove repetitive tasks such as notifications, reminders, and approvals.
  - Use KPIs to measure the efficiency and effectiveness of the approval process.

- Conduct regular reviews of the approval process to gather feedback and identify areas for improvement.
- Analyze performance data to identify bottlenecks and areas for improvement (Immediate, Medium, and Long-Term).

- **Prioritize EV Adoption:** As transport is one of the highest energy-consuming sectors, the adoption of electric vehicles should be given top priority.
- **Action Plan:** The Ministry of Climate Change must engage existing auto manufacturers to switch to electric technology in their vehicles by forming a committee that includes policymakers and stakeholders. Incentivize the import of electric vehicles by providing duty relief (Immediate, Long-Term).
- **Explore New Financing Options:** Due to the trust deficit in the current situation, the government should appeal to the general wealthy public for investment in energy-saving technologies, solar installations, and renewable energy projects.
- **Action Plan:** Introduce an investment amnesty scheme to incentivize the public by providing tax exemptions for a certain period and no scrutiny of their investment (Immediate and Long-Term).

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Carbon Financing, Carbon Credits, and Global Climate Resilience Investments

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Abstract:

The global economy is progressing towards a low-carbon future in response to climate change challenges. Countries are setting ambitious decarbonization targets, supported by United Nations-supervised funds to aid developing nations. This research paper outlines various funding sources available globally and examines mechanisms like carbon trading, addressing critical issues within these markets. It analyzes Pakistan's current regulatory framework and explores the potential for developing a carbon trading market. While voluntary carbon markets currently capture limited emissions, growth in carbon trading is expected in the next decade. Pakistan has significant potential for generating carbon credits, yet capacity challenges remain. This paper will identify essential steps to establish a robust carbon trading market in Pakistan, facilitating the country's transition towards a more sustainable economic model and improving its ability to mitigate climate change impacts effectively.

Key words:

Low-carbon economy, decarbonization, funding sources, carbon trading, Pakistan

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Introduction

Climate change is the greatest long-term threat faced by the world today. In response, the global community and multilateral organizations have taken the lead in countering these threats. The United Nations Framework Convention on Climate Change (UNFCCC) is the leading organization spearheading initiatives to combat this issue. At the COP 21 in Paris in 2015, a legally binding agreement was signed by 196 parties; its overarching objective is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" (United Nations, 2024). This objective envisions a reduction of GHG emissions by 43% by 2030 to arrest the devastating effects of climate change and to adapt to its impacts. The Paris Agreement reaffirms that developed countries should take the lead in providing financial assistance to less endowed and more vulnerable countries while, for the first time, encouraging voluntary contributions from other parties (ibid). It is estimated that a total of $6 trillion is required to achieve the goals set for 2030; so far, only $1 trillion has been directed toward these goals (CDPR, 2024).

The arena of climate finance is an emerging and integral part of this transformation of the global economy. As countries attempt to adhere to their Nationally Determined Contributions (NDCs), a host of transformative actions are required, meaning that requisite investments in mitigation and adaptation are key factors in their overall efforts. There are key areas of global finance directed toward these efforts, and countries working toward their NDCs can unlock financing from these sources. It is no surprise that Pakistan's fragile and unresponsive governance system has failed to benefit from these climate finance sources. It is imperative that Pakistan prepares a robust, adaptive, and progressive whole-of-government approach to achieve its NDCs, as Pakistan is one of the most vulnerable countries to climate change. The citizens of Pakistan must also play their part in this monumental effort, as the country's viability is at stake.

Statement on the Problem

Pakistan has been unable to secure significant climate funding from all sources. On one hand, the technical nature and prerequisites for international climate finance are difficult for Pakistan's complex governance systems to exploit. On the other hand, the lack of capacity in the public sector to engage the private sector in exploiting potential funding sources is a major stumbling block. Therefore, carbon trading markets can offer much-needed investment in climate finance in Pakistan.

Scope of Study

- The scope of this study is to examine existing international climate finance sources and the reasons for the low investment in climate-related projects in Pakistan.
- This paper will explore the regulatory framework in place at the federal and provincial levels designed to meet Pakistan's NDCs.
- Finally, this paper will outline a policy that will enable Pakistan to secure more climate finance and use it to adapt to climate change.

Research Methodology

This paper will rely on secondary data extracted from reports by reliable organizations on the subject. Some academic papers on the topic have also been examined to build background knowledge. Various analyses, such as situational, institutional, comparative, stakeholder, and SWOT analyses, have been conducted on issues related to the topic.

Literature Review

There is an emerging body of literature on the subject as the world increases its focus on climate change. In 2024, Transparency International outlined the critical issues in Pakistan related to climate finance. Weaknesses in public financial management have been identified, along with the need for capacity building to attract more climate finance. The report also traces the history of Pakistan's regulatory framework and the projects undertaken for mitigation and adaptation efforts. In another article from the Pakistan Institute of Development Economics, Zahid Majeed explained the opportunities for increasing climate finance in Pakistan. Additionally, a research paper by the Islamabad Policy Research Institute discussed the operationalization of a carbon market in Pakistan, identifying the challenges and prospects in this emerging field of climate finance.

Background – Global Climate Finance Perspective

Developed nations have formally agreed to jointly mobilize $100 billion per year by 2020 from various sources to provide developing countries with funds needed for adaptation and mitigation measures (Green Climate Fund, 2023). However, this funding target has been met only once, in the year 2022-23. The flow of funds has been uneven, and there is no mechanism to enforce this commitment by developed nations (Butt, 2024).

The UNFCCC, considering the funding requirements for climate finance in the developing world, has developed certain mechanisms to push for reforms in global economies. The Clean Development Mechanism (CDM), introduced by the Kyoto Protocol, allows countries to earn certified emission reduction (CER) credits, each equal to one tonne of CO2. These credits are traded and can be used by developed nations to meet part of their emission reduction targets. The "Adaptation Fund" is financed by a 2% levy on CERs issued by the CDM. This mechanism stimulates sustainable development and emission reductions while providing developed nations with flexibility in meeting their emissions targets. The Adaptation Fund has reached $1.1 billion and gives developing nations full ownership of adaptation projects (United Nations, 2024).

Recently, at COP 28, a landmark agreement on the Loss and Damage fund was reached, but it received pledges worth only $700 million, which is 0.2 percent of the estimated funding needs (Butt, 2024). It is evident that the funding required for 2030 NDCs is not readily available, and developing countries must be creative to unlock more climate funding from the West.

Another source for developing countries to raise funds for climate-related efforts is the voluntary markets for carbon trading. In this model, companies, NGOs, governments, and individuals can buy and sell carbon offset credits. To capture one ton of CO2 emissions, approximately 50 trees must be grown for one year. The size of the voluntary carbon markets reached almost $2 billion by 2022 (Lawrence, 2022).

Situational Analysis – Global Carbon Market Evolution

The global carbon market is in flux, with major differences among international players regarding the investment needed and the role they can play in the transition to a low-carbon economy. Given the race to Net-Zero, their importance has significantly increased, as climate action requires more funding to avoid environmental destruction. Stakeholders can take steps such as boosting integration across markets and platforms, establishing globally uniform accreditation standards, and bolstering support market infrastructure to facilitate more efficient carbon trading (Martinez, 2023).

There are two types of carbon markets: compliance-driven and voluntary. There are currently 36 compliance carbon markets that offer cap-and-trade programs for heavy polluters, with an estimated size of approximately $850 billion, catering to nearly 20% of GHG emissions (ibid). The voluntary carbon markets (VCMs) allow companies and governments to purchase credits, and their size has grown to $2 billion as of 2022 (ibid). It is further estimated that the value of VCMs could reach $1 trillion if the market structure improves by addressing concerns about the quality of carbon credits and placing more emphasis on removal technologies (ibid). Globally, removal credits are estimated to be more effective in reducing historical emissions and are priced at a premium compared to avoidance (or reduction) credits. Only 3% of the credits traded are removal credits (ibid).

Quality issues and oversupply of credits have led the market to struggle in recent years. As of 2023, the cumulative value of credits traded was roughly $11 billion. The size of the voluntary carbon market reduced by 61% in 2023, with the value of traded carbon credits dropping to $723 million from $1.9 billion in 2022 (Greenfield, 2024). According to the World Bank, Pakistan has created a total of 21 million credits through all available mechanisms. In comparison, Bangladesh has created 43 million credits, and India has created 631 million credits as of the end of 2023 (World Bank, 2024). Total revenue raised from carbon trading mechanisms (voluntary and compliance) totals $104 billion (ibid).

Institutional Analysis – Pakistan Regulatory Framework Evolution and Carbon Credits Potential

Pakistan has developed a regulatory framework aimed at addressing climate change challenges through carbon financing, carbon credits, and climate resilience investments. This framework encompasses various policies, strategies, and institutions that facilitate the implementation of climate-related projects and promote sustainable development (Butt, 2024). The acts are as follows:

Jurisdiction	**Legislative Framework**	**Year**
Federal	Pakistan Environment Protection Act	1997
Federal	Climate Change Act	2017
Punjab	Punjab Environmental Protection Act	2012
Khyber Pakhtunkhwa	KP Environmental Protection Act	2014
Sindh	Sindh Environmental Protection Act	2014
Baluchistan	Baluchistan Environmental Protection Act	2012

Pakistan's first Climate Change Policy was produced in 2012. The policy is accompanied by a framework for implementation (2014-2030), which details the mitigation and adaptation actions identified by the federal government. Following this overarching policy, the provinces have also developed Climate Change Action Plans, which are detailed as follows:

Jurisdiction	**Policy framework**	**Year**
Federal	National Climate Change Policy	2012 & 2021
	Framework of Implementation of CC Policy	2013
	National Adaptation Plan	2023
Punjab	(Draft) Punjab Climate Change Policy	2017
	(Draft) Provincial Climate Action Plan	2021
Gilgit Baltistan	GB Climate Change Strategy & Action Plan	2017
Azad Jammu & Kashmir	AJ&K Climate Change Policy	2017
Khyber Pakhtunkhwa	KP Climate Change Policy	2022
	KP Climate Change Action Plan	2022
Sindh	Sindh Climate Change Policy	2022
Baluchistan	(Draft) Baluchistan Climate Change Policy	Under development

According to Transparency International, grey areas in the realm of climate change governance have resulted in misaligned resource allocations, institutional dependencies, duplication of work, and opaque decision-making (ibid). The World Bank estimates that Pakistan needs $348 billion during 2023-2030 for climate adaptation and mitigation (ibid). Overall, Pakistan's share of international finance is minuscule. The economic loss and damage of $30.1 billion inflicted by the 2022 floods was more than the total disbursement from all UNFCCC (United Nations Framework Convention on Climate Change) funds since their inception: the Global Environment Facility (1991), Adaptation Fund (2001), and Green Climate Fund (2014) (Shaikh, 2024). According to some estimates, these funds have collectively disbursed about $22 billion globally. Pakistan has accessed less than $1 billion from all three funds in the last 30 years. Clearly, the gap between Pakistan's investment needs for resilience and low-carbon development cannot be met by the current climate finance ecosystem (ibid).

In the last two decades, the private sector has also successfully gained benefits through the UNFCCC Clean Development Mechanism. A total of 42 schemes are listed in the CDM registry, allowing them to earn certified emission reductions based on their carbon offsetting. However, due to the

price crash in 2012 and the absence of a climate finance framework, many businesses were unable to sell CERs (Butt, 2024). Independent experts on carbon trading estimate that Pakistan could generate between $2 billion and $5 billion by 2030 if the carbon market is developed (Hussain, 2024).

Comparative Analysis – India and Pakistan

According to World Bank data, Pakistan has issued a total of 21 million carbon credits, whereas India has produced 631 million credits. India has effectively engaged all its stakeholders to establish a green economy focused on solarization, afforestation, energy efficiency, and reducing coal use for power plants. India has utilized the Clean Development Mechanism (CDM) to actively participate in the carbon market; currently, India holds around 15% of the carbon credits issued globally and has earned $1 billion to date. India has a robust procedure for identification, validation, emissions reduction verification, and issuance of credits that is not currently available in Pakistan. The carbon market in Pakistan is in a nascent stage, with growing awareness of the potential for carbon trading. Unfortunately, flagship projects like the Billion Tree Tsunami are not generating revenue due to the lack of a national strategy to align projects and investments with global markets. Pakistan's most successful project is the restoration of mangroves under the Sindh Delta Blue project, which has been able to earn some funds for the Sindh Government (Hussain, 2024).

Stakeholder Analysis

Addressing climate change requires a whole-of-government and whole-of-society approach to tackle the multifaceted challenges and transition to a low-carbon economy. The meaningful development of a robust carbon trading market will require all stakeholders to act in harmony to promote a new economy. The stakeholder analysis of the carbon trading market is as follows:

Government, Policymakers, and Regulatory Agencies

Work closely with industry leaders and peer agencies to create guidelines for generating high-quality credits and align monitoring and oversight protocols. The development of a centralized trading platform and robust registry to capture real-time information about the quality and age of credits is essential. Policymakers also need to publish strategic priorities and certification standards that will encourage the private sector to invest in these efforts.

Industry Groups, Climate Alliances, and Associations

Draft voluntary standards regarding the use of credits in their transition plans, specifying how they fit into net-zero frameworks. Advocacy for robust exchanges and the introduction of new products and platforms is also essential. Furthermore, trading rules need to be developed to align incentives with greater transparency. Some proponents also suggest setting a minimum price for carbon credits.

Carbon Registries

Carbon registries can improve confidence by enhancing transparency and developing quality standards. The data they hold should be accessible to market participants to provide clear information on pricing and the sale of credits. All registries should be linked to each other to create an international platform, as registries currently operate in isolation.

Buyers

Buyers should first limit emissions across their business supply chains and then use carbon credits to account for residual emissions. Buyers should demand to purchase credits that are vetted by registries and have certifications to ensure better outcomes. The purchase of sub-standard credits would lead to misalignment with long-term goals.

Sellers and Project Developers

Sellers should ensure legal and insurance buffers against risks such as bankruptcy and the reversal of sequestration through events like wildfires. They should also trade on public exchanges to reach a larger pool of participants and further establish credibility.

Financial Intermediaries (Exchanges, Brokers, Banks)

Improving access to capital would be a significant step toward a low-carbon economy. Carbon markets need to work toward standards that provide a fair market price, facilitate long-term contracts, and reduce information asymmetry. New products and tools should be developed to ensure greater market participation and support early-stage climate investments. Greater efficiency in the trade of credits would signal to the market the prices and suitability of the credits available for trade.

SWOT Analysis – Ministry of Climate Change and Environmental Coordination

Strengths

1. Robust laws and a master plan for action exist in the form of NDCs.
2. Growing importance among policymakers and the public regarding climate change.
3. Provides critical input to the planning commission, which can create a robust framework for all climate-resilient investments.
4. Has led to the development of provincial laws for protecting the environment and adapting to climate change.
5. Can leverage innovative sources of funding such as debt swaps.

Weaknesses

1. Implementation mechanisms are weak, as the Climate Change Authority and Climate Change Council are non-functional.
2. Priority areas for provincial government climate-resilient investments need to align with the federal government's vision.
3. The capacity to fully prepare Pakistan for climate change is lacking, as experts in finance, law, biodiversity, and the green economy are not available, leading to reliance on foreign consultants.
4. Has not capitalized on the available carbon trading mechanisms. If constructed with all relevant stakeholders, it has the potential to plant the seeds for sustainable climate-related investments across all sectors of the economy.

Opportunities

1. Unlimited potential for renewable energy can provide guidelines and effective mechanisms for a low-carbon economy.
2. Can promote sustainable agriculture, livestock, land use, tourism, transport, and mining sectors.
3. Engage the private sector to invest in the green economy and earn carbon credits through a robust mechanism, requiring the development of a carbon trading regulatory authority and markets.
4. Utilize Pakistan’s natural resources to create high-quality carbon credits that can equip Pakistan with the tools to secure its due share of climate finance.
5. By educating policymakers, citizens, and businesses about the threats of climate change, it can lay the foundation for a low-carbon green economy. This would also address the youth bulge that has become a burden on Pakistan.

Threats

1. Political stability is essential for a long-term vision for a climate-resilient economy. Given Pakistan's history, this appears challenging, as national priorities are often held hostage to the national security paradigm.
2. Economic constraints have historically hampered Pakistan's development spending. Given recent trends in economic governance and political economy, it seems unlikely that the organization will successfully conduct its mission.
3. The geopolitics of climate is also crucial in Pakistan's context. Multilateral funding institutions have embedded climate action in their policies, making it expected that Pakistan will struggle to secure additional funding as climate action becomes a priority in many foreign development programs.
4. Population growth and rampant poverty indicate that Pakistan's current economic governance needs overhauling. Climate-resilient investments and a low-carbon economy will require increasingly more resources to tackle these issues. Unless the country can find innovative solutions to its development needs, existing problems and climate change could wreak havoc on the nation.

Issues and Challenges

1. Pakistan needs substantial resources to prepare for climate change adaptation and mitigation. Our internal and foreign resources are insufficient to move the country forward. We need innovative approaches and new economic governance models to tackle this challenge.
2. Pakistan requires a grand strategy involving all levels of government to address climate change issues. This will necessitate the alignment of national, provincial, and local governments to work collaboratively toward priority areas.
3. There is a lack of expertise and technology available to engage global policymakers in our efforts to achieve a low-carbon economy.
4. Policy consistency is paramount for addressing the issues at hand. Pakistan needs better planning, and its implementation should be insulated from political stability concerns.
5. The absence of a carbon trading market and proper certification of carbon credits represents a significant capacity gap. Developing a carbon trading market can provide Pakistan with resources and open pathways to foreign investment for a low-carbon economy. The evolution of the global carbon trading market should also be considered while designing Pakistan's market.

Conclusion

Pakistan holds immense potential for generating carbon credits due to its renewable energy resources and a growing emphasis on climate change adaptation. By developing a local carbon trading market in line with global market developments, Pakistan can earn significant revenues and signal the private sector toward low-carbon economic development. However, Pakistan's current economic governance is not very efficient in addressing the country's development needs, necessitating a significant overhaul to ensure that the priority areas identified by the NDCs are robustly tackled. This will also enhance Pakistan's image as a responsible nation globally and provide much-needed geopolitical space for further improvement. The time for climate-resilient investment is upon us, and unless we change course, Pakistan will be left at the mercy of climate change and its devastating effects. Carbon trading can provide some resources, but it will not be a panacea for our climate-related investments, as trading markets are competitive, and other countries may earn more due to the quality of their credits and their better image.

Recommendations

1. Climate change institutions need to be operationalized and empowered (Climate Change Authority and Climate Change Council). Integration of federal, provincial, and local governance policies and actions with overarching priority areas for action is necessary.
2. Once established, the Climate Change Authority should outline guidelines and develop a robust, responsive carbon registry. A certification body for carbon credits also needs to be created, as foreign consultants and expertise are very expensive for the local market.
3. Development of a carbon trading market is essential to provide direction for local and foreign investors. The regulatory authority for carbon crediting should be developed at the federal level, as provincial governments may lack the resources to build the authority.
4. Engage with industry leaders, such as Japan (for carbon credit development), to identify best practices and transfer the latest technology for mitigation and adaptation projects. Japan has invested significantly in mitigation efforts in developing countries and shares the credits from these projects.
5. Pakistan needs to integrate transparency and a climate perspective in project design, planning, and budgeting to attract international climate finance.
6. Develop training programs for various stakeholders, including government officials, businesses, and the public, to encourage investment in low-carbon projects.
7. Pakistan should project a value-added perspective in its housing market. Over the next two decades, the country will create more than 2 million housing units. If developed in alignment with low-carbon principles, this sector will attract more climate-sensitive investment.

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Capacity Building, Climate Education, and Mass Awareness

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Abstract:

Effective climate change mitigation and adaptation in Khyber Pakhtunkhwa, Pakistan, necessitates collaborative efforts among government institutions, civil society, and local communities. The Khyber Pakhtunkhwa Climate Change Policy outlines key intervention sectors such as agriculture, water, and forestry, yet challenges persist in education, capacity building, and public awareness. This analysis identifies significant gaps in skilled personnel, financial resources, and institutional coordination that hinder effective policy implementation. Moreover, the absence of climate-related topics in educational curricula restricts public engagement, while mass awareness campaigns struggle with inconsistent messaging. To overcome these challenges, it is essential for government agencies, educational institutions, and community organizations to work together, developing inclusive strategies that emphasize targeted capacity-building programs, enhanced climate education, and cohesive awareness campaigns. These efforts can cultivate a resilient society prepared to confront both current and future climate impacts.

Key words:

Climate change, capacity building, climate education, public awareness.

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Introduction

Effective implementation of climate change mitigation and adaptation strategies in Pakistan, particularly in Khyber Pakhtunkhwa, requires collaborative efforts from government institutions, civil society, and local communities (Saeed, 2020). The Khyber Pakhtunkhwa Climate Change Policy provides a framework for provincial action, outlining key sectors for intervention, including agriculture, water, and forestry (Government of Khyber Pakhtunkhwa, 2022). To enhance policy impact, capacity-building initiatives for government officials and local stakeholders are crucial, focusing on climate-resilient practices and disaster risk reduction (Ahmed & Iftikhar, 2022). Simultaneously, integrating climate change education into school curricula and promoting mass awareness campaigns can foster a culture of sustainability, driving behavioral change and community-led initiatives (Raza, 2023; IPCC, 2021).

Problem Statement

At the global and national levels, initiatives have been taken to address climate change vulnerabilities; however, there appears to be a significant gap in education, capacity building, and public awareness. Consequently, a comprehensive analysis is needed to identify the challenges faced at the federal level and particularly by the Khyber Pakhtunkhwa government in effectively implementing climate change policies and to propose recommendations for improvement.

Scope

This study aims to:

- Encompass a multidimensional approach to the issue, taking into account both national and global aspects related to capacity building, climate education, and mass awareness regarding climate change.
- Provide comprehensive insights into the challenges posed by existing policies at the national and provincial levels in capacity building, climate education, and mass awareness.
- Conduct a detailed comparative analysis with India to put forth certain recommendations and a way forward, using different analytical tools.

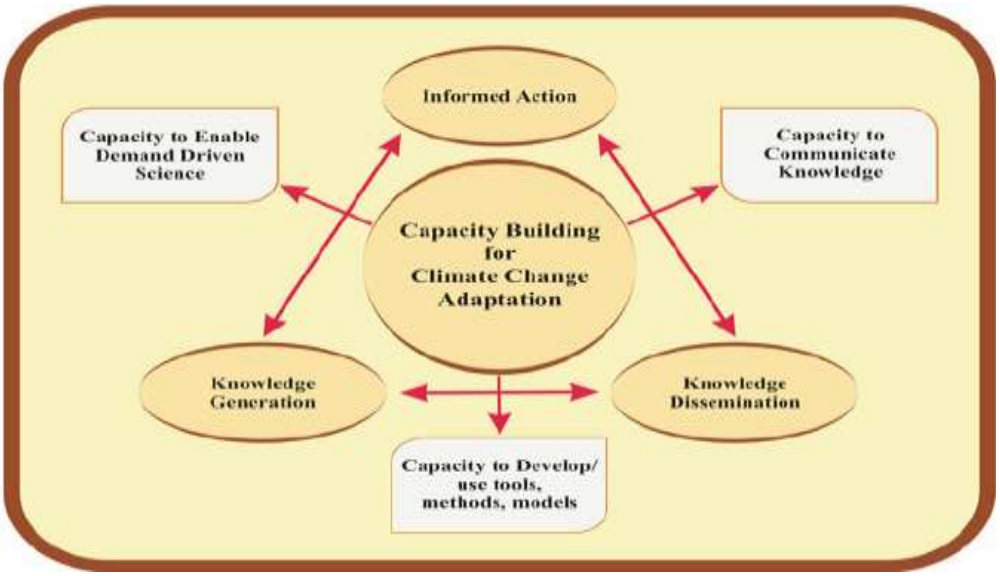
Research Methodology

Qualitative and quantitative approaches have been applied, utilizing both primary and secondary sources. These sources include the institutional legal framework, policies at the provincial and federal levels, and research articles published on climate change. Additionally, interviews were conducted with ten groups in their respective departments regarding climate change capacity building, education, and mass awareness. Besides this, comparative analysis, gap analysis, statistical analysis, and PESTEL analysis have been conducted, followed by a log framework.

Literature Review

The capacity building, climate education, and mass awareness regarding climate change at the national level and Khyber Pakhtunkhwa level reveal a complex interplay of challenges and opportunities that hinder effective climate action. Various studies highlight the critical gaps in institutional capacity and the lack of trained professionals in governmental and non-governmental organizations, which impede the implementation of climate-related programs (Awan et al., 2022; Khan et al., 2023). Additionally, the integration of climate education within school curricula remains insufficient, with many educational institutions failing to address climate change comprehensively, resulting in a lack of awareness among students (Ali & Bibi, 2023). This is compounded by limited resources allocated for training educators and the absence of consistent communication strategies that can engage the broader public effectively (Raza & Ali, 2023). Furthermore, existing mass awareness campaigns often deliver mixed messages, which can confuse stakeholders and dilute public engagement (Saeed et al., 2023). The literature also points to the necessity of fostering collaboration among various stakeholders, including government agencies, educational institutions, and community organizations, to create cohesive strategies that enhance climate education and awareness (Khan & Ahmad, 2023). By synthesizing these findings, it becomes clear that a multifaceted approach is essential to address the critical issues surrounding climate change in Khyber Pakhtunkhwa, emphasizing the need for increased investment in capacity building, comprehensive climate education, and targeted mass awareness initiatives to empower communities and enhance resilience against climate impacts.

The Role of Capacity Building for Climate Change Adaptation.



The Role of Federal Institutions in Capacity Building for Climate Change Adaptation in Pakistan

Pakistan is highly vulnerable to climate change impacts, including extreme weather events, rising temperatures, and water scarcity. Building capacity to adapt to these changes is crucial for resilience and sustainable development. Federal institutions play a vital role in capacity building for climate change adaptation in Pakistan.

Policies and Frameworks

National Climate Change Policy (2012)

Pakistan's climate policy aims to strengthen government and community capacity for climate action through training, institutional support, research, private sector engagement, and international collaboration. Key efforts are detailed in Sections 5.4 and 6.4 on Capacity Building and Implementation.

National Adaptation Plan (2013)

The National Adaptation Plan (2013) emphasizes strengthening institutions, technical expertise, and communities for climate resilience, with a focus on agriculture, water, and infrastructure. Key actions are detailed in Sections 3.2, 4.2, and 5.2.

Climate Change Act (2017)

The Climate Change Act (2017) prioritizes capacity building by establishing the National Climate Change Authority (NCCA) to oversee training, research, public awareness, and international collaboration. The Act mandates resource allocation for these efforts, outlined in Sections 4, 7, 10, and 15.

Pakistan's Nationally Determined Contributions (NDCs) under the Paris Agreement

Pakistan's NDCs under the Paris Agreement stress capacity building in Sections 3 (Mitigation), 4 (Adaptation), 5 (Finance), and 6 (Technology Transfer). The Ministry of Climate Change is tasked with coordinating these efforts, emphasizing institutional capacity, technical expertise, and public awareness.

National Disaster Management Plan (2010)

The National Disaster Management Plan (2010) emphasizes capacity building through enhanced institutional capacity, technical expertise, and public awareness (Section 3.4). It establishes the NDMA to oversee initiatives (Section 4.2) and prioritizes training and research in disaster management (Sections 5.3 and 6.4).

Federal Institutions

Ministry of Climate Change (MoCC)

The Ministry of Climate Change (MoCC), under the Climate Change Act (2017), focuses on capacity building through institutional strengthening, research (Section 7), and international cooperation (Section 10). MoCC's initiatives support climate adaptation, emissions mitigation, and NDC implementation.

National Disaster Management Authority (NDMA)

The NDMA, under the Disaster Management Act (2010), enhances disaster risk management capacity through training and stakeholder

collaboration (Sections 5 and 6), preparing officials and communities to respond effectively to disasters.

Pakistan Environmental Protection Agency (EPA)

The Pakistan Environmental Protection Agency (EPA) prioritizes capacity building under the Environmental Protection Act (1997) (Section 6(a)) to enhance compliance and technical expertise (Section 7), promoting environmental awareness and sustainable development through training programs.

Ministry of Water Resources

The Ministry of Water Resources, under the Indus River System Authority Act (1992) (Section 5(1)(d)) and the Pakistan Water and Power Development Authority Act (1958) (Section 3(2)), enhances capacity for sustainable water management through training programs and stakeholder engagement, while collaborating on water policies and strategies.

Ministry of Food Security

The Ministry of Food Security, under the Agriculture Produce Markets Act (1977) (Section 3(1)(c)) and the Pakistan Agricultural Research Council Ordinance (1984) (Section 4(2)), focuses on capacity building to enhance agricultural productivity and food security through training programs for farmers and stakeholder engagement.

Projects and Programs at Federal Level.

Name of Project	Executed by	Funded by	Cost	Duration	Key Objective
Climate Phase II	MoCC	UNDP	540,000 USD	2023 – 2024	Train youth and women in green skills, and on eco-tourism and livelihood opportunities.
Water Sector Capacity Building and Advisory Services	Ministry of Water Resources	IDA/World Bank	44.81 (M) USD	2016 to 2021	Training and capacity building at federal and provincial levels, i.e., MoWR, O/o

Project					CEA/FFC, PCIW, PIDs, FATA, Gilgit-Baltistan.
Climate Resilient Urban	MoCC	UNDP	56.825 (M) PKR	2019-2024	Climate-resilient, safe, and sustainable cities.
Building Pakistan's Resilience to Climate Change	MoCC	WWF	77.8 (M) USD	2021 onward	Ecosystem-based flood risk management.
Water Resource Management in Leather Industrial Zone	MoCC	UNIDO	5.5 Million USD	2022 onward	Low emissions and climate-resilient development.
MYHP Project	AKRS	AKRS, UNICEF	7.8 (M) USD	2017 onward	Natural disaster response and recovery.
Sustainable Waste Management Solutions	MoCC	UNIDO	20.7 (M) USD	2022 onward	Municipal and industrial waste management.
SAR Strengthen Climate Adaptation and Resilience	MoCC	GIZ	10 (M) Euro	2021 onward	Climate adaptation and resilience risk management focusing on vulnerable populations.

S. No	Year	No. of Courses	Men	Women	Total
1.	2010	27	750	95	845
2.	2011	24	777	169	946
3.	2012	5	277	18	295
4.	2013	25	1012	124	1136
5.	2014	47	1204	239	1443
6.	2015	25	595	174	769
1	2016	20	749	111	860
8.	2017	9	288	36	324
9.	2018	27	905	163	1068
10.	2019	17	541	170	711
11.	2020	6	259	28	287
12.	2021	17	356	77	433
13.	2022	6	162	36	198
14.	2023	20	1307	406	1713
15.	2024	17	872	214	1186
Total		292	10079	2035	12114

The Role of Khyber Pakhtunkhwa's Institutions in Capacity Building for Climate Change Adaptation in the Province

Khyber Pakhtunkhwa is vulnerable to climate change impacts, including glacier melting, floods, and droughts. To address these challenges, KP's institutions play a crucial role in capacity building for climate change adaptation.

Policies and Frameworks

KP Climate Change Policy (2016)

The KP Climate Change Policy (2016) emphasizes capacity building to address climate change through training programs for officials (Section 4.2), institutional development in vulnerable districts (Section 4.3), and research collaborations with universities and organizations (Section 5.1(c)).

KP Disaster Management Policy (2015)

The KP Disaster Management Policy (2015) focuses on capacity building for disaster resilience through training programs (Section 3.2), the establishment of the KDMA to coordinate efforts (Section 4.1), and the development of disaster management plans with regular drills (Section 5.3). Section 6.2 encourages research collaborations with universities for improved disaster risk reduction.

The KP EPA Act (2014)

The KP EPA Act (2014) focuses on capacity building through stakeholder training (Section 11), research (Section 15), and collaboration with organizations for knowledge sharing (Section 26), with the Provincial Environmental Protection Council advising on these initiatives (Section 22).

Institutions

KP Environmental Protection Agency (EPA)

The KP EPA, under the 2014 Act, prioritizes capacity building through stakeholder training (Section 11) and environmental research (Section 15), enhancing regulation, enforcement, and sustainable development.

Provincial Disaster Management Authority (PDMA)

The PDMA Khyber Pakhtunkhwa, under the 2015 Act, emphasizes capacity building through training (Section 28) and disaster risk reduction research (Section 30), enhancing preparedness and resilience.

KP Agriculture Department

The Agriculture Department in KP, under the 2016 Climate Change Policy, focuses on capacity building through training in climate-resilient agriculture (Section 4.3) and research in climate-smart farming (Section 5.2).

KP Forest Department

The Forest Department in KP, under the 2019 Act, prioritizes capacity building for sustainable forest management (Section 6) and conducts training on climate-resilient practices and reforestation (Section 11).

Projects

Name of Project	Executed by	Funded by	Cost	Duration
SAP 039	P&D Deptt KP	UNDP &World Bank	9.8 Million USD	2024 on word
BTTP	Environment Deptt KP	Local	13.669 Billion PKR	2019 on word
BTASP	Environment Deptt KP	Local	372 Million PKR	2022 on word
Climate Resilience through Horticulture Intervention in KP	Agriculture Department	World Bank	778 Million PKR	2022 on ward
GZD Command Area	Agriculture Department	Local & World bank	4.23 Billion PKR	2016 on ward
KP-RISP	P&D Department	Local & World Bank	109 Billion PKR	2023 on word
KP-FSSP	Agriculture Department	Local, ADB &Japan Aid	88 Million USD	2024 on word
KP-RAP	C&W Department	Local & World Bank	69.440 Billion PKR	2022 on ward

The Role of Climate Education for Climate Change Adaptation.

The Role of Federal Institutions in Climate Education for Climate Change Adaptation in Pakistan

Climate education is crucial for climate change adaptation in Pakistan. Federal institutions play a vital role in promoting climate education.

Policies and Frameworks

National Climate Change Policy (2012)

The National Climate Change Policy (2012) emphasizes integrating climate education into school curricula (Section 3.5) and capacity-building programs for stakeholders (Section 4.2(c)). It also supports public awareness campaigns (Section 5.3(d)) and the establishment of research centers for climate change management (Section 6.2).

Climate Change Act (2017)

The Climate Change Act (2017) prioritizes climate education and awareness in Pakistan by mandating the promotion of education through curricula and training (Section 9), the establishment of research centers (Section 10), and capacity building for stakeholders (Section 12).

National Education Policy (2017)

The National Education Policy (2017) emphasizes climate education for sustainable development by integrating it into curricula (Section 4.3), including sustainable living skills (Section 5.2.0), and providing teacher training in climate change (Section 7.3).

Pakistan's Nationally Determined Contributions (NDCs)

Pakistan's Nationally Determined Contributions (NDCs) stress the importance of climate education for adaptation (Section 3.2), capacity building for stakeholders (Section 4.1(c)), and promoting sustainable lifestyles (Section 5.3).

Federal Institutions

Ministry of Climate Change (MoCC)

The Ministry of Climate Change (MoCC) is tasked with promoting climate education in Pakistan under the Climate Change Act (2017), coordinating nationwide programs (Section 5), and developing curricula for stakeholders (Section 9(1)(c)), while also establishing research centers (Section 12(1)(d)).

Ministry of Education and Professional Training (MoEPT)

The Ministry of Education and Professional Training (MoEPT) is responsible for integrating climate change education into Pakistan's educational framework as mandated by the National Education Policy (2017), which includes curriculum incorporation (Section 4.3), development of sustainable living skills (Section 5.2.0), and teacher training programs (Section 7.3).

National Disaster Management Authority (NDMA)

The National Disaster Management Authority (NDMA) promotes climate education under the Disaster Management Act (2010) by raising awareness (Section 4(h)), coordinating training programs (Section 5(1)(c)), and developing guidelines for educational curricula (Section 6(2)(d)).

Pakistan Environmental Protection Agency (EPA)

The Pakistan Environmental Protection Agency (EPA) promotes climate education by conducting public awareness programs (Section 6), training stakeholders (Section 7(1)(c)), and collaborating with educational institutions to integrate climate education into curricula (Section 12(2)(d)).

Higher Education Commission (HEC)

The Higher Education Commission (HEC) promotes climate education by advancing research in environmental science (Section 3(2)(c)), establishing climate study centers (Section 4(2)(b)), and developing related curricula (Section 10(1)(d)).

Projects

Name of Project	Executed by	Funded by	Cost	Duration
Climate Box	MoCC	UNDP (the Government of the Russian Federation.)	$766,422	2017-2021
Recharge Pakistan	MoCC Federal Flood Commission (FFC) WWF-Pakistan	Green Climate Fund (GCF) (USAID) Coca-Cola Foundation and WWF-Pakistan	66 Million USD 21 Million USD	2023 on ward
Pakistan Hydro met & Climate Services Project (PHCSP)	MoCC	World Bank	188 (M) USD	2018-2024
Ten Billion Tree Tsunami Phase-1	MoCC	Govt of Pakistan PSDP	125 Billion PKR	2019-2023

The Role of Khyber Pakhtunkhwa's Institutions in Climate Education for Climate Change Adaptation in the Province

Khyber Pakhtunkhwa (KP) is vulnerable to climate change impacts. Climate education is crucial for adaptation.

Policies and Frameworks

KP Climate Change Policy (2016)

The KP Climate Change Policy (2016) emphasizes climate education by integrating it into school curricula (Section 4.2.3), establishing university research centers (Section 5.1.2), and promoting capacity building and public awareness (Sections 6.3.1 and 7.2.2).

KP Environmental Protection Act (2014)

The Khyber Pakhtunkhwa Environmental Protection Act (2014) mandates climate education through public awareness programs (Section 11(1)(c)), curriculum integration (Section 15(2)(d)), and training for stakeholders (Section 20(1)(e).

KP Provincial Disaster Management Authority (PDMA) Act (2012)

The KP PDMA Act (2012) mandates public awareness programs on climate and disaster management (Section 5(1)(f)), collaboration with educational institutions for curriculum development (Section 6(2)(c)), and training centers for stakeholders (Section 12(1)(d)).

The Khyber Pakhtunkhwa Universities Act (2012)

The KP Universities Act (2012) requires universities to promote climate change research (Section 5(1)(v)), establish centers for related education (Section 11(2)(iii)), and develop sustainability-focused curricula (Section 15(1)(vii)).

Institutions

KP Environmental Protection Agency (EPA)

The KP Environmental Protection Agency (EPA) is essential for climate education, conducting public awareness programs (Section 11(1)(c)), collaborating with educational institutions to integrate

climate education into curricula (Section 15(2)(d)), and establishing training programs for stakeholders (Section 20(1)(e)).

KP Provincial Disaster Management Authority (PDMA)

The KP Provincial Disaster Management Authority (PDMA) promotes climate education through public awareness programs, collaboration with educational institutions for curriculum development, and the establishment of training centers for stakeholders (Sections 5(1)(f), 6(2)(c), & 12(1)(d)).

Department of Elementary & Secondary Education

The KP E&SE Department is mandated to include climate education in curricula, as stated in Section 10(1)(b) of the Right to Free and Compulsory Education Act (2017), and requires private schools to do the same under Section 12(2)(a) of the Schools and Colleges Registration and Admission Regulation Rules (2020).

Department of Agriculture

The KP Agriculture Department is mandated by law to promote climate education for farmers, focusing on sustainable practices under the Agriculture Produce Marketing Regulatory Authority Act (2016) and soil conservation techniques as required by the Soil Conservation Act (2019).

Department of Higher Education

The KP Higher Education Department advances climate education through legal mandates. The KP Universities Act (2012) requires universities to promote research in environmental science and climate change (Section 5(1)(v)), establish centers for climate change and disaster management (Section 11(2)(iii)), and integrate climate change into curricula (Section 15(1)(vii)).

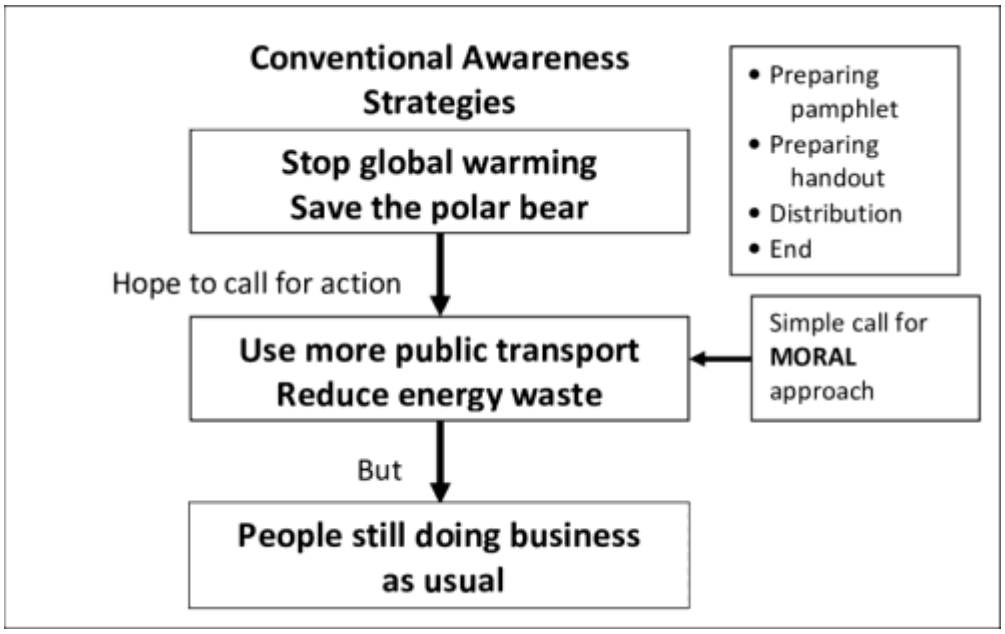
University of Peshawar (Centre for Climate Research)

The University of Peshawar's Centre for Climate Research promotes climate education and research in KP, focusing on interdisciplinary studies and capacity building. It aims to develop climate change mitigation and adaptation strategies.

Projects

Name of Project	Executed by	Funded by	Cost	Duration
KP-RETP	P&D Deptt KP	IFAD	30.265 Billion PKR	2021 on word
BTTP	Environment Deptt KP	Local	13.669 Billion PKR	2019 on word
BTASP	Environment Deptt KP	Local	372 Million PKR	2022 on word
BRT Peshawar	T&MTD KP	Local ADB AFD	70 Billion PKR	2018 on ward
KPIAIP (IDA-Credit)	Agriculture Deptt	World Bank	30.048 Billion PKR	2019 on ward
Climate Resilience through Horticulture Intervention in KP	Agriculture Department	World Bank	778 Million PKR	2022 on ward
GZD Command Area	Agriculture Department	ADP World bank	4.23 Billion PKR	2016 on ward
KP-RISP	P&D Department	Local World Bank	109 Billion PKR	2023 on word
KP-FSSP	Agriculture Department	Local ADB Japan Aid	88 Million USD	2024 on word
KP-RAP	C&W Department	Local World Bank	69.440 Billion PKR	2022 on ward

The Role of Mass Awareness for Climate Change Adaptation



Overview of Mass Awareness in Pakistan

Pakistan is part of the developing world, where around 40% of the population is aware of climate change, compared to developed nations like Japan, the EU, and the USA, where the ratio exceeds 90%. Still, 40% of adults worldwide are unaware of climate change, and this ratio increases to 65% in developing countries (IPRI-2022).

Media Landscape in Pakistan

Print Media

- There are approximately 945 newspapers in the country. The print media is published in 11 languages, with Urdu and Sindhi as the largest language groups.
- Urdu newspapers are dominant in rural areas, while the English media primarily focuses on urban consumers.
- Print media coverage is limited, with some exceptions like Rina Saeed Khan, an environmental journalist who regularly writes about climate issues in *Daily Dawn*.

Electronic Media

- Presently, there are around 142 TV channels and 235 FM radio stations operating in the country, with a viewership of 141 million, consisting of both satellite and terrestrial TV channels.
- Electronic media rarely discusses climate change, except during occasional events like International Days observed for climate change, e.g., Earth Day, Biodiversity Day, etc.

Digital Media/Social Media

- Pakistan has a large internet user base and high mobile phone penetration, with 193.9 million cellular subscribers, of which 127.06 million have 3G/4G access, and 140.7 million have broadband connections.
- Social media has vast potential for rapid information sharing on climate change, including the internet and cellular phones. Popular applications among new media users include Twitter, Facebook, WhatsApp, and Instagram.

Conventional Media Forums

In addition to this, there are more than 0.8 million mosques, churches, and other religious places in Pakistan, which also serve as media forums for public awareness.

Government Initiatives in the Area of Mass Awareness

- According to the PEMRA Rules 2017, 10% of airtime on all electronic media must be dedicated to public interest messages/awareness. This has set a parameter for the allocation of rates in public sector advertisements under the Advertisement Policy, 2021.
- Earmarking of up to 2.5% of the total budget outlay for advertisement and publicity in PC-1 of the PSDP Projects (Federal Government Direction 2022).

The Role of Federal Institutions in Mass Awareness for Climate Change Adaptation in Pakistan

Pakistan faces significant climate change impacts, necessitating effective adaptation and awareness measures. This analysis examines federal institutions' roles in promoting climate resilience through mass awareness.

Policies and Frameworks

National Climate Change Policy (2012)

The National Climate Change Policy (2012) of Pakistan highlights the need for public awareness on climate change. It mandates public campaigns to educate citizens on its causes and adaptation (Section 4.2.3), integrates climate education into school curricula (Section 5.1.2), and calls for a media cell to share information through various channels (Section 6.3.1).

Framework for Implementation of Climate Change Policy (2014-2030)

The Framework for Implementation of Climate Change Policy (2014-2030) mandates a national climate change awareness strategy (Section 3.2.1) to improve public understanding, integrates climate education into formal and non-formal systems (Section 4.1.3), establishes resource centers for training (Section 5.2.2), and assigns provincial governments to lead public awareness campaigns (Section 6.1.4).

Pakistan's Nationally Determined Contributions (NDCs)

Pakistan's NDCs under the Paris Agreement emphasize mass awareness for climate change mitigation, with Section 4.2.1 highlighting the need for "climate change education and awareness" and Section 5.1.3 calling for "capacity building and training" for stakeholders.

NDMA Act (2010)

The National Disaster Management Act (2010) mandates public awareness for disaster risk reduction, with Section 6(2)(d) requiring the NDMA to educate the public, Section 12(1)(c) allowing the National Executive Committee to launch awareness campaigns, and Section 23(1)(e) directing state governments to incorporate climate change education into school curricula.

Institutions

Ministry of Climate Change

The Ministry of Climate Change is essential for promoting awareness of climate adaptation, as mandated by the Climate Change Act, 2017, which requires it to educate the public (Section 4(2)(d)), conduct

awareness campaigns and training (Section 5(1)(c)), and integrate climate education into national curricula (Section 12(1)(e)).

Pakistan Environmental Protection Council (PEPC)
The PEPC promotes mass awareness of climate change, mandated by the Pakistan Environmental Protection Act, 1997, to educate the public (Section 5(1)(c)), conduct awareness campaigns and training (Section 6(2)(d)), and collaborate with educational institutions to integrate climate education into curricula (Section 15(1)(e)).

Global Change Impact Studies Centre (GCISC)
The GCISC promotes climate change awareness in Pakistan, as mandated by the Pakistan Environmental Protection Act, 1997, conducting research (Section 3), disseminating information (Section 5(1)(d)), collaborating with educational institutions (Section 6(2)(e)), and developing public awareness campaigns (Section 12(1)(f)).

National Disaster Management Authority (NDMA)
The NDMA promotes climate change awareness in Pakistan, as mandated by the National Disaster Management Act, 2010, to educate the public on risks (Section 6(2)(d)), conduct awareness campaigns and training (Section 12(1)(c)), and integrate climate education into national curricula (Section 23(1)(e)).

Ministry of Information & Broadcasting
The Ministry of Information and Broadcasting promotes climate change awareness in Pakistan, mandated by the PEMRA Ordinance 2002, to disseminate information on public interest issues (Section 4(2)(e)), produce public service messages (Section 6(1)(c)), and promote climate coverage in the media (Section 10(1)(d)).

Higher Education Commission
The HEC promotes climate change awareness through academia, mandated by the HEC Ordinance 2002, to promote research (Section 3(1)(d)), integrate climate education into curricula (Section 5(1)(e)), and establish research centers (Section 10(1)(f)).

The Role of Khyber Pakhtunkhwa's Institutions in Mass Awareness for Climate Change Adaptation in the Province

Khyber Pakhtunkhwa faces significant climate change impacts. Institutions play a vital role in promoting mass awareness and adaptation.

Policies and Frameworks

Khyber Pakhtunkhwa Climate Change Policy 2022

The KP Climate Change Policy 2018 emphasizes mass awareness and education, mandating public education (Section 4.2.3), curriculum integration (Section 5.1.2), resource centers (Section 6.3.1), and awareness campaigns by the provincial government (Section 7.2.2).

Khyber Pakhtunkhwa Climate Change Action Plan

The KP Climate Change Action Plan 2018 prioritizes mass awareness, mandating public education (Section 3.2.1), the development of educational materials (Section 4.1.3), training programs for stakeholders (Section 5.2.2), and awareness campaigns by the provincial government (Section 6.1.1).

Provincial Environmental Protection Act 2014

The KP Environmental Protection Act (2014) mandates climate change awareness, empowering the Provincial Environmental Protection Agency to educate the public (Section 6(2)(c)), conduct campaigns (Section 10(1)(d)), integrate education into schools (Section 15(2)(b)), and require industries to run awareness programs (Section 22(1)(e)).

PDMA Act (2012)

The KP PDMA Act (2012) prioritizes climate change awareness, mandating the PDMA to educate the public on risks (Section 12(1)(c)), conduct media campaigns (Section 15(2)(b)), and integrate climate education into school curricula (Section 20(1)(d)).

Institutions

Forestry, Environment & Wildlife Department

The KP Forestry, Environment & Wildlife Department's climate change awareness efforts are mandated by the Khyber Pakhtunkhwa Environmental Protection Act (2014), empowering it to educate the public (Section 6(2)(c)), integrate education into school curricula (Section 12(1)(e)), and conduct media campaigns (Section 15(2)(b)).

Provincial Climate Change Implementation Committee

The KP Provincial Climate Change Implementation Committee, under the Climate Change Act (2022), is mandated to disseminate information (Section 7(1)(d)), conduct public campaigns (Section 10(2)(e)), and collaborate with educational institutions on climate education (Section 14(1)(f)).

Environmental Protection Agency Khyber Pakhtunkhwa (EPA KP)

The KP Environmental Protection Agency (KP EPA) promotes climate change awareness under the Environmental Protection Act (2014) by conducting public campaigns (Section 6(2)(c)), integrating climate education into curricula (Section 12(1)(e)), and collaborating with media (Section 15(2)(b)).

PDMA KP

The KP PDMA promotes climate change awareness under the Disaster Management Act (2010) by conducting public campaigns (Section 12(1)(c)), collaborating with educational institutions and media (Section 14(2)(e)), and developing climate contingency plans (Section 18(1)(f)).

Khyber Pakhtunkhwa Agriculture Department

The KP Agriculture Department promotes climate awareness through laws mandating sustainable farming (Section 4(2)(d)), farmer education on soil conservation (Section 7(1)(e)), and climate-resilient water management (Section 10(2)(f)).

Comparative Study of Pakistan and India Regarding Capacity Building, Climate Education, and Mass Awareness for Climate Change Adaptation

Pakistan and India, neighboring countries in South Asia, face similar climate change challenges. The following table compares the role of government institutions in capacity building, climate education, and mass awareness for adaptation in both countries.

Aspect	Pakistan	India
Institutional Framework	• Ministry of Climate Change (MoCC) • National Disaster Management Authority (NDMA) • Pakistan Environmental Protection Agency (EPA) • Provincial climate change departments • Provincial Climate Change Implementation Committees •	• Ministry of Environment, Forest and Climate Change (MoEFCC) • National Disaster Management Authority (NDMA) • State Climate Change Departments • National Institute of Disaster Management (NIDM) • National Clean Energy and Environment Fund (NCEEF) • Indian Meteorological Department (IMD)
Initiatives for Capacity Building, Climate Education & Mass Awareness	• Training programs for government officials • Climate change research and development • Community-based adaptation projects • International collaborations (e.g., UNDP, World Bank) • Climate Change Research and Development (CCRD) program • Climate Change Adaptation and Resilience (CCAR) project • National Climate Change Knowledge Portal • Climate Change	• National Action Plan on Climate Change (NAPCC) • State Action Plans on Climate Change (SAPCC) • Climate Change Knowledge Portal • Training programs for officials and communities • National Climate Change Research Program • Climate Change Adaptation Program

	Education and Awareness (CCEA) program • Mass Awareness Campaigns • Provincial Climate change policies	
Challenges	• Limited funding • Institutional capacity gaps • Coordination issues	• Implementation gaps • Funding constraints • State-level capacity building
Differences	• Pakistan's institutional capacity is limited • Institutional structure and scope • Funding mechanisms	• India's NAPCC and SAPCC provide a comprehensive framework • India's climate change knowledge portal is a best practice
Similarities	• Both countries have dedicated climate change ministries • National disaster management authorities play key roles • Emphasis on community-based adaptation	

Gap Analysis of Pakistan and India Regarding Capacity Building, Climate Education & Mass Awareness for Climate Change Adaptation

The gap analysis identifies the gaps in capacity building, climate education, and mass awareness for climate change adaptation in Pakistan and India, highlighting areas for improvement.

GAP	Pakistan	India
Institutional Gaps	• limited institutional capacity (human resources, expertise) • lack of coordination among ministries and departments. • Insufficient funding for climate education initiatives	• limited capacity for climate change research and development. • Insufficient funding for climate education initiatives

Capacity Building, Mass Awareness & Climate Education Gaps	• limited training programs for teachers and educators • inadequate climate change research and development • Insufficient community engagement and awareness	• Limited training programs for state and local officials • Inadequate community engagement and awareness • Limited private sector engagement
Policy and Framework Gaps	• lack of comprehensive climate change education policy • insufficient integration of climate change into school curricula • limited international cooperation	• limited integration of climate change into sectoral policies • insufficient monitoring and evaluation of climate education initiatives • limited international cooperation.
Common Gaps	• Limited funding for climate education initiatives • Insufficient community engagement and awareness • Limited capacity for climate change research and development	

Current Situation	
Pakistan	**India**
• Limited awareness among general public (30% awareness rate) • Insufficient climate change education in schools • Inadequate media coverage	• Moderate awareness among general public (50% awareness rate) • Climate change education integrated into school curricula • Significant media coverage

Desired Situation	
Pakistan	**India**
• 80% awareness rate among general public • Comprehensive climate change education in schools • Regular media coverage and public awareness campaigns	
GAP	
Pakistan	**India**
• Awareness gap: 50% (30% current vs. 80% desired) • Education gap: Climate change education not integrated into school curricula • Media gap: Inadequate media coverage	• Awareness gap: 30% (50% current vs. 80% desired) • Implementation gap: Climate change education not uniformly implemented • Funding gap: Insufficient funding for public awareness campaigns

GAP Analysis Table

Category	Pakistan	India	Common GAPs
Institutional	40 %	30 %	Limited funding |
Capacity Building	30 %	25 %	Insufficient community engagement
Policy & Frame Work	30 %	45 %	Limited international cooperation

Prioritization Matrix

Gap	Priority	Recommendation
Institutional capacity	High	Strengthen institutional capacity
Funding	High	Increase funding for climate change initiatives
Community engagement	Medium	Increase community engagement and awareness
Research and development	Medium	Enhance capacity for climate change research and development

PESTEL Analysis

The PESTEL Analysis focuses on the situation of capacity building, climate education, and mass awareness regarding climate change adaptation in Pakistan. The details are as follows:

Political

1. Government support: Climate change policies and initiatives demonstrate government commitment.
2. International agreements: Pakistan's ratification of the Paris Agreement and UNFCCC commitments guides climate action.
3. Regulatory frameworks: The Climate Change Act (2017) provides a legal framework.
4. Policy stability: Political changes impact climate policy continuity.

Economic

1. Funding: Insufficient allocation hinders climate initiatives.
2. Economic benefits: Climate-resilient infrastructure drives economic growth.
3. Cost of adaptation: Climate change impacts burden the economy.
4. Resource allocation: Climate initiatives compete for resources.

Social

1. Public awareness: Growing concern about climate change drives action.
2. Community engagement: Local involvement in climate initiatives enhances ownership.
3. Cultural sensitivity: Climate education is tailored to the local context.
4. Demographic changes: Population growth amplifies climate impacts.

Technological

1. Climate modeling: Advanced technologies enhance climate research.
2. Renewable energy: Solar, wind, and hydroelectric power reduce emissions.
3. Digital resources: Online climate education platforms expand access.
4. Innovative solutions: Climate-resilient infrastructure mitigates impacts.

Environmental

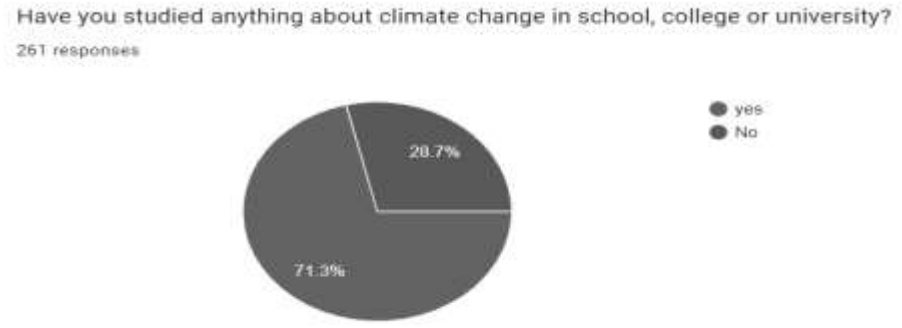
1. Climate change impacts: Pakistan's vulnerability to extreme events.
2. Natural resources: Sustainable management is essential.
3. Disaster risk reduction: Climate-resilient infrastructure is necessary.
4. Ecosystem services: Protection of biodiversity is crucial.

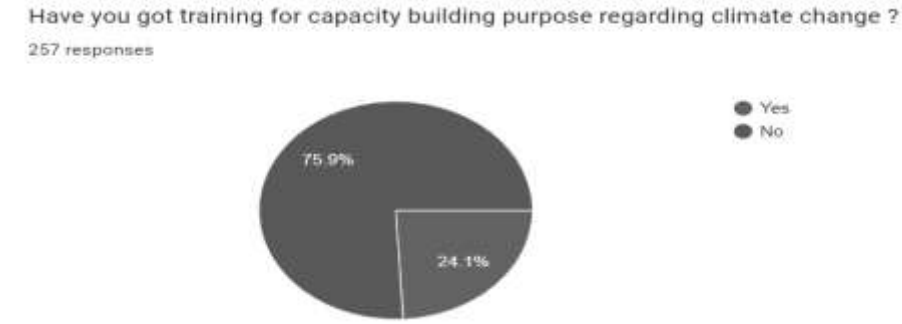
Legal

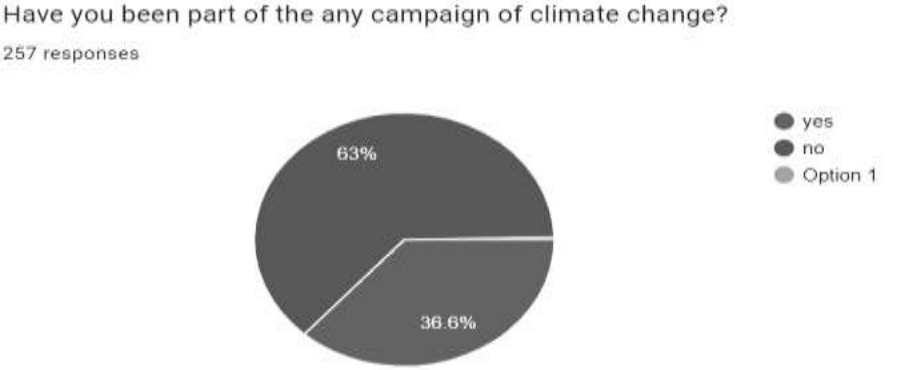
1. Climate change laws: Compliance with international agreements.
2. Policy frameworks: National and provincial climate policies guide action.
3. Regulatory enforcement: Implementation of climate laws is essential.
4. International cooperation: Collaboration on climate change.

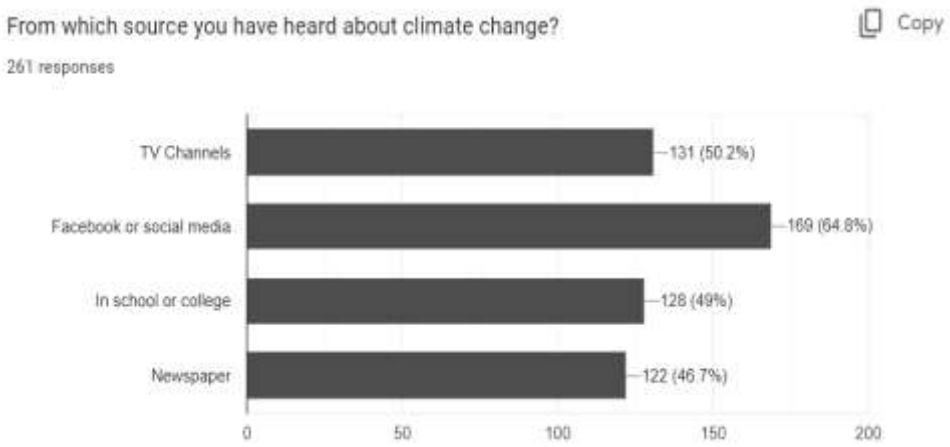
STATISTICAL ANALYSIS

A survey was conducted through Google Forms to gather feedback from the general public regarding capacity building, climate education, and mass awareness for climate change adaptation. The analysis is as follows:









Issues and Challenges

Capacity Building Challenges

- **Limited Institutional Capacity**
  - **Lack of Skilled Personnel:** The lack of trained climate change professionals in government and NGOs undermines the effectiveness of climate programs, resulting in poor responses to environmental challenges.
  - **Insufficient Training Programs:** Current capacity-building initiatives inadequately train staff, hindering their ability to effectively tackle complex climate issues.
- **Resource Constraints**
  - **Financial Limitations:** Limited budget allocations in the environmental sector restrict essential training and educational activities, undermining the development of impactful climate capacity programs.
  - **Inadequate Infrastructure:** Insufficient physical and technological infrastructure limits the effectiveness of capacity-building programs, preventing stakeholders from accessing vital training resources.
- **Coordination Issues**
  - **Fragmented Approach:** Lack of coordination among agencies leads to overlapping efforts that weaken climate change capacity-building initiatives.
  - **Poor Communication Channels:** Poor communication among stakeholder's limits collaboration and impedes progress in capacity-building efforts.

Climate Education Challenges

- **Curriculum Gaps**
  - **Inadequate Integration of Climate Education:** Many educational institutions neglect to include climate change topics in their curricula, leading to a lack of awareness among future decision-makers.
  - **Limited Resources for Educators:** Teachers often lack resources and training for effective climate education, limiting the quality of students' learning on the subject.
- **Public Awareness**
  - **Low Public Awareness:** A lack of public awareness about climate change hinders meaningful community engagement and minimizes participation in initiatives.
  - **Ineffective Communication Strategies:** Current communication strategies fail to reach marginalized communities affected by climate change, limiting the impact of awareness campaigns.
- **Engagement with Educational Institutions**
  - **Limited Collaboration with Schools and Universities:** Insufficient collaboration between environmental agencies and educational institutions undermines effective climate education initiatives.
- **Mass Awareness Challenges**
  - **Inconsistent Messaging**
    - **Mixed Messages from Authorities:** Inconsistent messaging on climate change from various entities confuses the public and undermines the effectiveness of awareness campaigns.
  - **Resource Allocation**
    - **Insufficient Funding for Awareness Campaigns:** Limited funding for mass awareness campaigns restricts their ability to effectively reach broader audiences.
  - **Cultural Barriers**
    - **Resistance to Change:** Cultural beliefs can resist climate change initiatives, necessitating tailored approaches that align with local values to promote sustainability.
    - **Socioeconomic Factors:** Vulnerable communities often prioritize immediate economic concerns over long-term environmental issues, leading to resistance against climate education initiatives.

Conclusion

The effective management of climate change in Khyber Pakhtunkhwa hinges on overcoming significant issues related to Capacity Building, Climate Education, and Mass Awareness. The current landscape reveals gaps in skilled personnel, financial resources, and institutional coordination, all of which impede the development of a comprehensive climate response. Furthermore, the lack of integration of climate-related topics in educational curricula limits public understanding and engagement. Mass awareness campaigns face challenges such as inconsistent messaging and cultural resistance, which can undermine public support for climate initiatives. To address these multifaceted challenges, it is crucial for government agencies, educational institutions, and community organizations to collaborate closely, ensuring the design and implementation of inclusive and effective strategies. By investing in targeted capacity-building programs, enhancing climate education in schools, and promoting cohesive awareness campaigns, KP can foster a more resilient and proactive society capable of tackling the ongoing and future impacts of climate change.

Recommendations & Way Forward

Based on the identified issues and challenges regarding Capacity Building, Climate Education, and Mass Awareness in Khyber Pakhtunkhwa (KP), the following recommendations and strategies are proposed to enhance the province's response to climate change:

Recommendations and Way Forward

- **Strengthening Capacity Building**
    - **Develop Comprehensive Training Programs:** Create targeted training programs on climate change for officials and leaders, collaborating with academic and international organizations to enhance effectiveness.
    - **Enhance Recruitment and Retention Strategies:** Implement policies that offer competitive salaries and professional development to attract and retain skilled personnel in environmental sectors.
- **Improving Resource Allocation**
    - **Increase Budget Allocations:** Push for increased budget allocations for climate education and capacity-building by emphasizing their long-term benefits to policymakers.

  - **Leverage Public-Private Partnerships:** Encourage partnerships among government, the private sector, and NGOs to pool resources and expertise for sustainable climate action.

- **Enhancing Climate Education**
  - **Integrate Climate Change into Curricula:** Work with educational authorities to integrate climate change topics into curricula at all levels, ensuring expert input for comprehensive environmental education.
  - **Provide Training and Resources for Educators:** Equip teachers with training and resources through professional development workshops to effectively teach climate-related subjects.
- **Boosting Mass Awareness Efforts**
  - **Develop Consistent Messaging Campaigns:** Establish a cohesive communication strategy to ensure consistent climate change messaging across diverse media and to target various demographics.
  - **Engage Communities through Local Initiatives:** Encourage community involvement in climate action through local awareness campaigns and participatory activities to enhance the effectiveness of mass awareness initiatives.
- **Fostering Collaboration and Coordination**
  - **Establish Multi-Stakeholder Platforms:** Create collaborative platforms for government, educational institutions, NGOs, and communities to share knowledge and resources on climate change through regular workshops.
  - **Enhance Communication Channels:** Utilize technology to streamline communication and coordination among stakeholders for enhanced climate resilience.
- **Monitoring and Evaluation**
  - **Implement Robust Monitoring Frameworks:** Establish a comprehensive monitoring and evaluation framework to assess the effectiveness of climate initiatives and drive continuous improvement.
  - **Utilize Data for Informed Decision-Making:** Improve climate data accessibility in KP to inform policy and program development.

Log Framework

In order to implement the recommendations, the following log framework is proposed:

LOG FRAME WORK			
Activity	Action by	Timeline	Cost PKR (M)
Strengthening Capacity Building of the policy makers and field staff	PDMA, EPA,	Short & Medium	Regular Activity
Boosting Mass Awareness Efforts **Ring tone Generation:**	PTA, Info. Deptt, Envt Deptt, EPA, PDMA	Short term (occasional)	Regular Activity
Conduct research for the use of Artificial Intelligence	NDMA/PDMA, Envt Dept, EPA & P&D Deptt	Medium term	Project (PSDP & ADP)
Introducing On line training	PDMA, Envt dept. EPA KP	Short term (occasional)	Regular Activity
Encourage and facilitated the Academia/research on the scientific dimension of climate change	HED and Universities	Long Term	Project (PSDP & ADP)

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Climate-Adaptive Infrastructure and Environmentally Sustainable Urban Growth

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Abstract:

This research paper addresses the critical issue of urban growth in Pakistan amidst the challenges posed by climate change, including urban flooding, heat, and rising energy demands. While developed nations are exploring advanced theoretical frameworks and policies for sustainable urbanization, Pakistan grapples with severe environmental vulnerabilities exacerbated by inadequate land-use planning and ineffective climate strategies. Focusing on Khyber Pakhtunkhwa – a region particularly susceptible to climate hazards – this study advocates for the implementation of climate-adaptive infrastructure as a solution to mitigate the impacts of climate change. The paper highlights Pakistan's legislative efforts, including the Pakistan Climate Change Act of 2017, and critiques the gaps between policy and actionable outcomes. Through a review of current urban planning initiatives and recommendations for improved governance and stakeholder engagement, the study underscores the necessity for context-specific strategies and the integration of green building codes. Ultimately, the findings suggest that addressing institutional limitations and enhancing resource allocation are vital for transitioning towards a resilient and sustainable urban framework in Pakistan.

Key words:

Urban Growth, Climate Change, Khyber Pakhtunkhwa, Climate-Adaptive Infrastructure, Sustainable Urbanization

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Introduction

The daunting challenge of unprecedented urban growth, in view of climate change issues, changing patterns of land use, urban flooding, urban heat, carbon emissions, and rising energy demands, is increasingly dominating the policy agenda worldwide (Desa, 2014; Desa, 2019; cited in Rayan et al., 2021). While the developed world is considering multiple theoretical frameworks and instrumental approaches, such as Urban Green Infrastructure modeling as a resilience tool (Davies et al., 2005), urban landscape and greening policies (Naeem et al., 2018), and enhancing the health of urban ecosystems (Weber and Allen, 2010) to mitigate their rapidly transforming urban outlook—moving beyond the concept of achieving urban sustainability—Pakistan is still struggling with floods, droughts, uncontrolled migration, and a major shift from agricultural land to poorly planned urban housing schemes to meet the demands of migrants (Tzoulas et al., 2007). Pakistan is among the top ten countries in the world (ranked eighth) considered most vulnerable to natural hazards, according to the long-term climate risk index (CRI) of German Watch (Eckstein et al., 2020), due to limited resources and poor planning (Ahsan, 2018). This leaves, among other regions of the country, the north-western region (Khyber Pakhtunkhwa) at relatively higher risk due to its natural geophysical position and the absence of strategic land use planning processes, urban green infrastructures, and climate change strategies to mitigate these multiple hazards (Khayyam and Noreen, 2020). Building resilient and climate-adaptive infrastructures, and planning green spaces to address climate variation through integrated planning instruments, can harness the potential for the protection, restoration, and advancement of ecological and economic benefits for the people (Gill et al., 2007; Rayan, Gruehn & Khayyam, 2021).

The shift towards Climate-Adaptive Infrastructure as a remedy is being advocated in literary sources as well as national, sub-national, and global forums, as a strategic intervention to mitigate the various hazards of climate change. Adaptation is the planned, responsive process of a nation's adjustments in their ecological, economic, and social systems to mitigate both existing and predicted climate change stimuli and their adverse impacts, reducing vulnerabilities and increasing resilience through active and knowledge-based stakeholder engagement to protect livelihoods and ecosystems. This can involve building flood protection measures, early warning systems, drought-resistant cropping practices, redesigning systems, and efficiently enforcing governmental policies (UNFCCC, 2024; GCA, 2024). Climate-adaptive infrastructure, while addressing public needs amidst growing population and urbanization, simultaneously addresses the risks and opportunities of the "accelerating climate crisis." Similarly, climate-resilient infrastructure is "planned, designed, built, and operated" to comply with and respond to climate

impacts, with the ability to withstand climate impacts and recover early and easily in case of disruption (CAI, 2024; Cho, 2024). Adaptation refers to the process and ability of adjusting to actual and expected climate change effects, whereas resilience refers to the capacity to bounce back from the hazards of climate change and withstand such challenges (DLA, 2023).

On a further and ideal note, a climate-adaptive city reflects effective resource management, a low-carbon economy, adaptability, resilience, future-oriented planning, innovation, sustainability, and the capacity of stakeholders to cope with the impacts and negative consequences of climate change (Yari et al., 2024). Environmentally sustainable urban growth involves housing, transportation, energy, water, waste, food, and health standards, while also addressing heritage preservation, disaster planning, and urban-rural linkages in a holistic manner to support growing urban populations, ensuring sustainable livelihoods, improved quality of life, and minimizing the environmental impact of such growth. However, it is equally important to note that population diversity and city size—for instance, cities like Manila and Beijing, with populations almost ten times larger than individual countries like Slovenia and Lesotho—cannot be considered for similar climate change solutions. Likewise, the geographic location of coastal cities compared to cities with water scarcity issues, given their context-specific characteristics, cannot be addressed equally for climate change mitigation (Yari et al., 2024).

The growth of urban centers and cities involves land use intensity, density, and transportation, with a trend toward minimizing the human footprint. As a result, the application of efficient green technologies is necessary to pave the way for sustainable urban growth, with the ideal goal of a development process that has the potential to LAST (Life Cycle, Aesthetics, Scale, Technologies) across an indefinite period (Calendar, 2012).

Pakistan's Response

As a responsible state, Pakistan has ratified all the global conventions on climate change and, as an appreciable step, has passed the Pakistan Climate Change Act, 2017, as a commitment "to meet Pakistan's obligations under international conventions relating to climate change and to provide for the adoption of comprehensive adaptation and mitigation policies, plans, programmes, projects, and other measures required to address the effects of climate change." The Act further calls for the establishment of the Pakistan Climate Change Council under the Prime Minister, with Provincial Chief Ministers as members (Section 3 of the Act), and an Authority (Section 5 of the Act Ibid.). Pakistan has explicitly ratified the following conventions in their entirety as overarching guiding sources of action against climate change: United Nations Framework Convention on Climate Change (UNFCCC), Rio De Janeiro, 1992; Kyoto Protocol to the UNFCCC, 1997; and the Paris Agreement, 2015. The Act was preceded by the National Climate Change Policy 2012 (updated in 2021), the National Sustainable Development Strategy 2012, the Pakistan Environmental Protection Act 1997, the Pakistan Climate Change Action Plan 2021-25, and the Framework for Implementation of Climate Change Policy 2014-30, along with a multitude of cross-cutting climate change legislative actions in other sectors like irrigation, agriculture, energy and power, disaster risk management, etc., in addition to assigning climate change responsibilities to the Federal Ministry of Climate Change.

The Federal Government updated the National Climate Change Policy in 2021, which includes initiatives like the Ten Billion Tree Tsunami Project and the Prime Minister's Urban Forest Project (inspired by the Japanese Miyawaki technique, which enables trees to grow 10 times faster and 30 times denser; 21 sites in Islamabad and 51 in Lahore were selected), Clean Green Pakistan, and Protected Areas and National Park Initiatives, with a vision to increase the forest area by at least 15%. The updated policy emphasizes the Eco-System Restoration Initiative (ESRI) as a key initiative for an environmentally resilient Pakistan (NCCP 2021).

Priorities in urban planning include a focus on technological innovation in urban planning and transport, changing energy consumption and building construction patterns, integrated and biodegradable waste management systems, wastewater treatment plants, promoting private sector involvement in designing zero-emission buildings through renewable energy, land use planning and zoning, and the development and adoption of a Green Building Code (NCCP, 2021). A Climate-Resilient Urban Human Settlements Unit has been established in the Ministry of Climate Change, which is currently working on the Climate Change Resilient Urban Human Settlement Strategy.

Statement of the Problem

Unprecedented rapid urbanization, mainly due to population explosion in recent decades, has gradually evolved into a multidisciplinary climate challenge across the country, especially in major metropolitan cities, including Khyber Pakhtunkhwa, with Peshawar as the province's major metropolitan city, along with the volatile northern region. Adherence to the principle of climate-adaptive infrastructure and environmentally sustainable urban growth lies at the core of all local, national, and global public policy debates and strategies as the first step in the right time and direction. The public perception of the ground situation is a mix of both improvement, in terms of vertical buildings, shopping malls, and public transport with reduced carbon emissions, and worsening, in terms of repeated urban floods, emissions, traffic chaos, poorly planned drainage and sewerage systems, and increasing heatwaves. This paper will undertake a detailed review of the actions and strategies of the government and concerned agencies, with the aim of identifying the Khyber Pakhtunkhwa government's alignment with climate change goals, as well as gaps in the process. It will assess whether efforts to mitigate climate change challenges—especially in pursuing climate-adaptive infrastructure and environmentally sustainable urban growth—are on the right track, in order to facilitate the development of workable recommendations for policy action by the government.

Scope and Significance of the Study

The issue of climate change, being global in nature, has primarily been viewed from a national perspective owing to Pakistan’s ratification of global charters. However, the explicit focus of this study is on the case of Khyber Pakhtunkhwa, a prime province prone to climate change issues and inherently vulnerable to natural climate variability hazards, including floods, major river outflows, and a limited revenue and resource base to tackle such complex issues. The case of Peshawar, as the major provincial metropolis, has been examined in further detail to gather evidence of actions taken and to identify gaps in achieving the goals of climate-adaptive infrastructure and environmentally sustainable urban growth. The study is limited to urban growth and development, with a focus on the Urban Policy Unit of the Planning and Development Department and the Peshawar Development Authority, both of which are central to the area under analysis, while also taking input from other relevant agencies. The study will revolve around the existing pace of progress in the urban sector in the direction of climate mitigation, viewed through the lenses of adaptation and resilience, to highlight environmentally sustainable urban growth, the progress achieved, and the gaps that remain.

Methodology

Reliance has been placed on deductive analysis of the available literature and the information retrieved from the concerned government agencies involved in urban planning and development. A major emphasis has been placed on deductive analysis through a mix of qualitative and quantitative methods to support the objectives of this paper. Further reliance is placed on discourse analysis and a literature review of the most relevant papers accessed on the subject. Simultaneous government and international agencies' reports, legislative documents, parliamentary acts, etc., have also been reviewed through a deep analytical lens. Ethical considerations are prioritized. Time limitations are a key point in undertaking the research, as this is a multifaceted issue requiring in-depth analysis. The key area of analysis also includes consultation with relevant government agencies through direct interviews and critical discussions.

Analysis

The Khyber Pakhtunkhwa Picture

The Khyber Pakhtunkhwa Environmental Protection Act 2014, Khyber Pakhtunkhwa Climate Change Policy 2022, and Khyber Pakhtunkhwa Climate Change Action Plan 2022 are in line with the recommendations and policy direction of the Federal Climate Change Policy 2021, aiming to reduce the vulnerabilities of natural and human systems and decrease emissions through technology-based solutions.

The constituents of the policy include the primary idea of promoting urban and peri-urban forestry through plantation drives on highways and near high-rise buildings, solid waste management, carbon sequestration, energy efficiency and conservation, low-emission transport sector development, relocation of hazardous industries, strengthening the urban policy structure—including city development agencies, land use zoning, promotion of vertical buildings in urban areas, and spatial planning for urban development—for a target of 22 metropolitan regions in the province. According to the most recent dialogues with the IMF, it was acknowledged that the land and building acts of Khyber Pakhtunkhwa (up to 2021) have been addressing several key factors related to natural hazards, the availability of green spaces, and the types and structures of buildings, which is a positive sign.

Key projects funded by the World Bank include the Community Infrastructure Program (CIP II), with an Environmental Management Plan as one of its key objectives at the district, tehsil, and community levels. Additionally, the Khyber Pakhtunkhwa Rural Investment and Institutional Support Project and the Rural Water Supply and Sanitation

Project are addressing various environmental concerns from different angles at the tertiary levels of the province. The progress in action by the province can be assessed through the following table from the donors' reports:

Provinces Climate-focused Action and Investment Plans

Province	Climate Focused Action Plan
Baluchistan	Baluchistan has not yet formulated a climate plan that links with the NCCP.
Khyber Pakhtunkhwa	The Khyber Pakhtunkhwa Climate Change Policy 2022 aims to reduce the vulnerability of natural and human systems as well as lessen greenhouse gas emissions through technological or nature-based solutions. The policy is aligned with the NCCP. The policy also has an action plan and investment plan that outlines specific measures and activities for achieving its objectives in relevant sectors. The action plan identifies potential sources of financing and implementation mechanisms for each sector.
Punjab	The Punjab Provincial Climate Change Action Plan contains planned actions and projects to improve climate change resilience and achieve mitigation targets, but these are not costed.
Sindh	Sindh developed a Provincial Climate Change Policy in 2022 and a Provincial Climate Change Action Plan with the support of UNDP.

Ministry of Planning, Development and Special Initiatives, Government of Pakistan 4o mini

In the following sections, major actors and their roles in the climate change front have been elaborated in order of actions and priorities:

The Actors

A-1 Planning & Development Department: responsible for overall planning management and coordination of all policies and procedures concerning development, including the preparation and approval of the provincial development programme.

A-2 Urban Policy Unit: established under the Planning & Development Department as a focused body to tackle the urban policies of the province.

B-1 Local Government, Elections and Rural Development Department: being the custodian of the entire local government system in the province, it has

further been mandated with the regulation of climate change rules and regulations through the local governments at the district and tehsil levels in line with the Khyber Pakhtunkhwa Local Government Act 2013.

B-2 Peshawar Development Authority: the main administrative body under the LG&RD Department, overseeing major urban areas of the provincial metropolis, including Hayatabad, Regi Model Town, and limited surrounding areas, including building control, rules, regulations, and by-laws.

C-1 Climate Change, Forestry, Environment & Wildlife Department: the main climate response department of the province, responsible for environment, forestry, wildlife, and biodiversity, and in charge of formulating, implementing, and coordinating climate change policies with the federal ministry of climate change.

C-2 Environmental Protection Agency: the main regulatory body for the formulation, execution, and enforcement of environmental protection policies in the province, working under the Climate Change, Forestry, Environment, and Wildlife Department.

D-1 Transport Department: responsible for the preparation and implementation of transport policies in the province.

D-2 Provincial Urban Mobility Authority: a recently established authority mandated to formulate urban mobility policies and mechanisms in line with the emerging demands of the province, especially rapid urbanization.

E-1 Private Sector, Civil Society, and Community.

The Factors

A-1 Planning, Coordination, Monitoring, and Evaluation: including Public Investment Management Assessment (PIMA) and the recently approved Climate-PIMA and 5Es Framework at the heart of all climate change policies, under the guiding principles of the Federal Ministry of Planning, Development, and Special Initiatives.

Climate-PIMA:

On the recommendations of the multilateral partners, the Government of Pakistan pledged to initiate a comprehensive Public Investment Management Assessment (PIMA) to translate the public investment objectives into reality from all dimensions. Recently, after approval by the Federal Cabinet, the National Economic Council (NEC) also approved the Climate-PIMA to make it an integral part of the entire public sector development programme. Preceding the most recent bailout and structural adjustment package from the International Monetary Fund (IMF), a detailed technical assistance study was carried out by the IMF in August 2023, approved in November 2023, and finalized in June 2024. All provinces, including Khyber Pakhtunkhwa, have been directed to integrate the Climate-PIMA into the entire planning process to ensure climate-aware planning from project inception, appraisal, selection, to approval and execution, while also ensuring the best value for public investments and effective climate risk management.

*Source: Ministry of PD&SI, GOP

5Es Framework

Recently approved by the Federal Government and disseminated to all provinces for strict adherence, the 5Es Framework serves as a short- to medium-term strategy for achieving Vision 2025, encompassing five major areas: Exports, E-Pakistan, Environment and Climate Change, Energy and Infrastructure, and Equity and Empowerment. The Government of Pakistan has committed to planning Climate-Smart Municipal Services for mitigation and adaptation targets, Nature-Based Solutions (NbS), Green Infrastructure for flood control and groundwater recharge, Green Building Codes for the public sector, the National Flood Protection Plan for urban flooding, and land use planning and community engagement to raise awareness. The idea of Green Infrastructure for Resilient Cities is also at the forefront of the 5Es Framework. Additionally, a comprehensive National Climate Finance Framework is being envisioned.

5Es Framework

*Source: Ministry of PD&SI, GOP

Climate Markers

The following tables reflect the overall picture of the Provincial Annual Development Programme 2023-24 of Khyber Pakhtunkhwa, showcasing various sectors addressing the climate change issue from specific angles as a first step in planning for climate action. There is, however, a need to strengthen the existing capacities of the provincial departments as well as the districts to maintain harmony in this regard. To this effect, a climate-specific digitalization initiative is being planned in the Ministry of Climate Change as the central secretariat. The tables highlight the ability and extent of various sectors, based on data from individual projects, to accommodate and plan climate-specific interventions, including adaptation, mitigation, and further cross-cutting interventions and rehabilitation initiatives for prior climate hazards. A further exercise has been undertaken to bifurcate the partial or complete/full climate compliance of these projects on a sector basis (Table-1). Similarly, the data has been quantified.

Table-1: Khyber Pakhtunkhwa ADP 2023-24 showing Climate Response

Sector	Adaptation	Cross-Cutting	Mitigation	Post Disaster Rehab.	Total	Partially Compliant	Fully Compliant	Total
Agriculture	**15**	**1**	**4**		**20**	**14**	**6**	**20**
Elementary & Secondary Education	**72**		**9**		**81**	**69**	**12**	**81**
Energy & Power		**23**	**23**	**1**	**47**	**28**	**19**	**47**
Environment			**4**		**4**		**4**	**4**
Forestry	**12**		**17**		**29**	**7**	**22**	**29**
Industries	**1**	**3**	**10**		**14**	**13**	**1**	**14**
Livestock & Dairy Development	**6**		**3**		**9**	**6**	**3**	**9**
Roads	**277**	**19**	**3**	**6**	**305**	**287**	**18**	**305**
Tourism	**14**	**4**	**17**	**1**	**36**	**26**	**10**	**36**
Transport			**2**		**2**	**2**		**2**
Water	**50**	**50**	**50**	**50**	**200**	**87**	**113**	**200**
Total:	**447**	**100**	**142**	**58**	**747**	**539**	**208**	**747**

Source: Planning and Development Department, Khyber Pakhtunkhwa, Annual Development Programme 2023-24

Table: ADP 2024-25 Showing Financial Contribution to Climate Change Initiatives

Sector Name	Allocation	Climate Schemes Allocation	% share in Climate
Agriculture	4629.84	1714.971	37%
Auqaf, Hajj, Religious & Minority Affairs	1164.68		
Board of Revenue	1486.57		
Drinking Water & Sanitation	6676.50		
Elementary & Secondary Education	10583.67	9761.905	92%
Energy & Power	4107.18	3849.678	94%
Environment	67.17	67.173	100%
Establishment & Administration	756.79		
Excise, Taxation & Narcotics Control	177.60		
Finance	20.00		
Food	309.00		
Forestry	3124.68	1823.246	58%
Health	19786.41		
Higher Education	4674.89		
Home	6544.99		
Housing	302.01		
Industries	2224.16	944.214	42%
Information	71.50		
Labour	152.94		
Law & Justice	2146.90		
Livestock & Dairy Development	2718.72	885.772	33%
Local Government	3387.99		
Mines & Minerals	217.66		
Multi Sectoral Development	51310.14		
Population Welfare	499.00		
Public Private Partnership	224.00		
Relief & Rehabilitation	1640.69		
Roads	27715.67	20751.877	75%
Science Technology & Information Technology	1167.96		
Social Welfare	1338.92		
Sports	6630.57		

Sector Name	Allocation	Climate Schemes Allocation	% share in Climate
Tourism	3282.87	2933.721	89%
Transport	104.19	68.682	66%
Urban Development	7560.06		
Water	13194.06	12804.842	97%
Grand Total:	**190,000.00**	**55606.081**	**29%**

Source: Planning and Development Department, Khyber Pakhtunkhwa, Annual Development Programme 2023-24

A-2 Land use planning, zoning, and city master plans serve as technical support to the execution department, i.e., the Local Government and Rural Development Department.

B-1 Implementation and enforcement occur primarily through the local government system (not yet in place) and the devolved Tehsil-level municipal administration. The LG Act 2013 is in place; however, the Provincial Land Use and Building Control Act 2021 has also been enacted.

B-2 The Rapid Bus Transit (BRT) system has achieved international gold standard awards, significantly minimizing carbon emissions.

C-1 The Provincial Climate Change Policy 2022 and Climate Change Action Plan 2022 have been prepared to complement the Federal Climate Change Policy through the Environmental Protection Agency. The province pioneered the flagship Billion Trees Tsunami Project successfully and is further executing federal programs such as the Ten Billion Trees Tsunami and Green Pakistan initiatives.

C-2 Overall enforcement of IEE/EIA is especially important in the planning, appraisal, and approval process of developmental projects.

D-1 The Transport Department is developing new policies and projects, including traffic management plans, particularly in urban areas.

D-2 The KP Urban Mobility Authority is in place but has yet to fully address the rising demands and challenges of rapid urbanization. It has been established to construct, develop, operate, and maintain the mass transit system and supporting systems. The operation of the major mass transit system, Peshawar BRT, has also been assigned to the authority.

E-1 Engagement with the private sector, civil society, and the community has so far remained limited to a few forestry initiatives, particularly in the mass plantation drives of the flagship projects.

Comparative Analysis with International Best Practices

A unique example of an environmentally sustainable urban growth model is Masdar City in Abu Dhabi, designed as a zero-carbon, zero-waste city powered by wind and solar energy. It produces no greenhouse emissions, incorporates water recycling and composting, and promotes green transportation, mostly electric, along with energy-efficient buildings, minimizing its ecological footprint. The city has planned innovative technologies, including a Smart Grid system, a 10MW solar farm, advanced battery systems, sustainable construction materials, and atmospheric water

harvesting facilities, with the potential for job creation, research and development, and an institute of science and technology. In 2015, it was declared by Forbes as the greenest city in the world.

Prominent examples of climate-adaptive infrastructures in the West include seawalls and coastal protection, flood-resilient design, green infrastructure, climate-resilient water management, heat island mitigation, climate-resilient transportation, smart grids, and energy efficiency. Similarly, initiatives addressing environmentally sustainable urban growth include the use of renewable energy, the establishment of green spaces, a shift to green transportation, innovation in waste management, construction of energy-efficient buildings, water conservation, innovative urban planning, and green architecture. A detailed outline of the aforementioned initiatives has been provided in Table "X" appended to this paper for reference.

Application of Analytical Models

PESTLE Analysis

Political	The call and need for Climate-Adaptive infrastructure due to the frequency of natural and climate hazards especially floods both in the northern hilly areas and the urban areas, has attained political significance in the recent decades.
Economic	Demand for addressing climate change issues through resilience, mitigation and adaptation warrants to be placed as an economic priority in all governmental planning and policy formulation due to involvement of the factor of security of life and properties of humans. Proper resourcing needs to be aligned with all policies and planning across sectors.
Social	Healthy, safe and secure human life being the priority of state agencies require major consideration in all climate change policies. The need for climate-adaptive infrastructure for instance securing the people from the hazards of repeated floods in swat and Kabul rivers warrants prioritization through mitigating policies under the flood protection measures, rapid response and early warning systems, disaster risk reduction and management, rivers embankments, enforcement of anti-river encroachment drives and above all building construction protocols for maximizing public safety and benefits on the one hand and reducing burden of rehabilitation portfolios on the public exchequer on the other hand.
Technological	The need for new technological additions to the existing policies of introducing innovative climate-adaptive infrastructure is gaining momentum. The current shift towards solarization in view of the ever-increasing energy shortfall is one example besides the growing trend of using hybrid and electric vehicles. On a similar note, new climate-aware technologies are needed in introducing environmentally safe, cost-effective and energy friendly construction patterns in urban areas.
Environmental	Flagship projects are in place in the province which needs to be made sustainable and replicated across the province in context-specific scenarios. For example, the Miyawaki model of Japanese

	plantation as being considered by the Federal Government in Islamabad and Lahore can also be studied for implementation.
Legal	Legal frameworks are although in place both at national and provincial levels in line with global commitments, however, these frameworks, policies and legislation still need translation into reality through aggressive implementation plan with an action plan including financing arrangements.

GAP Analysis

Area	Present situation	Desired State	GAPs and Actions Required
Climate-Adaptive Infrastructure	Frequent flooding	Resilient state of rivers	Well-planned river embankments and plantation
	Increasing energy demands	Renewable energy sources	Incentivizing private sector for innovative solutions in green energy investments
	Fossil fuels use for energy projects	Maximizing renewable energy production	Investments and incentivization in solar solutions
	High emission transportation	Green and climate resilient transport systems	Enforcement and regulation; hybrid and electric vehicles import and manufacturing policies (high costs may be relooked) Practice of Cycling lanes in urban roads planning
	Conventional buildings prone to emissions, internal and external	Energy efficient buildings, insulation and heat reduction, energy saving, green roofing, green architecture on international lines	Technology transfer Climate friendly, cost-effective building materials be encouraged. R&D and Industrial-academia linkages be ensured
	Depleting ground water resources	Water conservation and Aquafer recharge systems	Implementation, regulation and enforcement with public awareness. Rainwater harvesting and aquafer recharge systems be promoted.
Environmentally Sustainable	Rapid and unplanned	Land use planning and	

Area	Present situation	Desired State	GAPs and Actions Required
Urban Growth	urbanization	zoning	
	Water logging, salinity. Discharge of non-treated wastewater into river system	Wastewater treatment plants	Investment in sewerage treatment and wastewater treatment plants
	Ill-managed waste disposal	Recycling plants and regulated waste management	Investment and awareness emphasized
	Deforestation	Biodiversity and eco-system	Community awareness, regulation,

SWOT Analysis

STRENGTHS	WEAKNESSES
1- Legal Framework and Policies in place 2- Commitment in line with global ratified conventions 3- Coordination with Federal Government 4- PIMA and Climate-PIMA 5- Centrality of Environment in the 5Es Framework 6- KP Government's progress already lauded by multilateral aid agencies and bilateral donors 7- Commitment to involve private sector, civil society and community	1- Institutional Capacity especially at the districts level 2- Implementation frameworks and timelines yet to be established 3- Financial resourcing 4- Conflicting roles of developers and regulators e.g., PDA, TMAs 5- Digitalization yet to take place
OPPORTUNITIES	**THREATS**
1- Learning opportunities from international best practices 2- Donors' commitment to the	1- Rising energy demands versus fossil fuels e.g., IPP issue 2- Rapid urbanization

extent of US$ 12 billion can be directed towards climate-change (ref: IMF's bail out package of US$ 7 billion) 3- Carbon market and carbon financing 4- Private sector engagement in innovative climate solutions	3- Climate impacts 4- Frequency of floods 5- Existing focus on prior rehabilitation works

Issues and Challenges

Climate-Adaptive Infrastructure:

1. Continuous flood risks in the northern regions of the province as well as in settled districts along the banks of the Kabul and Swat rivers.
2. Landslides and soil erosion due to forest cutting or flood damage, especially during cloudbursts and flash rains.
3. Ill-managed, ill-planned, and uncontrolled construction practices.
4. Energy shortages hindering economic activity.
5. Heatwaves and rising temperatures correlated with building structures and energy demands.

Environmentally Sustainable Urban Growth:

1. Rapid urbanization, growth strains, and increasing loads on energy supply, services, and road infrastructure.
2. Air and water pollution and loss of biodiversity.
3. Inadequate waste management, wastewater disposal, drainage, and sewerage systems, resulting in a major shortfall of sewage treatment plants.
4. Inadequate public transportation, contributing to increased emissions.
5. Neglected private sector involvement to help reduce the financial burden on the public sector.

Conclusion

Recollecting from the analysis of the paper, especially the role of the actors and their contributing factors, as well as the analysis part, it is evident that despite a serious level of commitment to climate change action, there are still visible gaps that need to be addressed. Khyber Pakhtunkhwa, while at the forefront of progressing on the climate change agenda on several accounts, is also the most hazard-hit province. It needs to translate the already framed policies into actions. Limitations in institutional capacities and frameworks, as well as the need for updating existing policies and action plans into reality, are key challenges, along with the financial factor.

Although prima facie, the provincial ADP 2024-25 shows 29% of resources across various sectors flowing towards climate change actions as partial or full compliance—appearing to be a commendable approach—a review from a critical perspective, as observed by donor agencies, indicates that explicit actions are still needed to reap the benefits of such a strategy. The most

recent IMF conditionality is thus directed and aimed in the right direction to lay more emphasis on the adoption of both the 5Es Framework and Climate-PIMA in the entire planning process.

It is of pivotal importance that bilateral and multilateral donors, upon the recommendation of the IMF, are also considering a funding package estimated at US$ 12 billion, wherein climate change is a priority area. This funding can be envisioned as a major source of contribution to the government's plans and strategies, alongside learning from international best practices. In a similar vein, the land use zoning and planning exercise for all the remaining districts (29 pending so far) by the Urban Policy Unit also needs to be first aligned with the emerging climate challenges. Furthermore, through the application of green building codes, it should be integrated for strict adherence to climate-adaptive infrastructure and environmentally sustainable urban growth. The penultimate goal of making Khyber Pakhtunkhwa a Green Province will thus be achieved accordingly.

Recommendations

1. There is a need for a comprehensive national and provincial strategy incorporating adaptation plans at the city levels (context-specific while taking cognizance of the Urban Policy Unit's prior land use zoning; 6 districts completed and 29 in the pipeline; and master plans as and when finalized) to facilitate the Provincial Climate Change Policy 2022 and Action Plan Target of 22 Metropolitan Regions in a realistic manner.
2. Region-specific Green Building Codes should be accorded top priority to ensure climate-aware planning.
3. The environmental component of the 5Es Framework and the Climate-PIMA needs to be explicitly embedded within the public investment portfolio, i.e., the Provincial ADP, especially in the environmental cross-cutting sectors. Limited resources should be prioritized and directed in this direction with clear indicators for periodic monitoring.
4. There should be an emphasis on planning coordination, monitoring, and capacity building of the stakeholders to achieve the desired output in line with the Provincial and Federal policies concerning climate change.
5. All existing urban planning guidelines and building by-laws must be aligned with the above-mentioned recommendations.

Operational Plan (Logical Framework Analysis)

#	Action	Responsibility	Resourcing	Timeline	KPI
1	Integration of 5Es Framework into the entire planning process	P&D Department	P&D Department	1 to 2 Years	Climate-Aware Planning
2	Application of Climate-PIMA into the ADP process and projects	P&D Departments and Line Departments	Collective under supervision of Climate Cell of P&D Department. Donor funding options open. MOCC can be consulted soon.	1 to 2 years	Climate Change Compliance of public investments
3	Institutional Capacity Building of all stakeholders	Collective responsibility under supervision of P&D Department	Donor funding options through MOCC	1 to 3 years	Coping ability
4	Green Building Code	C&W, Finance, EPA, UPU, LG&RD	P&D and Finance Departments	1 to 2 years	Climate resilient infrastructure
5	Climate-adaptive infrastructure	Collective	Diverting resources and shifting priorities for funding from available sources till exploration of donor assistance	1 to 2 years and continued onwards	Multiple indicators
6	Environmentally sustainable urban growth	Collective	Reordering investment priorities	As above	Climate response
7	Adopt the slogan of KP Climate Governance	P&D Department with stakeholders	Monitoring progress on 5Es and C-PIMA	1-5 years medium 5-10 years long term Intervention	Green KP

Table-"X"
A Quick Look at Some Global Examples

Climate-Adaptive Infrastructure	Environmentally Sustainable Urban Growth
1. Sea walls and coastal protection 2. Flood-resilient design 3. Green infrastructure 4. Climate-resilient water management 5. Heat island mitigation 6. Climate-resilient transportation 7. Smart grids and energy efficiency	1. Renewable energy 2. Green spaces 3. Green transportation 4. Waste management 5. Energy-efficient buildings 6. Water conservation 7. Innovative urban planning 8. Green architecture
Sea Walls and Coastal Protection: 1. Rotterdam, Netherlands: Maasvlakte 2 sea wall. 2. New York City, USA: Staten Island seawall. 3. Miami, USA: Sea wall and beach nourishment. 4. Singapore: Coastal protection measures. 5. Copenhagen, Denmark: Coastal protection and flood gates. **Flood-Resilient Design:** 1. Amsterdam, Netherlands: Floating homes and flood-resistant buildings. 2. Venice, Italy: MOSE floodgate project. 3. Hamburg, Germany: Flood-resilient urban design. 4. Bangkok, Thailand: Flood protection walls and canals. 5. Jakarta, Indonesia: Giant Sea wall and flood control project. **Green Infrastructure:** 1. Chicago, USA: Green roofs and urban forestry.	**Europe:** 1. Copenhagen, Denmark: Carbon-neutral city by 2025. 2. Stockholm, Sweden: Green spaces, public transport, waste-to-energy. 3. Barcelona, Spain: Superblock program, pedestrian-friendly streets. 4. Amsterdam, Netherlands: Canal-based transportation, green roofs. 5. Freiburg, Germany: Solar-powered city, green architecture. **North America:** 1. Vancouver, Canada: Greenest City Action Plan, renewable energy. 2. San Francisco, USA: Zero-waste policy, green buildings. 3. New York City, USA: Green infrastructure, sustainable transportation. 4. Portland, USA: Walkable neighborhoods, green spaces. 5. Toronto, Canada: Green roof bylaw, public transportation. **Asia:** 1. Singapore: Urban planning,

2. Tokyo, Japan: Green spaces and urban parks. 3. Copenhagen, Denmark: Green roofs and green spaces. 4. Vancouver, Canada: Greenest City Action Plan. 5. Singapore: Gardens by the Bay and green infrastructure. **Climate-Resilient Water Management:** 1. Copenhagen, Denmark: Rainwater harvesting and green roofs. 2. Rotterdam, Netherlands: Water-sensitive urban design. 3. Singapore: Water management system and rainwater harvesting. 4. Melbourne, Australia: Water-sensitive urban design. 5. New York City, USA: Green infrastructure for stormwater management. **Heat Island Mitigation:** 1. Phoenix, USA: Urban forestry and cool pavement. 2. Los Angeles, USA: Cool pavement and urban forestry. 3. Tokyo, Japan: Green spaces and heat island mitigation. 4. Paris, France: Urban forestry and cool roofs. 5. Melbourne, Australia: Urban forestry and green spaces. **Climate-Resilient Transportation:** 1. Copenhagen, Denmark: Bike-friendly infrastructure and electric buses. 2. Amsterdam, Netherlands: Electric vehicles and bike-sharing. 3. San Francisco, USA: Electric buses and green transportation.	green infrastructure, water management. 2. Tokyo, Japan: Energy-efficient buildings, public transportation. 3. Seoul, South Korea: Green spaces, bike-sharing, renewable energy. 4. Hong Kong: Public transportation, green architecture. 5. Curitiba, Brazil: Innovative urban planning, green spaces. **South America:** 1. Curitiba, Brazil: Green spaces, public transportation. 2. Medellín, Colombia: Urban renewal, green infrastructure. 3. Buenos Aires, Argentina: Bike-sharing, green spaces. **Africa:** 1. Cape Town, South Africa: Renewable energy, water conservation. 2. Nairobi, Kenya: Green spaces, public transportation. **Middle East:** Dubai, UAE: Sustainable transportation, green buildings. **Oceania:** 1. Sydney, Australia: Green spaces, public transportation. 2. Melbourne, Australia: Sustainable transportation, green architecture.

4. Vancouver, Canada: Green transportation and bike-friendly infrastructure. 5. Singapore: Electric vehicles and autonomous transportation. **Smart Grids and Energy Efficiency:** 1. Barcelona, Spain: Smart grid and energy efficiency. 2. Copenhagen, Denmark: District heating and smart grid. 3. Singapore: Smart grid and energy efficiency. 4. Tokyo, Japan: Smart grid and energy efficiency. 5. New York City, USA: Smart grid and energy efficiency.	
Climate-adaptive infrastructure in India	**Environmentally Sustainable Urban Growth in India**
Flood-Resilient Cities: Flood protection walls, tidal gates, and stormwater drainage system in Mumbai, Chennai, Tamil Nadu, Kolkata, West Bengal, Ahmedabad and Surat in Gujarat. Green Infrastructure: Green spaces, urban forestry, lakes restoration, watershed management, stormwater harvesting in Bengaluru, Karnataka, Hyderabad, Telangana, Pune, Chandigarh, Delhi (urban forestry and waste-to-energy plants. Climate-Resilient Water Management: Rainwater harvesting, graywater reuse in Chennai, Tamil Nadu, Bengaluru, Karnataka, Hyderabad, Telangana, Ahmedabad, Gujarat	Green Cities: Green spaces, lakes, parks and gardens in major cities of Pune, Bengaluru. Chandigarh: Designed by Le Corbusier, it's a planned city with ample green spaces. Mysuru, Karnataka: Has a strong focus on sanitation, waste management, and green initiatives. Thiruvananthapuram, Kerala: Known for its greenery, clean beaches, and eco-tourism. Smart Cities: 1. Bhubaneswar, Odisha: Selected as one of the first Smart Cities in India. 2. Ahmedabad, Gujarat: Has implemented various smart city initiatives. 3. Surat, Gujarat: Known for its IT infrastructure, smart traffic management. 4. Indore, Madhya Pradesh:

Indore, Madhya Pradesh. Heat Island Mitigation: Cool pavement, urban forestry, and green spaces, cool roofs in Ahmedabad, Gujarat, Pune, Maharashtra, Bengaluru, Karnataka, Hyderabad, Telangana, Delhi. Climate-Resilient Transportation and Smart Grids and Energy Efficiency Initiatives: Electric buses, metro expansion, non-motorized transport infrastructure in Delhi, Mumbai, Maharashtra, Bengaluru, Karnataka, Hyderabad, Telangana and Pune, Maharashtra.	Implemented smart city initiatives, including waste management. 5. Jaipur, Rajasthan: Has implemented smart city initiatives, including public transportation. Sustainable Transportation: 1. Delhi: Has expanded its metro network, promoting public transportation. 2. Mumbai, Maharashtra: Has implemented bus rapid transit (BRT) systems. 3. Bengaluru, Karnataka: Has introduced electric buses and bike-sharing. 4. Pune, Maharashtra: Has implemented bike-sharing and public bicycle systems. 5. Chandigarh: Has introduced electric buses and non-motorized transport infrastructure. Waste Management: 1. Mysuru, Karnataka: Known for its efficient waste management system. 2. Pune, Maharashtra: Has implemented waste-to-energy plants. 3. Bengaluru, Karnataka: Has implemented waste segregation and composting. 4. Thiruvananthapuram, Kerala: Has implemented waste management initiatives. 5. Indore, Madhya Pradesh: Has implemented waste-to-energy plants. Energy Efficiency: 1. Hyderabad, Telangana: Has implemented energy-efficient street lighting. 2. Bengaluru, Karnataka: Has implemented energy-efficient

	buildings. 3. Pune, Maharashtra: Has implemented solar-powered streetlights. 4. Ahmedabad, Gujarat: Has implemented energy-efficient initiatives. 5. Chandigarh: Has implemented energy-efficient buildings. Innovative Urban Planning: 1. Lavasa, Maharashtra: A planned city with sustainable design principles. 2. Navi Mumbai, Maharashtra: A planned city with green spaces and efficient transportation. 3. Gurugram, Haryana: Has implemented innovative urban design principles. 4. Kochi, Kerala: Has implemented innovative urban planning initiatives. 5. Visakhapatnam, Andhra Pradesh: Has implemented smart city initiatives.

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Circular Economy and Sustainable Waste Management

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Abstract:

This research explores the challenges and opportunities of implementing a Circular Economy (CE) for Sustainable Waste Management (SWM) in Pakistan, with a particular focus on Khyber Pakhtunkhwa (KP). Although developed countries have transitioned towards CE, developing nations like Pakistan face technological, human resource, institutional, and financial limitations. Current waste management policies in Pakistan focus primarily on hazardous waste disposal, neglecting broader CE principles such as resource recovery, recycling, and reuse. The study critically examines the legal frameworks, such as the Pakistan Environmental Protection Act, 1997, and the Khyber Pakhtunkhwa Climate Policy 2022, revealing gaps in policy enforcement and regulatory capacity. Through a thorough analysis, the paper presents policy and implementation-level recommendations, including regulatory amendments, incentives for industries, and capacity building. The findings underscore the importance of public-private partnerships (PPP), integration of the informal waste sector, and technological upgrades in modern recycling facilities.

Key words:

Circular economy, Sustainable waste management, Pakistan, Khyber Pakhtunkhwa, public-private partnerships

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Introduction

With the increase in population, conurbations, dependence on processed/furnished materials, and industrialization, waste management is becoming more challenging. Most developed countries have shifted towards a Circular Economy (CE) to ensure Sustainable Waste Management (SWM) (Khan & Ali, 2021). This paradigm shift actively engages people, local bodies, environmental institutions, and industries to responsibly act by reducing, recycling, and reusing waste. However, this shift is a gigantic task that developing countries are struggling to achieve. The challenges of transitioning to a circular economy range from a lack of technological infrastructure to human resource capacity constraints, as well as institutional and financial limitations (Ferronato, 2019).

In this context, this study explores the use of CE in SWM in Pakistan at the federal level and specifically in Khyber Pakhtunkhwa at the provincial level. Pakistan's current policies on waste management predominantly focus on hazardous waste disposal and sanitation; they lack the broader vision of a circular economy, which emphasizes resource recovery, reuse, and sustainable practices (Iqbal et al., 2022). The situation in KP is no exception. Both the federal and KP governments have introduced numerous laws, such as the "Pakistan Environmental Protection Act, 1997," the "Pakistan Climate Change Act, 2017," and the "Khyber Pakhtunkhwa Environmental Protection Act, 2014." Additionally, various policies like the "National Climate Change Policy, 2021," and the "Khyber Pakhtunkhwa Climate Policy 2022" have been implemented. Pakistan established the "Pakistan Environmental Protection Agency," while the KP government established the "Environment Protection Authority." The Capital Development Authority was authorized for waste collection and disposal in the Islamabad Capital Territory. Similarly, KP amended the Local Government Act 2014 (by inserting Section 115(A)) to empower Water and Sanitation Services Companies (WSSCs) for municipal functions of waste collection and disposal, which were previously managed by Tehsil Municipal Administrators (TMAs). However, their performance on the ground is below optimal, raising serious questions about the existing legal and institutional framework. In the global shift towards a circular economy, there is a growing need to assess Pakistan's legal and institutional frameworks to align them with sustainable waste management principles. This paper analyzes the issues, challenges, and opportunities to provide pragmatic suggestions.

Statement of Problem

There is no denying that Pakistan, and especially KP, has made considerable progress in waste management and established new institutions to shift towards a Circular Economy. However, it appears that Pakistan and KP have not fully transitioned to a Circular Economy and Sustainable Waste Management. Therefore, there is a need to review the existing situation, analyze the issues and challenges, and propose a way forward.

Scope

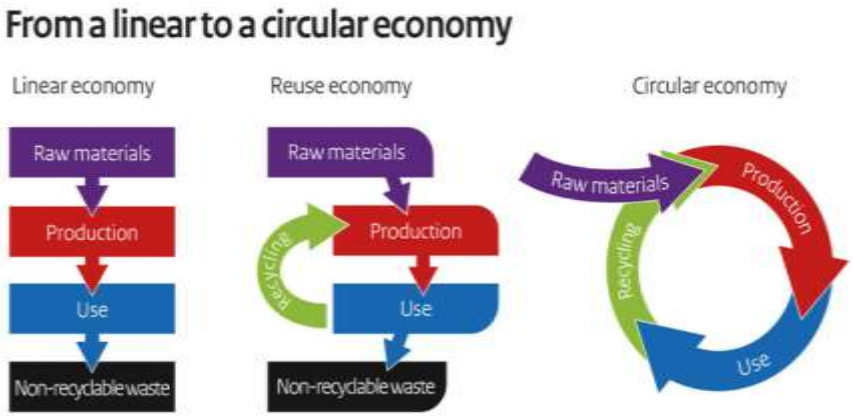
The scope of the research includes an assessment of Pakistan's and KP's existing policies, frameworks, and initiatives aimed at promoting a circular economy. The study will analyze both federal and provincial strategies to determine their effectiveness in addressing waste management challenges. Additionally, the research will explore the roles of key institutions, such as the KPEPA and Water and Sanitation Services Peshawar (WSSP), in implementing sustainable practices. The study aims to identify issues in the current system, examine operational challenges, and provide actionable recommendations for enhancing waste management systems in KP and across Pakistan by integrating circular economy principles.

Research Methodology

This study follows a descriptive analysis consisting of primary and secondary data. Research articles, existing laws, and various reports are analyzed. It further employs analytical tools such as regulatory framework analysis, situational analysis, gap analysis, comparative analysis, PESTEL analysis, SWOT analysis, and EETH analysis for the identification of issues and resolution of the problem.

Circular Economy and Sustainable Waste Management

The CE concepts have garnered significant attention in achieving sustainable development goals in Pakistan. However, the implementation of CE in solid waste management remains a distant dream, as it envisions a transformation of processes from a linear model to CE and SWM, as shown in the diagram below (Contec, 2024).



There are drivers and barriers in the implementation process, as well as multiple dimensions of waste concepts at household and industrial levels. For a country like Pakistan, the concept of CE in SWM is crucial because it produces 3.3 million tons of plastic waste per year, which is higher than the height of K2 (UNDP Report, 2022).

International Obligations

Pakistan is a signatory to the Paris Agreement and, in its Nationally Determined Contribution (NDC), has committed to reducing 50% of its greenhouse gas emissions by 2030. Pakistan has also adopted the Sustainable Development Goals (SDGs), among which SDG No. 13 pertains to climate change. The linked sectors include clean energy, industrial innovation, and sustainable cities and communities. The current estimates of greenhouse gas emissions from the waste sector are unreliable, and no mitigation measures have been planned by the government. These commitments require Pakistan to focus on Circular Economy (CE) and Solid Waste Management (SWM) concepts. Thus, adopting CE becomes a priority, as waste is eliminated in the design of products, materials are used and reused multiple times, and nature thrives due to a reduction in the extraction rate of raw materials (Hazemba, 2023). It will help reduce land and water source pollution, make it easier to quantify GHG emissions, and improve visual aesthetics (ADB, 2019).

Regulatory and Institutional Framework Analysis

Legal Framework

At the federal level, Pakistan's primary environmental legislations, the Pakistan Environmental Protection Act (1997) and the Pakistan Climate Change Act (2017), along with the Khyber Pakhtunkhwa Environmental Protection Act (2014) at the provincial level, provide a general framework for environmental protection but lack specific provisions for Circular Economy (CE) and Solid Waste Management (SWM).

Institutional Framework

Institutions involved in CE and SWM fall into two categories: regulatory institutions and implementing agencies. The Pakistan Environmental Protection Agency and the Khyber Pakhtunkhwa Environmental Protection Agency are the regulatory bodies at the federal and provincial levels, respectively. The implementing bodies include the Capital Development Authority (CDA), the Commerce Division in Islamabad, and in Khyber Pakhtunkhwa, the Water and Sanitation Services Peshawar (WSSP), Water and Sanitation Services Companies (WSSC), Tehsil Municipal Administrations (TMAs), and the Industries Department. The regulatory and implementing bodies at both the federal and provincial levels face similar issues, such as a lack of clear vision, inadequate institutional capacity, and no prioritization of SWM.

Policies

Pakistan's existing waste management policies are primarily focused on hazardous waste and sanitation. Two key policies include:

1. **National Climate Change Policy (2021):** This policy is designed to ensure environmentally sound management.
2. **Khyber Pakhtunkhwa Climate Change Policy (2022):** This policy has relevance to circular economy and waste management but includes broad parameters that have not been properly conveyed to relevant stakeholders. It also lacks specific areas of intervention.
3. **Khyber Pakhtunkhwa Climate Change Action Plan (2022):** Like the policy, the action plan lacks coordinated efforts toward CE and SWM practices. A thorough analysis of the plan reveals that it merely references terminologies and assigns tasks to various departments, but has not resulted in concerted and coordinated efforts.

New Projects

- WSSP has initiated a new project, the "Khyber Pakhtunkhwa Cities Improvement Project," which includes an integrated sustainable waste management system in the Water Supply and Sanitation Companies of Khyber Pakhtunkhwa, worth Rs. 10 billion with assistance from the Asian Development Bank. The project includes a source segregation plant and the reuse of waste material.
- Another project, converting "Waste to Energy in District Peshawar," is in the proposal stage. The project objectives include the CE concept at the provincial level. The Environment Department is seeking a grant of US $900 million. While the objectives seem promising, the estimated amount is inflated and may be difficult to secure.
- Additionally, WSSP is actively working on a public-private partnership model of CE in SWM. The project is based on a Build-Own-Operate (BOO) model, where WSSP will receive a nominal fee. However, this project overlaps with the ADB's Citizen Improvement Project.

Situational Analysis

Current Situation

In Pakistan, recent economic growth has triggered rapid migration toward urban areas. This growth leads to increased municipal solid waste generation, while government institutions are only able to collect 50 to 60% of the total waste (Pak-EPA, 2020).

The country generates approximately 49.6 million tons of solid waste annually, including 30% food waste. Waste generation is increasing by more than 2.4% annually. Like many developing countries, Pakistan faces challenges in waste management infrastructure, resulting in significant environmental issues. In big cities, 60% of solid waste is collected daily, while 40% remains in empty plots, street corners, abandoned buildings, open drains, and nullahs. In rural areas, where municipal services are often non-operational, nearly all garbage stays in open fields, rainwater streams, and street corners. Even 60% of the waste collected by municipal authorities in big cities is disposed of at a few landfill sites (ITA, 2024). Therefore, it is clear that SWM is essential and can be practiced efficiently by incorporating CE concepts.

Current Status of Household Waste Management

a. Solid Waste Generation

Islamabad and Peshawar produce approximately 0.5 to 0.6 kg of waste per person daily, aligning with Pakistan's national averages. Urban centers like Peshawar and Islamabad are the largest contributors, where 60-65% of waste is organic, and 10-15% consists of plastic. Municipal services collect a portion of this waste, but a significant amount remains uncollected or is openly dumped, leading to environmental contamination (World Bank, 2018).

b. Waste Collection and Disposal

Islamabad has comparatively better waste collection services than Peshawar, which has limited coverage, particularly in rural and peri-urban areas. Unsanitary landfill practices are widespread, and open dumping remains the norm, causing land and water contamination. Only a small fraction of the waste generated is processed in an environmentally safe manner (JICA, 2016).

c. Recycling Practices

Recycling practices in Peshawar and Islamabad remain underdeveloped. Although informal recycling activities exist, the overall recycling rate is low. According to WWF-Pakistan (2020), only 10% of plastic waste is

recycled, with the remainder improperly managed, contributing to pollution in rivers and agricultural fields.

Current Status of Industries in Circular Economy

Several industries in Pakistan are shifting toward CE concepts, such as National Foods (reusable glass bottles), Gul Ahmed Textile Mills (recycling textile waste), Engro Polymer and Chemicals (recycling plastic waste, renewable energy), and Waste Buster (composting organic waste and other materials). However, the industry as a whole is lagging in CE adoption. Major companies still operate on a linear economic model and rely on conventional waste disposal techniques.

Issues of Waste Management

a. Inadequate Collection and Segregation

The majority of households do not practice waste segregation, leading to the contamination of recyclable materials (Ali et al., 2020).

b. Plastic Pollution

Plastic waste, especially plastic bags, continues to pollute the environment despite a government ban (Pak-EPA, 2020).

c. Informal Sector Dominance

The informal waste collection sector dominates the waste management system. Waste pickers collect recyclable materials from dumpsites but often lack institutional support or access to modern tools, limiting the efficiency and scale of recycling (Wilson et al., 2012).

d. Lack of Institutional Capacity

WSSP, WSSCs, and TMAs in KP lack the financial and technical resources to build modern waste management infrastructure. There is little investment in recycling or waste-to-energy projects (ADB, 2019). Islamabad has also not implemented CE concepts in SWM due to capacity issues.

e. Industrial-Level Issues

Small industries in isolated areas and industrial parks are neither energy-efficient nor working on sustainable waste management philosophies. There are even reports that large industries are involved in linear production, leaving waste in open air and water. Additionally, there is weak enforcement, and environmental protection agencies have not succeeded in enforcing their regulations.

Regional Comparative Analysis

Countries across the globe have embraced circular economy principles to manage waste sustainably and mitigate environmental impacts. Neighboring countries like India, Bangladesh, and Sri Lanka offer valuable lessons for Pakistan.

India's Circular Economy Approach

India has made significant strides in managing its waste, particularly through its Swachh Bharat Mission (2014), which focuses on cleanliness, sanitation, and waste management at a national scale. Under this initiative, cities have implemented strict policies on waste segregation at the source, recycling, and composting. For example, Indore, known as the cleanest city in India, practices door-to-door waste collection, segregation, and composting of organic waste, leading to a recycling rate of over 75% (Singh & Kumar, 2021). India's focus on creating a recycling economy has resulted in around 100 waste-to-energy plants operating across the country (Central Pollution Control Board, 2022).

Bangladesh's Waste Management Initiatives

Bangladesh, despite being one of the most densely populated countries in the world, introduced the 3R Strategy (Reduce, Reuse, Recycle) in 2015, focusing on waste minimization and resource recovery. The Dhaka North City Corporation implemented waste segregation at the household level and promoted community-based waste management initiatives. The country's focus on recycling plastic has reduced around 36% of its plastic waste (Islam & Hossain, 2020).

Sri Lanka's Waste Reduction Efforts

Sri Lanka has been a regional leader in waste minimization through its National Waste Management Strategy (2007). The Kelaniya Waste-to-Energy Project, which began operations in 2020, converts 500 tons of solid waste daily into energy, contributing to both energy production and waste reduction (Wijesinghe, 2021).

Comparative Analysis

Aspect	Peshawar (Pakistan)	Indore (India)	Dhaka North City (Bangladesh)	Kelaniya (Sri Lanka)
Policy Framework	KP Climate Change Policy (2022), and Action Plan (2022)	Plastic Waste Management Rules (2016)	National Waste Management Policy (2006)	National Solid Waste Management Policy (2007)
Waste Generation (per capita)	0.5 to 0. 6 kg/day (2019)	0.54 kg/day (2020)	0.60 kg/day (2020)	0.70 kg/day (2020)
Recycling Rate	Landfill practice	~30% (2021)	~15% (2021)	~30% (2021)
Public Participation	Low awareness, limited community engagement	High public participation in initiatives	Moderate, with awareness campaigns	Strong community engagement initiatives
Investment in Infrastructure	Limited, inadequate waste management systems	Significant investments in recycling	Moderate, focus on landfill management	Investment in waste-to-energy facilities
Use of Technology	Minimal adoption of advanced technologies	Growing use of technologies in recycling	Limited technological implementation	Advanced waste-to-energy technologies
Economic Incentives	Limited, minimal support for circular economy	Government incentives for recycling	Some incentives for waste management	Strong support for green job creation
Success Stories	Peshawar Waste Management Company (WSSP)	Swachh Bharat Mission (Clean India)	Urban Resilience Program	Waste-to-Energy Projects
Challenges	Poor enforcement, lack of infrastructure	Fragmented implementation, pollution issues	Inadequate infrastructure, funding	Waste management issues in urban areas

Lessons Learned for Pakistan

- Strong public participation and awareness.
- A robust policy and regulatory framework.
- Significant investment in infrastructure development.
- India introduced economic incentives for recycling.
- Sri Lanka has made significant contributions to waste-to-energy projects.

PESTEL Analysis of EPA (Regulatory Body)

- **Political:** Strong government support for environmental initiatives. The Chief Minister is the head of the Environment Protection Council under the EPA Act, 2014. However, meetings are not held regularly, hindering its performance.
- **Economic:** The EPA issues NoCs to industries and various bodies. However, the CE concept is not assessed in their framework, and little emphasis is placed on SWM. Additionally, the EPA is facing financial constraints, which adversely affect its performance.
- **Social:** EPA's policies lack a participatory approach. There is a need to engage the intelligentsia and increase public awareness.
- **Technological:** Emerging technologies in recycling and waste-to-energy offer promising solutions, but the EPA has not utilized these technologies in SWM solutions.
- **Environmental:** There is significant potential to reduce landfill use and environmental degradation through circular economy practices, but the EPA, as a regulator, has not focused on this critical area.
- **Legal:** Existing laws, such as the Environmental Protection Act (2014), Climate Policy (2022), and Action Plan (2022), provide a framework, but the implementation and enforcement mechanisms are lacking.

Issues in EPA

- No mention of CE in the EPA Act.
- Weak institutional framework of the EPA.
- Lack of coordination among implementing bodies and federal-level entities.
- Lack of an integrated policy framework (Hussain et al., 2024).
- Issuance of 18 NoCs to housing societies in Peshawar recently[5] without SWM assessment.

How to Address Issues

1. An exhaustive review of policies and their realignment towards CE and SWM is required.
2. The EPA should strengthen its institutional framework.
3. The EPA should thoroughly review its NoC issuance process to housing societies to achieve SWM through CE.
4. The EPA should enhance coordination with all stakeholders.
5. The EPA should encourage PPPs to promote innovation in waste management technologies, recycling processes, and sustainable production methods (Ahmed et al., 2021).

[5] EPA Website (https://epakp.gov.pk/environmental-approvals)

SWOT & EETH Analysis of WSSP (Implementing Body)

S.W.O.T. Analysis	E.E.T.H. Analysis
Strengths: • Strong legal mandate (115A of Local Government Act) • Has HR staff • Waste collection mechanism • Strong internal control • ADB funding for SWM	**How these can be Enhanced?** • Needs to focus on SWM. • Increase field presence • Increase waste collection per day • Focus on efficient utilization of ADB resources in SWM.
Weaknesses: • Garbage containers are less than the required number • Linear waste disposal (landfill disposal) • Lack of clear directions • Duplicity of projects	**How these can be Eliminated?** • Needs to formulate a clear CE and SWM strategy • Increase number of containers • Remove duplicity of projects
Opportunities: • Unofficial CE market • Unofficial CE workers, retailers • Private firms interested	**How to Take Advantage?** • Bring unofficial CE market in to main net • Train and capacitate private workers • Introduce PPP
Threats: • Increase in urbanization • Dependence on processed/industrial products • People's deviant behavior	**How to Hedge Against?** • Increase public awareness campaigns • Focus on at source segregations

Issues and Challenges

There is a lack of infrastructure to support large-scale recycling and waste-to-energy projects. WSSCs lack proper waste segregation facilities, resulting in continued reliance on landfills, which are reaching capacity at alarming rates.

Public-private partnerships, which are crucial for the expansion of waste management infrastructure, are still in their infancy due to unclear regulatory frameworks and insufficient incentives for private sector involvement. Both WSSP and EPA are lacking in this area.

Another pressing issue is the low level of public awareness and participation in waste segregation and recycling programs. Surveys conducted in Peshawar and other urban areas reveal that fewer than 30% of households participate in any form of waste segregation, leading to inefficiencies in the collection and recycling processes.

Weak enforcement of existing regulations is another major issue. Although the KP Environmental Protection Act (2014) mandates waste segregation at the source, enforcement mechanisms are poorly resourced, leading to widespread non-compliance.

Conclusion

The transition towards a circular economy (CE) in Pakistan, particularly in Khyber Pakhtunkhwa, presents significant challenges but also opportunities for improvement in solid Both regulatory and implementation issues persist. These issues include a lack of clear policies and approaches towards CE and SWM, a weak regulatory framework, limited institutional capacity, poor enforcement, a weak monitoring regime, a lack of coordinated efforts, low public awareness and participation, insufficient incentives for the industrial sector, and limited public-private partnerships (PPP). By prioritizing resource reuse, recycling, reduction, and sustainable practices, the goal of CE can be achieved effectively. Waste management (SWM). However, under the present circumstances, it remains a distant dream.

Recommendations

Policy Level Recommendations

- The government should promote the use of biodegradable and reusable materials by offering tax incentives to industries.
- The government should amend the EPA Law to provide explicit provisions for CE and SWM.
- Further, amended laws and policies should strengthen regulatory frameworks like Extended Producer Responsibility (EPR), making manufacturers responsible for the disposal of their products. Incentives should also be offered to businesses adopting eco-friendly practices.
- The government should introduce policies to integrate the informal CE sector into the formal economy. The informal waste-picking sector should be provided better wages, health benefits, and modern tools.
- The EPA should strengthen its institutional capacity for the enforcement of existing waste management policies.
- The EPA should increase the frequency of Environment Protection Council meetings to garner more political support.
- It should focus on robust monitoring and evaluation.

Implementation Level Recommendations

- The WSSP should focus on dumping-site level segregation, as household segregation is a challenging task that requires a change in civic behavior, and the WSSP's collection model is container-based.
- The WSSP needs to focus on modern recycling facilities that process not only plastics but also metals and organic waste. Additionally, focusing on waste-to-energy technologies can help reduce landfill dependency and generate clean energy.
- Engaging the private sector through PPP can expedite CE and SWM.
- The WSSP should focus on capacity building for its staff, as enhanced technical and managerial capacities are required to implement CE strategies.

Action Plan

Proposed Actions (20%)	Rationale/Impact (80%)	Responsibilities	Resources	Timeline	KPIs
Amend EPAs Laws and Develop CE Strategy	• Explicit mention of CE in EPA laws • A unified policy framework for CE and SWM will drive coordination between federal and provincial efforts among all stakeholders • Increase Extended Producer Responsibility • Provide tax incentive to CE sector	• Ministry of Climate Change and Environmental Coordination • Provincial governments	• Policy drafting team (Legal experts) • Stakeholder consultations	12-18 months	• Laws amended • Strategy published • Public awareness campaigns conducted
Policy to formalize informal CE	• Will increase CE documentation • Increase number of jobs • Revenue generation • Contribute to GDP	• Ministry of Climate Change and Environmental Coordination • Planning and Development Department • Provincial governments	• Policy drafting (Legal experts) • Stakeholder consultation	1-12 months	• Number of businesses registered • Number of labours registered
Institutional Capacity Building of EPA and WSSP	• Enhance institutional capacity to implement CE strategies • Focus on research oriented and evidence-based policies • Ensure strong enforcement mechanism	• EPAs • WSSP	• Training of staff • Logistic support to staff (funding available through ADB)	0-6 months	• Number of trainings imparted • Gadgets provided to staff • Monitoring and evaluation increased
Promote PPP and Waste-to-Energy (WTE) Projects	• Boost infrastructure and technology • Attracting private investment for CE and SWM	• Ministry of Climate Change and Environmental Coordination • KP Environment Department • Industries Department	• Investment incentives Tax breaks Technical experts and • WTE infrastructure	12-24 months	• Number of PPP agreements signed • Number of WTE projects initiated
Launch Public Awareness Campaigns	• Influence Public Behaviour • Sensitize stakeholders • Increase compliance trends	• Private sector partners • EPA • WSSP • Information Department • Education Departments • Local Government Department • Tourism Department • EPA • WSSP • City Mayors	• Activate social media • Educational institution-based awareness • Start radio campaigns • Print media campaigns • Billboards at prominent public places and tourist spots • Workshops with stakeholders • Include in Trainings of NSPP & NIM	Ongoing	• Number of Advertisements • Number of awareness campaigns • Number of workshops conducted
Implement Monitoring and Waste Audits	• Will reduce use of waste • Will increase enforcement • Highlight issues for corrective measures	•EPA •WSSP	• Training of existing staff • Technical Staff for monitoring • Hiring of reputable environment audit firms (ADB fund)	3 to 6 months	• Number of staff trained • Number of firms hired • Number of monitoring visits • Number of audits conducted

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Climate Risk Reduction, Disaster Preparedness and Flood Resilience in Pakistan

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Abstract:

This research paper examines the increasing vulnerability of Pakistan to climate-related disasters, particularly floods, as highlighted by the Global Climate Risk Index 2019. As one of the most susceptible nations to climate change, Pakistan has experienced devastating floods that have resulted in substantial loss of life and property, exacerbating socioeconomic vulnerabilities and jeopardizing national development. The analysis underscores the urgent need for improvements in disaster preparedness, risk assessment, and climate adaptation measures. It emphasizes the necessity for a cohesive legal framework, enhanced collaboration among various governmental levels, and increased budget allocations for disaster management institutions. Furthermore, the paper advocates for investment in modern telecommunication infrastructure and advanced early warning systems to improve disaster response capabilities. By addressing these critical areas, Pakistan can enhance its resilience to climate-induced calamities and safeguard vulnerable populations against future risks.

Key words:

Climate change, Disaster management, Flood resilience, Pakistan, Risk assessment

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Introduction

According to the Global Climate Risk Index 2019, the growing effects of climate change, climate risk reduction, disaster preparedness, and flood resilience are becoming increasingly important issues in Pakistan. Pakistan ranks among the top ten countries and is one of the most vulnerable nations in the world to climate-related calamities (Global Climate Risk Reduction, n.d.).

In recent years, Pakistan has witnessed several extreme floods, resulting in major loss of life and property and causing chaos and destruction in several hotspots. The International Union for Conservation of Nature (2009) highlighted that Pakistan is highly vulnerable to disasters caused by climate change, particularly prone to floods due to unpredictable rains and micro-cloudbursts.

According to the Annual PDMA Report 2022, the most frequent and destructive natural disaster in the nation is flooding, which includes riverine floods, glacial lake outburst floods (GLOF), and urban flooding. Socioeconomic vulnerabilities coupled with climate unpredictability have made Pakistan's infrastructure, environment, and populations extremely susceptible to the negative consequences of natural disasters (Annual PDMA Report KP, 2022).

The Climate Change Preparedness Report 2017 notes that Pakistan has experienced several devastating floods in recent decades that have negatively impacted both rural and urban areas. The disastrous 2010 floods, which affected more than 20 million people and resulted in losses exceeding $10 billion, highlight the nation's vulnerability. More recently, Pakistan was devastated by the 2022 floods, which forced millions of people to relocate and caused significant property and human loss. In addition to causing daily disruptions for millions, these disasters seriously jeopardize national development by leading to food insecurity, health problems, and unstable economies.

In response, there has been a growing emphasis on climate risk reduction, disaster preparedness, and flood resilience as part of Pakistan's national policies. Climate risk reduction aims to minimize the exposure and vulnerability of communities to climate-related hazards by integrating climate adaptation measures into planning and governance.

Statement of Problem

Natural hazards, particularly climate change-induced floods, have severely impacted the social and economic well-being of Pakistan. Despite the institutional framework, the strategies outlined in the national disaster management policy have not been fully implemented. This study aims to identify the reasons behind the existing gap between theory and practice in climate risk reduction, disaster preparedness, and flood resilience.

Scope

This research aims to provide a critical analysis of the disaster management policies, laws, and practices in relation to climate risk reduction, disaster preparedness, and flood resilience in Pakistan. The study will focus on the legal and institutional framework for disaster management, the enforcement mechanisms for these laws at the federal, provincial, and district levels, and the role of civil society and communities in promoting a disaster management culture.

Research Methodology

The topic at hand is exploratory and requires thorough investigation; therefore, a qualitative method of research is adopted for the study. Data has been obtained directly by interviewing relevant resource persons from academia and institutions. Journals, reports, research papers, and online resources have been consulted, and the required data has been retrieved. Thus, the data reviewed comes from both primary and secondary sources.

Literature Review

Due to geophysical conditions, extreme climate conditions, and high degrees of exposure and vulnerability, Pakistan is a disaster-prone country. Pakistan's exposure to natural hazards and disasters can be ranked as moderate to severe. A range of hydro meteorological, geophysical, and biological hazards—including earthquakes, floods, tsunamis, cyclones, storms, droughts, glacial lake outbursts, landslides, avalanches, pest attacks, and epidemics—pose risks to Pakistani society (Asian Disaster Reduction Report, 2015).

According to the NDMA, the analysis of hazard risks, vulnerabilities, and dynamic pressures highlights a scenario of more people living in and around hazard-prone areas. More people are likely to be living in existing settlements in hazard-prone areas, and new settlements will continue to increase with the expanding population. This trend may worsen over the years, as the population of Pakistan is expected to double in another 25 to 30 years. On the other hand, the frequency, severity, and intensity of certain hazards are on the rise, such as droughts, flooding, soil erosion, and

landslides, resulting from environmental degradation and climate change (NDMA Annual Report, 2022).

An essential component of management is understanding the concepts of emergency planning, community readiness, and their connections to drills, training, and plans. Effective emergency planning is a constant effort. Organizational personnel and equipment, emergency facilities, organizational structure, and hazard vulnerability all have the potential to transform over time. The process of emergency preparedness serves as a tool for recognizing, tracking, and handling these modifications. A component of readiness is preparation (Perry, R. W., & Lindell, M. K., 2003).

Generally, heavy concentrated rainfall during the monsoon season causes floods, which are sometimes intensified by the melting of snow that flows into rivers. Occasionally, destructive floods are also caused by monsoon currents originating in the Bay of Bengal and resultant depressions, which often result in heavy downpours in the Himalayan foothills, additionally affected by weather systems from the Arabian Sea (Seasonal Low) and from the Mediterranean Sea (Ministry of Water & Power, 2010).

Heavy monsoon rains induced massive and unprecedented floods from August to September 2022 across most of Pakistan. The Government of Khyber Pakhtunkhwa's Relief, Rehabilitation, and Settlement Department declared a rain emergency in 17 affected districts of the province. According to official estimates, floods have claimed the lives of 306 individuals, caused the temporary displacement of approximately 674,318 people, and roughly 70,000 people have been rescued. Approximately 121,390 acres of agricultural land have been damaged due to inundation, affecting sugarcane, rice, maize, and vegetable crops, while 6,577 livestock, mainly cattle, have perished. The floods also resulted in severe damage to communication infrastructure, with approximately 1,600 kilometers of roads and 107 bridges damaged. Similarly, the floods have damaged 91,000 houses (both fully and partially) across the province (MSRNA, 2022).

Institutional Framework

Disaster Management System of Pakistan

Pakistan has three administrative levels of governance:

- **National Disaster Management Authority (NDMA)** as the focal point at the federal level.
- **Provincial Disaster Management Authority (PDMA)**, which is the focal point for disaster risk management (DRM) endeavors in respective provinces.
- **District Disaster Management Units (DDMUs)** at the district level.

If a disaster occurs, the DDMUs are the first responders for rescue operations, and if needed, the situation is dealt with by provincial or national management authorities. The Director General of PDMA performs his duties as Secretary at the provincial level. The stakeholders responsible for executing pre-disaster activities and managing post-disaster scenarios include the district administration, with the help of the civil defense department, other member departments, NGOs, and international organizations (IOs).

The enactment of the National Disaster Management Act of 2010 provides for the following institutional arrangements:

- Disaster Management Commission at the national level (NDMC)
- Provincial/Regional levels (PDMC)
- National Disaster Management Authority (NDMA)
- Provincial Disaster Management Authority (PDMC)
- District Disaster Management Units (DDMUs)
- National Emergency Operation Centers (NEOC)
- Provincial Emergency Operation Centers (PEOC)
- Disaster Management Force 1122-KP
- National Disaster Response Force (NDRF)
- Pakistan Meteorological Department
- Civil Defense

National Disaster Management Authority (NDMA)

The National Disaster Management Authority (NDMA) was formed in 2007. It is the executive arm and secretariat of the National Disaster Management Commission (NDMC) and is responsible for managing the complete spectrum of disasters in Pakistan. NDMA maps all hazards in the country, organizes training and awareness-raising activities, and acts as the Government of Pakistan's focal point for dealing with the national and international community. The National Disaster Risk Management Framework (NDRMF) was prepared by the NDMA in March 2007. The NDRMF serves as an overall guideline for disaster risk management at the national, provincial, and district levels. In March 2010, the NDMA formulated the National Disaster Response Plan (NDRP), which presents emergency response activities for all stakeholders, including Standard Operating Procedures (SOPs) for emergency response. NDMA is responsible for performing the following functions:

- Mapping all hazards in the country and conducting risk analyses on a regular basis.
- Developing guidelines and standards for national and provincial stakeholders regarding their roles in disaster risk management.
- Providing technical assistance to federal ministries, departments, and provincial disaster management authorities for disaster risk management initiatives.
- Organizing training and awareness-raising activities for the capacity development of stakeholders, particularly in hazard-prone areas.

- Coordinating the emergency response of the federal government in the event of a national-level disaster through the National Emergency Operations Centre (NEOC).
- Establishing a National Disaster Management Fund.
- Coordinating, formulating, and developing guidelines and standards for provincial/regional and local stakeholders regarding their roles in disaster risk management.
- Ensuring the preparation of disaster risk management plans by all districts.

Promoting education, awareness, and training on disaster risk reduction and response. (NDMA Act, 2010)

SUPARCO

- Provides space-based information and services to support disaster management in the country (SUPARCO website, n.d.).

Pakistan Meteorological Department (PMD)

- National Weather Forecasting Centre, Islamabad (NWFC)
- Marine Meteorology & Tropical Cyclone Early Warning Centre, Karachi (TCWC)
- National Drought Monitoring Centre, Islamabad (NDMC)
- National Seismic Monitoring and Tsunami Early Warning Centre, Karachi (NTWC)
- Flood Forecasting Division, Lahore (FFD) (PMD website, n.d.).

Federal Flood Commission (FFC)

- Prepare flood protection plans for the country.
- Review and approve flood protection schemes prepared by provincial governments and concerned federal agencies.
- Implement measures to improve the flood forecasting and warning system.
- Prepare a research program for flood control and protection.
- Standardize designs and specifications for flood protection works.
- Evaluate and monitor the progress of the National Flood Protection Plan implementation (Ministry of Water Resources website, n.d.).

Provincial Disaster Management Authority (PDMA)

- Formulate the provincial disaster management policy, obtaining the approval of the Provincial Commission.
- Coordinate and monitor the implementation of the National Policy, National Plan, and Provincial Plan.

- Examine the vulnerability of different parts of the province to various disasters and specify prevention or mitigation measures.
- Lay down guidelines to be followed for the preparation of disaster management plans by the Provincial Departments and District Authorities.
- Evaluate preparedness at all governmental and non-governmental levels to respond to disasters and enhance preparedness, coordinating response in the event of a disaster.
- Give directions to any provincial department or authority regarding actions to be taken in response to a disaster.
- Promote general education, awareness, and community training in this regard.
- Provide necessary technical assistance or advice to district authorities and local authorities for carrying out their functions effectively (PDMA Act, 2012).
- Advise the provincial government regarding all financial matters related to disaster management.
- Examine construction in the area and, if it is of the opinion that the standards laid down have not been followed, it may direct compliance with those standards.
- Ensure that communication systems are in order and that disaster management drills are carried out regularly.
- Perform such other functions as may be assigned to it by the national authority.

District Disaster Management Unit (DDMU)

- Prepare a disaster management plan, including a district response plan for the district.
- Coordinate and monitor the implementation of the national policy, provincial policy, national plan, provincial plan, and district plan.
- Ensure that areas in the district vulnerable to disasters are identified and that measures for the prevention of disasters and the mitigation of their effects are undertaken by the government departments at the district level as well as by the local authorities.
- Ensure that the guidelines for prevention, mitigation, preparedness, and response measures, as laid down by the national authority and the provincial authority, are followed by all departments of the government at the district level and by the local authorities in the district.
- Give directions to different authorities at the district level and local authorities to take such other measures for the prevention or mitigation of disasters as may be necessary.
- Lay down guidelines for the preparation of disaster management plans by the government departments at the district level and local authorities in the district.

- Monitor the implementation of disaster management plans prepared by the government departments at the district level.
- Lay down guidelines to be followed by the government departments at the district level.
- Organize and coordinate specialized training programs for different levels of officers, employees, and voluntary rescue workers in the district.
- Facilitate community training and awareness programs for the prevention of disasters or mitigation, with the support of local authorities, governmental organizations, and non-governmental organizations.
- Set up, maintain, review, and upgrade the mechanism for early warnings and dissemination of proper information to the public.
- Prepare, review, and update the district-level response plan and guidelines.
- Coordinate with and give guidelines to local authorities in the district to ensure that pre-disaster and post-disaster management activities in the district are carried out promptly and effectively.
- Review development plans prepared by the government departments at the district level, statutory authorities, or local authorities to make necessary provisions therein for the prevention of disasters or mitigation.
- Identify buildings and places that could, in the event of a disaster situation, be used as relief centers or camps, and make arrangements for water supply and sanitation in such buildings or places.
- Establish stockpiles of relief and rescue materials or ensure preparedness to make such materials available on short notice.
- Provide information to the provincial authority relating to different aspects of disaster management.
- Encourage the involvement of non-governmental organizations and voluntary social-welfare institutions working at the grassroots level in the district for disaster management.
- Ensure communication systems are in order and that disaster management drills are carried out periodically.
- Perform such other functions as the provincial government or provincial authority may assign to it or as it deems necessary for disaster management in the district (PDMA Act, 2012).

The Irrigation Department of Khyber Pakhtunkhwa

The Irrigation Department is pivotal in flood control and enhancing flood resilience by managing water resources and infrastructure. Its key roles include:

1. **Flood Protection Infrastructure:** The department constructs and maintains embankments, spurs, dikes, and levees to control flooding and safeguard vulnerable areas, while employing river training works to manage water flow and reduce erosion.
2. **Water Drainage Systems:** It manages drainage networks to prevent waterlogging and mitigate urban flooding, particularly during monsoon seasons.
3. **Flood Forecasting and Early Warning:** In collaboration with the Pakistan Meteorological Department (PMD), it forecasts floods and disseminates early warnings to at-risk communities for timely evacuation and preparedness.
4. **Water Resource Management:** The department manages watercourses for floodwater storage and implements canal systems to divert excess water, minimizing damage to critical areas.
5. **Resilience Building and Disaster Preparedness:** It integrates climate resilience into infrastructure planning and conducts community training on flood preparedness and recovery.
6. **Coordination with Authorities:** It works with the Provincial Disaster Management Authority (PDMA) to align flood control efforts with provincial disaster management plans.
7. **Post-Flood Recovery:** After floods, the department assesses damage to infrastructure and facilitates repairs to restore flood control systems.
8. This comprehensive approach enhances KP's capacity to manage and mitigate the impacts of floods (Water Act KP, 2020).

Environmental Protection Agency Khyber Pakhtunkhwa

1. **Policy Formulation:** The EPA helps develop policies that integrate environmental considerations into flood management strategies, promoting sustainable land use and watershed management.
2. **Environmental Impact Assessments (EIAs):** The agency conducts EIAs for development projects, ensuring that flood risks and environmental impacts are taken into account before approvals are granted.
3. **Monitoring and Data Collection:** The EPA monitors environmental indicators and collects data related to flooding, which aids in understanding trends and improving response strategies.
4. **Public Awareness and Education:** The agency engages in community outreach programs to raise awareness about flood risks

and promote preparedness and resilience measures among local populations (Environmental Protection Act KP, 2014).

5. **Collaboration and Coordination:** The EPA works alongside other government agencies, NGOs, and community groups to create integrated flood management plans that consider ecological health and community needs.
6. **Research and Capacity Building:** It supports research initiatives aimed at improving flood forecasting and resilience practices and builds capacity within local communities for better flood risk management.
7. **Restoration and Rehabilitation:** Post-flood, the EPA may be involved in efforts to restore ecosystems and rehabilitate affected areas, ensuring that recovery efforts consider environmental sustainability.

Forest Department Khyber Pakhtunkhwa

1. **Tree Planting Initiatives:** Implementing afforestation and reforestation projects to enhance forest cover, which helps in reducing soil erosion and increasing water retention.
2. **Community Engagement:** Collaborating with local communities to promote tree planting and sustainable land management practices.
3. **Biodiversity Conservation:** Protecting and managing forest ecosystems to maintain biodiversity, which is vital for ecosystem resilience against climate change.
4. **Planning, Monitoring & Evaluation:** Gathering data on forest health and changes in land use to inform policy and response strategies.
5. **Emergency Response Planning:** Preparing response plans that integrate forest management practices to mitigate the impact of disasters.
6. **Capacity Building:** Conducting training programs for communities on disaster preparedness and sustainable land management.
7. **Interdepartmental Collaboration:** Working with other government departments and agencies to develop comprehensive disaster management plans (Forest Ordinance KP, 2002).

Institutional Analysis

From August to September 2022, heavy monsoon rains led to unprecedented floods across much of Pakistan. The Khyber Pakhtunkhwa government declared a rain emergency in 17 affected districts. Official estimates report that the floods resulted in 306 fatalities, displacing around 674,318 people, with about 70,000 rescued. Approximately 121,390 acres of agricultural land, including crops like sugarcane, rice, and maize, were damaged, and 6,577 livestock, primarily cattle, were lost.

Despite the plethora of institutions working for climate risk reduction,

disaster preparedness, and flood resilience in KP, a huge loss was sustained, as mentioned above. The following are the weaknesses of the institutions employed for disaster management:

- **NDMA:** Limited local adaptation of national policies and insufficient real-time data-sharing mechanisms with provincial and district authorities.
- **PDMA:** Resource constraints limit the effective implementation of programs. There is weak collaboration with local communities for preparedness initiatives.
- **DDMA:** Limited capacity and resources across different districts, coupled with a lack of tailored disaster response plans that consider local vulnerabilities.

Legal Framework

- National Disaster Management Ordinance 2007
- National Disaster Management Act 2010
- Provincial Disaster Management Act 2012

Legal Analysis

The 18th constitutional amendment to the 1973 Constitution of Pakistan created confusion in the entire legal structure, as many subjects that were in the federal legislative list were devolved to the provinces. Now, the NDMA has no administrative control over the PDMAs, which limits disaster management to collaboration and sharing of information only.

Second, many provisions outlined in the PDMA Act exceed the scope of the PDMA, such as making the construction of buildings and houses disaster- and climate-resilient, which makes the implementation of these provisions very difficult.

Comparative Analysis with India and Bangladesh

Area	Pakistan	India	Bangladesh
Institutional Framework	NDMA	NDMA	Disaster Management and Relief Ministry
Policy Framework	National Disaster Management Act, 2010	Disaster Management Act, 2005	Disaster Management Act, 2012
Risk Assessment	Limitation in Date collection and Analysis	Regular Risk Assessment	Community based risk assessment
Response Mechanism	Slow due to infrastructure and bureaucratic delays	Well defined but slow in rural areas	Highly efficient and speedy due to community involvement
Community Involvement	Low	Moderate	Strong

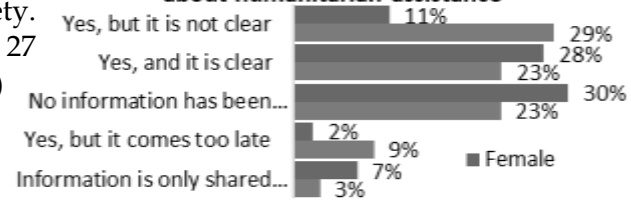
KP Floods of 2022: A Case Study

Heavy monsoon rains induced massive and unprecedented floods from August to September 2022 across most of Pakistan. The Government of Khyber Pakhtunkhwa's Relief, Rehabilitation, and Settlement Department declared a rain emergency in 17 affected districts of the province. According to official estimates, the floods claimed the lives of 306 individuals and caused the temporary displacement of approximately 674,318 people, while roughly 70,000 people were rescued. Approximately 121,390 acres of agricultural land were damaged due to inundation, affecting sugarcane, rice, maize, and vegetable crops, while 6,577 livestock, mainly cattle, perished. The floods also resulted in severe damage to communication infrastructure, with approximately 1,600 kilometers of roads and 107 bridges also being damaged. Similarly, the floods damaged either 91,000 houses (fully and partially) across the province.

Community Engagement

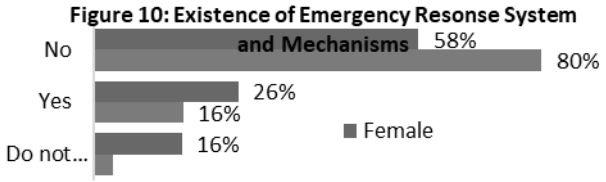
Sufficient and timely information sharing with communities about the provision of humanitarian assistance, including procedures, is vital to ensuring the inclusion of all segments of society. According to the MSRNA findings, 27 percent of key informants (KIs) reported that their communities had received information regarding humanitarian aid after the floods. The remainder received some information, but only 25 percent considered the information provided to be clear and, therefore, helpful to the community.

Figure 8: Has community received information about humanitarian assistance



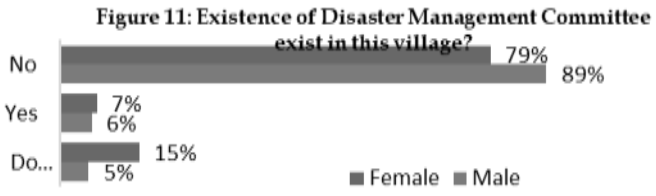
Similarly, 20 percent reported that the information was 'not clear,' while 7 percent of KIs highlighted that the information came very late, and 6 percent believed that it was provided to a small number of community members. Comparing the responses of male and female KIs, female respondents had a relatively clearer understanding of the information provided. Communities generally preferred to receive information through traditional sources. When asked about the preferred mode of communication, 54 percent of male KIs and 39 percent of female KIs mentioned that community members generally prefer to receive information through community leaders, followed by social media (51 percent and 40 percent, respectively).

Overall, 21 percent of KIs assumed that community members were well aware of the Complaint and Feedback Mechanisms (CFM) in place regarding the provided humanitarian assistance. Awareness of CFM stood at 19 percent across flood-affected areas of the province. Regarding the question related to the existence of emergency response systems and mechanisms (community emergency response teams, search and rescue teams, etc.) at the local level for saving lives and livelihoods from various hazards, over 80.4 percent of the responses from male responders and 58 percent of female respondents confirmed that no such systems exist in their villages, which were selected at random from the 10 highly affected priority districts of Khyber Pakhtunkhwa. Over 64.8 percent of male and female KIs in focus group discussions confirmed that emergency response systems/mechanisms are not established in their villages.



Khyber Pakhtunkhwa is prone to climate-induced and other natural disasters. The integration of Disaster Risk Reduction (DRR) and Emergency Preparedness into all sectors under the preparedness, response, recovery, and development phases is, therefore, critical and can contribute to saving the lives and livelihoods of vulnerable communities in hazard-prone districts across Pakistan, resulting in building the resilience of vulnerable communities to disasters.

The MSRNA questionnaire, therefore, included DRR-related questions for communities in 10 priority hazard-prone districts among the 17 districts of KP. Similarly, regarding the existence of Village Disaster Management



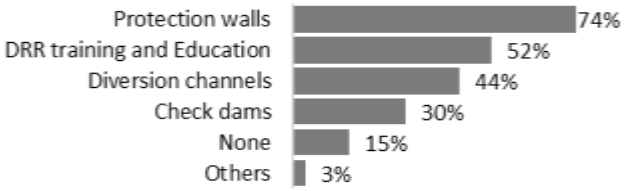
Committees (VDMCs) in villages, 88.9 percent of male respondents and 78.7 percent of female respondents confirmed that no such committees exist in their villages.

Concerning the status of training, equipping, and institutionalization of these Village Disaster Management Committees (VDMCs) in villages, over 96.1 percent of responses from male respondents and 95.8 percent of female respondents reported 'Not Applicable,' since this question was contingent upon the previous question—no existence of committees, therefore, made the question irrelevant.

DRR Related Priority Needs

On priority needs for saving lives and properties from natural disaster, overall, 74.1 percent of the responses from male respondents indicated construction of protection walls as their first priority need and 52.1 percent identified DRR training and education as a priority need.

Figure 12: DRR Related Priority Needs



Among female KIs, more than 52.0 percent identified protection walls as a priority need and over 43.8 percent highlighted DRR training and education as a priority need.

Affected Population in 2022 Floods KP

Estimated Number of Affected Population

Ranking	District	Estimated Number of Households in the affected areas	% Affected	Estimated Population Affected
1	D. I. Khan	147,853	66%	772509
2	Dir Upper	122,750	59%	575286
3	Swat	74,877	65%	384220
4	Nowshera	73,677	52%	304197
5	Tank	77,220	48%	294416
6	Dir Lower	68,050	53%	282506
7	Charsadda	39,155	80%	246791
8	Kohistan Lower	44,468	56%	198323
9	Kohistan Upper	29,489	62%	144374
10	Chitral Upper	14,507	89%	101426
	Grand Total	**692,042**	**63%**	**3,304,048**

MSRNA REPORT KP

Demographics of Flood Hit Villages of 2022 KP

S.No.	Villages affected/Covered	
	District	Number of Villages affected
1	**Charsadda**	38
2	**Chitral Upper**	20
3	**D. I. Khan**	152/200
4	**Kohistan Lower**	55
5	**Kohistan Upper**	37
6	**Dir Lower**	59
7	**Nowshera**	38
8	**Swat**	61
9	**Tank**	39

Faultline of the 2010 Flood Nowshera

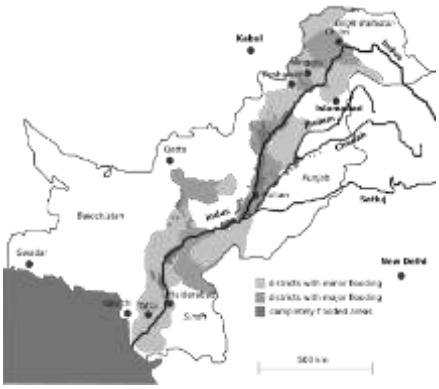
The 2010 monsoon flood disaster in Pakistan was massive and unprecedented, killing more than 1,700 people, affecting over 20 percent of the land area, and impacting more than 20 million individuals. It caused losses amounting to billions of dollars due to damages to infrastructure, housing, agriculture, livestock, and other family assets. Essential infrastructure, including roads, bridges, and markets, has been severely damaged, and many remain impassable. According to one of the United Nations surveys, approximately 10.1 million people were in need of shelter and humanitarian assistance. The number of people requiring food assistance to support recovery and rehabilitation is estimated at approximately 3.6 million. More than 1.1 million houses were completely destroyed or rendered uninhabitable, and over 2 million hectares of standing crops were damaged or lost.

Table 1: Flood Damages and Reconstruction Cost

(Rs. in Billion)

Province/ Area	Damages	Reconstruction Cost
AJK	7	13
Balochistan	53	27
FATA	6	8
Federal	93	96
Gilgit Bultistan	4	7
Khyber Pakhtunkhwa	100	106
Punjab	219	93
Sindh	373	228
Total	**855**	**578**

Source: National Flood Reconstruction Plan 2010



Source Report on 2010 floods Finance Division Website

Nowshera 2010 floods wrecked a havoc upon on the small town of PIR SABAQ because there was no Siphon Gate installed where the KHUWAR (nullah) opens in the River Kabul thus the torrential surge was let loose on the town because on the part of negligence of authorities.

Source Google Earth

PESTLE Analysis of Institutions

Political:
• Lack of political will regarding disaster management.
• Decentralized governance impacts the efficiency of disaster preparedness efforts.
• Ongoing political issues affect efficiency.

Economic:
• Insufficient allocation of resources.
• Floods impact economic conditions.
• Increases infrastructure vulnerability.

Social:
• Poor engagement of communities at the local level in terms of awareness and training.
• Increases the vulnerability of marginalized communities.
• Increases the tendency toward urbanization.

Technological:
• Lack of modern telecommunication systems and automatic weather radar systems for early warning.
• Conventional flood-resistant infrastructure and drainage systems.
• Performance audit of existing early warning systems.

Legal:
• Parallel and overlapping legal frameworks with unrealistic provisions.
• Lack of accountability of institutions in disaster preparedness and response.
• Limited scope of existing laws.

Environmental:

- Increased frequency and intensity of flooding events.
- Insufficient investment in biodiversity and ecosystems.
- Lack of adequate climate-resilient infrastructure.

GAP Analysis

Field	Current State	Desired State	GAP
Institutional Framework	Weak intuitional framework and lack of resources	Strong institutions and coordination	Lack of adequate resources
Legal Framework	Fragmented and unrealistic legal regime	Well defined and realistic	Lack of effective central control and realistic provisions
Funding	Insufficient funding	Sufficient funding allocation	Lack of adequate allocation of financial resources
Community engagement	Less involvement of community	Effective involvement of community	Lack of community involvement programs at large
Infrastructure	Poor and insufficient infrastructure	Improved and sufficient infrastructure	Lack of political will and financial resources
Annual Plans as per NDMA/PDMA Act	No annual plans instead partial contingency plans	Preparation and updation of annual disaster management plans	Ineffective administration
Demarcation of Flood Zones	Nil	Complete mapping of flood zones	Lack of political, administrative will and lack of financial resources

Issues and Challenges

1. **Fragmented Legal Framework:** Overlapping laws create confusion, hindering effective disaster management.
2. **Decentralized Governance:** The 18th Amendment's devolution of powers has led to inconsistent practices across provinces.
3. **Lack of NDMA Control:** The National Disaster Management Authority (NDMA) has no administrative control over Provincial Disaster Management Authorities (PDMAs).
4. **Resource Constraints:** Insufficient funding severely limits the capacity of disaster management institutions.
5. **Unrealistic PDMA Provisions:** Some provisions of the PDMA Act exceed their intended scope, complicating enforcement.
6. **Weak Institutional Coordination:** Poor synergy among federal, provincial, and local authorities impairs disaster response.
7. **Absence of Annual Plans:** The lack of comprehensive annual disaster management plans leads to inadequate preparedness.
8. **Limited Risk Assessment:** Poor data collection and analysis hinder effective risk assessments.
9. **Inadequate Funding:** Insufficient budget allocations hamper operational effectiveness in disaster management.
10. **Community Engagement Deficit:** Low community involvement reduces the effectiveness of disaster response efforts.
11. **Marginalized Group Vulnerability:** Increased vulnerability among marginalized communities due to a lack of awareness and resources.
12. **Urbanization Pressure:** Rapid urbanization exacerbates infrastructure vulnerabilities and disaster risks.
13. **Outdated Technology:** Insufficient modern telecommunication and early warning systems impede timely disaster response.
14. **Ineffective Early Warning Systems:** Poor audits of existing systems lead to missed warnings and inadequate preparedness.
15. **Frequent Flooding:** Increased flood intensity due to climate change challenges current disaster management strategies.
16. **Inadequate Flood Zone Mapping:** The lack of complete flood zone demarcation complicates planning and response.
17. **Poor Infrastructure:** Insufficient infrastructure hampers effective disaster response and recovery.
18. **Political Will Deficiency:** Political instability and a lack of commitment hinder disaster management initiatives.
19. **Bureaucratic Delays:** Slow bureaucratic processes delay emergency responses and recovery efforts.
20. **Lack of Accountability:** Insufficient accountability mechanisms for disaster management institutions lead to ineffective governance.

21. **Absence of Automatic Weather Radars:** Only one Automatic Radar Station is functioning in Mardan; the other two analogue radars in D.I. Khan and Chirat are dysfunctional.
22. **Limited Contact with DDMUs:** International organizations are in greater contact with NDMA rather than DDMUs.

Conclusion

In view of the study, it has been noted that the preparedness, mitigation, and prevention phases regarding the effects of climate change at PDMA-KPK need improvement. There is a continuous need for enhancements in the areas of risk assessment, prevention, hazard mapping, assessing vulnerability, contingency planning, warehousing, early warning, and evacuation planning for vulnerable populations. There is a dire need to invest resources in afforestation and disaster risk reduction (DRR) to address the effects of climate change.

Recommendations

Review and streamline existing laws related to disaster management to eliminate overlaps and ambiguities, ensuring a cohesive legal framework that facilitates effective disaster response.

- Establish formal mechanisms for collaboration among federal, provincial, and local authorities, including regular joint training exercises and communication protocols to improve synergy and response efficiency.
- Advocate for increased budget allocations and resource mobilization for disaster management institutions at all levels, ensuring they have the necessary funding to operate effectively and sustainably.
- Mandate the creation of detailed annual disaster management plans for each province and district, incorporating risk assessments, resource allocation, and community engagement strategies to improve preparedness.
- Invest in modern telecommunication infrastructure and advanced early warning systems, ensuring timely dissemination of alerts and improving overall disaster preparedness and response capabilities.
- Foster community involvement in disaster management through awareness programs and training while specifically addressing the needs of marginalized groups to enhance resilience and participation in preparedness efforts.
- Concrete steps must be taken for the implementation of the National Climate Change Policy devised by the Ministry of Climate Change for climate risk reduction.
- The weather radars installed at D.I. Khan and Chirat are analogue and have now become dysfunctional. Automatic weather radars, in line with international best practices, should be procured and installed.
- Budget allocations must be made according to the anticipated needs of

the concerned departments, keeping in view the nature of hazards.

- There is a need for greater coordination of international organizations with lower tiers of disaster management organizations.

Logframe Matrix (1/2)

Assumptions / Risks	Resources / Inputs	Activities	Outputs	Outcomes	Impact
Lack of Political Will	Government collaboration	Implement National Climate change policy	Policy actions taken	Improved climate risk management	Long term climate resilience
Non alignment of budget with hazards	Financial Analysis	Align budget with departmental needs	Needs-based budgeting	Adequate resource allocation	Effective disaster response
Lack of coordination among departments and donors	Communication channels	Establish collaboration mechanism among authorities	Enhanced partnership	Broaden support network	Comprehensive disaster strategies

Logframe Matrix (2/2)

Assumptions / Risks	Resources / Inputs	Activities	Outputs	Outcomes	Impact
Inadequate procurement	Investment in procurement	Procure and install modern weather radars	New weather installed	Improved forecasting capabilities	Better disaster preparedness
Lack of community engagement	Local NGOs and community groups	Foster community involvement through trainings/programs	Increased community participation	Enhanced community resilience	Stronger community ties
Overlapping legal framework	Review of existing law	Streamline disaster management laws	Revised legal framework	Improved legal clarity	Enhanced disaster resilience

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Women's Welfare Committee on Gender Inclusion and Cultural Engagement for Climate Mitigation

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Abstract:

This paper explores the intersection of social injustice, gender inequality, and climate change in Pakistan, focusing on the severe impacts of the 2022 floods and their disproportionate effects on marginalized groups, especially women. Despite Pakistan's minimal contribution to global greenhouse gas emissions, the country ranks among the most vulnerable to climate change. The study examines the importance of Gender Equality and Social Inclusion (GESI) and cultural engagement in climate mitigation and adaptation strategies, particularly in Khyber Pakhtunkhwa province. The paper highlights the challenges and potential in existing legal frameworks and institutional capacities and underscores the need for an integrated approach that incorporates gender-responsive policies, community engagement, and innovative solutions. By enhancing policy coherence, fostering inter-agency collaboration, and addressing cultural barriers, Pakistan can strengthen its climate resilience while promoting social inclusion.

Key words:

Climate change, Gender equality, Social inclusion, Climate resilience, Pakistan

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Introduction

In Pakistan, the intersection of social injustice and climate change is not just an emerging challenge; it is an immediate crisis. The devastating floods of August 2022 highlighted this reality, as countless vulnerable populations were displaced, their livelihoods shattered, and socio-economic disparities widened. These challenges disproportionately affect marginalized groups, particularly women, who often bear the brunt of environmental degradation due to socio-economic inequalities.

Despite contributing only 1% to global greenhouse gas emissions, Pakistan is one of the four countries most severely impacted by climate change, as reported by the National Disaster Risk Management Fund (NDRMF) and the World Risk Report 2023. This paradox exemplifies the urgent need for a nuanced understanding and inclusive solutions to the climate crisis.

Background

Gender Equality and Social Inclusion (GESI) addresses improving access to livelihood assets and services for all, including women, the poor, and the excluded. It supports more inclusive policies and mindsets, increasing the voice and influence of these marginalized groups (UNDP, 2016).

Cultural and citizen engagement is a deliberative form of public participation that informs effective policy-making by providing members of the public with a platform to discuss policy issues. It recognizes the views, perspectives, and knowledge of a diverse group of people within a particular region or country as part of policy discussions. This deliberative integration between the public and national policy-making distinguishes cultural engagement from other participatory governance mechanisms (Bombard, Abelso, Simeonov, & Gauvin, 2013).

Cultural engagement fosters ethical awareness, encouraging individuals to think, relate, and respond to local and global issues, connecting them to communities both near and far. Constructive relationships between communities and governmental institutions make community engagement not only desirable but necessary and viable. It leads to more equitable, sustainable public decisions and improves the livability of local communities, benefiting individuals, public organizations, and governments alike (Bombard, Abelso, Simeonov, & Gauvin, 2013).

Climate Change Mitigation and Adaptation

Climate change mitigation refers to actions taken by governments, businesses, or individuals to reduce or prevent greenhouse gas emissions, or to enhance carbon sinks that remove them from the atmosphere. These gases trap heat from the sun, keeping the planet warm. Climate change adaptation involves altering behaviors, systems, and—in some cases—ways of life to protect families, economies, and the environment from the impacts of

climate change. The more we reduce emissions now, the easier it will be to adapt to the changes we can no longer avoid (Fischer & Newell, 2008).

Mitigation aims to reduce heat-trapping greenhouse gases to prevent extreme temperature increases, but it will take decades to affect rising temperatures. Therefore, we must adapt now to the changes already upon us and those we will continue to face in the foreseeable future (Fischer & Newell, 2008).

Literature Review

As the international community becomes increasingly aware of the "gender gap" in agriculture sectors and the important role of women and marginalized groups in climate change solutions, commitments to integrating gender and social inclusion in climate change policies have grown. Article 7 of the Paris Agreement, Sustainable Development Goal 5 on gender equality under Agenda 2030, and the UNFCCC enhanced Lima Work Programme on Gender and its Gender Action Plan all indicate progress toward integrating gender and social inclusion in the global response to climate change.

Sectors that attract the most climate capital are also the ones where women are most underrepresented in business leadership. For instance, only 7% of startup founders in the energy sector are women (IFC, 2023). A 1% increase in the share of female managers leads to a 0.5% decrease in CO2 emissions (ECB, 2022). Lending volumes to more polluting industries are 10% lower when banks have at least 37% women on their boards (ECB, 2022). Companies with greater gender diversity on their boards are 60% more likely to reduce energy consumption intensity, 39% more likely to reduce greenhouse gas emissions, and 46% more likely to reduce water use (IFC, 2023).

People who are socially, economically, culturally, politically, institutionally, or otherwise marginalized are especially vulnerable to climate change and to some adaptation and mitigation responses. This heightened vulnerability is rarely due to a single cause. Rather, it is the result of intersecting social processes that create inequalities in socioeconomic status, income, and exposure. These social processes include discrimination based on gender, class, ethnicity, age, and disability.

Statement of Problem

The current climate crisis requires effective mitigation strategies that integrate diverse perspectives and inclusive practices across Pakistan. However, many initiatives overlook the crucial roles of gender inclusion and cultural engagement, disproportionately affecting vulnerable populations such as women and marginalized communities. This gap underscores the need for a comprehensive examination of existing policies to develop more effective and equitable solutions that foster resilience and ensure a just

response to climate change.

Scope of the Study

- This study will investigate the inclusion of women in climate mitigation efforts and the importance of cultural engagement in addressing climate change at both the federal and provincial levels in Pakistan.
- It aims to identify barriers that hinder the participation of women and marginalized communities in climate mitigation initiatives.
- Through qualitative research and case studies, the study will evaluate existing policies and highlight best practices that integrate gender perspectives.
- Ultimately, the research seeks to develop actionable recommendations for creating more equitable climate strategies that empower vulnerable populations and enhance community resilience.

Research Methodology

This study employs a mixed-methods approach, combining primary and secondary research. Primary research involves semi-structured interviews with government officials and representatives from non-governmental development organizations to gather firsthand information. Secondary research supplements this data through analysis of research articles, relevant laws and policies, newspapers, television talk shows, websites, and books. By integrating these sources, the study provides a comprehensive and nuanced understanding of the research topic.

Interviews with Officials

The Research Group team met with the Director General of the Environmental Protection Agency in Peshawar and the Additional Secretary of Climate Change, Forestry, Environment & Wildlife Department, Government of Khyber Pakhtunkhwa. A telephonic interview was also conducted with the Deputy Director of Social Welfare and the Women Development Department. Lastly, the team interviewed the Senior Chief of Environment Planning & Development Department regarding gender-inclusive and community-centric initiatives taken by their departments.

Interviews with NGO Representatives

Amongst the NGO sector, Khwendo Kor, a women-led, gender- and rights-based organization dedicated to promoting women's empowerment, gender equality, and social justice in Pakistan, was interviewed. During a visit to the NGO's head office, the management informed the team that KK works in villages of Khyber Pakhtunkhwa (KP) and New Tribal Districts. They have initiated projects on girls' education, civil rights, women's political

participation, economic empowerment, humanitarian responses, and climate change with local communities to create a conducive environment for women's development, access to opportunities, and climate resilience and justice at different levels.

Secondary Data

In secondary data collection, the study reviewed research articles, policies, newspapers, television talk shows, websites, and books. It also examined the following laws, which provided insights into Pakistan's and Khyber Pakhtunkhwa's environmental and climate change frameworks.

Federal Laws

- Pakistan Environmental Protection Act (1997)
- Pakistan Climate Change Act (2017)
- National Climate Change Policy (2012 & 2021)
- National Adaptation Plan (2023)

Provincial Laws

- Khyber Pakhtunkhwa Environmental Protection Act (2014)
- Khyber Pakhtunkhwa Climate Change Policy (2022)
- Khyber Pakhtunkhwa Climate Action Plan (2022)
- Khyber Pakhtunkhwa Women Empowerment Policy (2017)
- Khyber Pakhtunkhwa Social Protection Policy (2022)

The study also employs qualitative research to conduct an in-depth comparison of federal legislative and institutional frameworks with those of Khyber Pakhtunkhwa (KP). The research tools utilized include Situational Analysis, which provides an overview of the current context; Stakeholder Analysis, to identify key players and their interests; SWOT Analysis, to examine strengths, weaknesses, opportunities, and threats; PESTLE Analysis, to study the political, economic, social, technological, legal, and environmental aspects affecting gender inclusion and cultural engagement for climate mitigation; and Gap Analysis, to pinpoint areas for improvement.

By applying these tools, the study aims to provide a comprehensive understanding of the similarities and differences between the two frameworks, shedding light on potential areas for reform and enhancement. This qualitative approach enables a nuanced exploration of the complex relationships between legislative and institutional mechanisms, ultimately informing policy recommendations for effective governance in Pakistan and KP.

Stakeholder Analysis

International Stakeholders

i. International Donor Bodies

Several international governmental bodies are actively supporting climate mitigation efforts, prioritizing gender inclusion and cultural engagement. These organizations include the United Nations Development Program (UNDP), United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), Global Environment Facility (GEF), Green Climate Fund (GCF), Climate Investment Funds (CIF) of the World Bank, Asian Development Bank (ADB), and International Fund for Agricultural Development (IFAD). These entities integrate gender and cultural considerations into their climate mitigation initiatives, recognizing the critical role of gender equality and cultural engagement in effective climate action.

ii. International Non-Profit Organizations

Several International Non-Governmental Organizations (INGOs) are actively addressing climate change, prioritizing gender inclusion and cultural engagement. Notably, Oxfam International, CARE International, World Wildlife Fund (WWF), The Nature Conservancy, and Women's Environment and Development Organization (WEDO) are implementing gender-sensitive climate resilience projects. These INGOs work with local communities, governments, and other stakeholders to promote women's empowerment, cultural preservation, and climate justice. They also advocate for policy changes and support climate change adaptation and mitigation initiatives that address the unique needs and perspectives of women and marginalized communities.

National Stakeholders

i. The Ministry of Climate Change

The Ministry of Climate Change in Pakistan has been working toward climate mitigation, with a focus on cultural engagement and gender inclusion. The ministry is headed by the Prime Minister of Pakistan, who oversees initiatives aimed at reducing the country's carbon footprint and promoting sustainable development. The ministry's Climate Change Division has developed the National Climate Change Policy (2012) and the Climate Change Act (2017).

ii. Ministry of Planning, Development, and Special Initiatives

The main division under the ministry is the Planning Commission of Pakistan, responsible for financial and public policy development. It is headed by the Minister for Planning, Development & Special Initiatives, who must be a Member of Parliament. The Planning Commission

undertakes research studies and state policy development initiatives for the growth of the national economy and the expansion of public and state infrastructure.

iii. Planning and Development Department, Peshawar

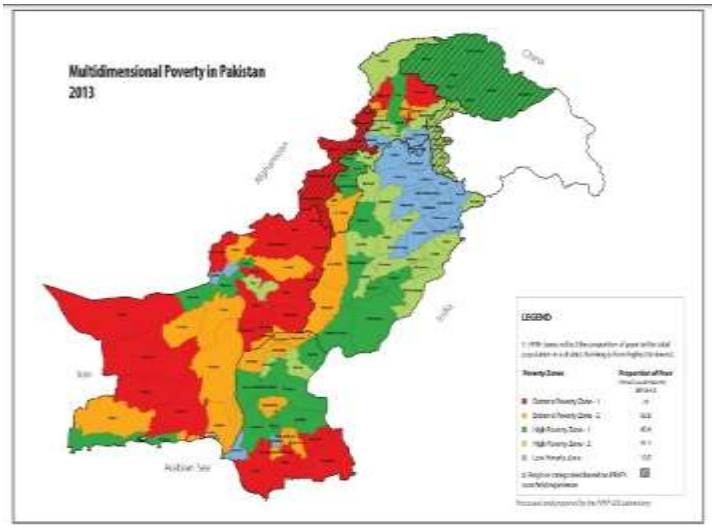
The Planning and Development Department, headed by the Additional Chief Secretary, provides policy and strategic guidance for provincial socio-economic development. This department is working toward climate mitigation, focusing on cultural engagement and gender inclusion. It has approved two donor-supported projects, namely KP-RAP and KP-RETP, where gender inclusion and cultural engagement are key components.

iv. Environmental Protection Agency, Peshawar

The Environmental Protection Agency (EPA) Peshawar, headed by the Director General of the EPA, operates under the supervision of the Ministry of Climate Change (MoCC), Government of Pakistan. As a regulatory body, the EPA focuses on environmental protection and conservation. It has issued the Khyber Pakhtunkhwa Climate Change Policy 2022, which emphasizes youth and women's development, creating guidelines for gender-inclusive climate change initiatives.

Target Population

Disparities in poverty within a country are linked to differences in geographic capital, biophysical endowment, access to infrastructure, and market areas. Spatial poverty has emerged as a severe challenge for developing countries, resulting in biased and unjust distribution of resources (Petrucci, Salvati, & Seghieri, 2004). FATA and Balochistan are the poorest larger administrative units in Pakistan. By and large, the poorest districts in Pakistan belong to Balochistan (i.e., Sherani, Kohlu, Chaghi, and Dera Bugti) and Sindh (i.e., Badin, Umerkot, Tando Muhammad Khan, and Tharparkar) provinces (Ullah & Chishti, 2023).



There is a tremendous need to invest in education and healthcare provision, which are particularly low in the poorest districts. Some of the populations facing the worst consequences of climate change belong to the coastal regions, high-altitude mountainous terrains, and desert regions of Sindh and South Punjab, where communities are entirely dependent upon rain cycles and weather patterns to farm their sustenance locally.

The gender discriminatory practices in Pakistani society also shape the distribution of poverty in the country. Traditional gender roles in Pakistan define a woman's place as in the home and not in the workplace, while defining the man as the breadwinner. Consequently, society invests far less in women than in men. Women in Pakistan suffer from a poverty of opportunities throughout their lives. Female literacy in Pakistan is 46% compared to male literacy at 69% (World Bank, 2022).

Situational Analysis

Expanding women's leadership roles in climate governance at the provincial level is crucial. Programs aimed at increasing female representation in decision-making processes will ensure that gender perspectives are better integrated into climate policies. At both the federal and provincial levels, Pakistan's climate change policies increasingly emphasize gender inclusion.

The National Climate Change Policy (NCCP) 2021 acknowledges the disproportionate impacts of climate change on women, especially in rural areas where they play a critical role in agriculture, water management, and fuel collection. The NCCP stresses integrating gender perspectives into all climate-related policies, ensuring women's participation in decision-making, and developing gender-sensitive climate mitigation strategies. The Climate Change Gender Action Plan (ccGAP) has also been developed to address gender vulnerabilities and encourage female leadership in climate action. Environmental problems in Pakistan, such as erosion, the use of agro-chemicals, and deforestation, contribute to rising poverty in the country.

Increasing pollution contributes to an increasing risk of toxicity, and poor industrial standards in the country contribute to rising pollution.

Key Points from Discourse Analysis with Government Officials & Experts:

In the course of data-gathering interviews from various related departments, the DG of the Environmental Protection Agency (EPA), Peshawar, briefed the team on the establishment and general functions of the EPA. When asked about initiatives taken by the EPA regarding gender inclusion in climate mitigation, he stated that the EPA focuses on human beings in general, without specific emphasis on gender. However, the EPA has launched an awareness campaign called "Green Club" in various schools, with the help of donors, organizing workshops in 21 schools, mostly focusing on female schools. Regarding cultural engagement in climate mitigation, he mentioned that the EPA is working on the Climate Change Action Plan 2022, which includes 34 sector guidelines currently under

process.

The Additional Secretary of the Climate Change Forestry, Environment, and Wildlife Department of the Government of Khyber Pakhtunkhwa discussed the forest department's climate-friendly projects. However, they noted that their projects aren't gender-specific, except for the Tsunami Tree Project, which involves recruiting women for plantation drives in many areas. The Deputy Director of the Social Welfare and Women Development Department, KP, informed the research team that their department is not directly involved in cultural engagement and gender inclusion for climate mitigation, emphasizing that agriculture and environmental departments primarily handle these issues. Nevertheless, they organize awareness campaigns, seminars, and tree plantation activities at Dar-ul-Amans and Special Education Institutes. Similarly, the Senior Chief of the Environment Planning & Development Department informed about various executed projects, including two provincial government initiatives—KP RAP and KP RETP—specifically focusing on gender.

Current/ Ongoing Projects in Khyber Pakhtunkhwa

KP-Rural Accessibility Project

The KP-Rural Accessibility Project, approved by ECNEC on May 31, 2023, allocates Rs 69.4 billion to enhance rural accessibility to markets, education, and health facilities through infrastructure upgrades and transport service improvements. Component 2 focuses on safe and affordable school journeys for girls, promoting education for women.

The KP-RAP Education Component aims to facilitate girls by providing transport to and from school to enroll 5,000 out-of-school middle-school girls initially, with potential expansion to primary school girls, support 60,000 enrolled girls, ensuring regular attendance and reducing attrition, as well as to benefit female teachers to enhance safety perceptions among parents.

Khyber Pakhtunkhwa Rural Economic Transformation Project (KP-RETP)

The Khyber Pakhtunkhwa Rural Economic Transformation Project (KP-RETP) is a flagship initiative between the Government of Khyber Pakhtunkhwa and the International Fund for Agricultural Development (IFAD) aimed at revitalizing the rural economy. Approved by the Provincial Development Working Party (PDWP) on October 8, 2021, and the Executive Committee of the National Economic Council (ECNEC) on March 16, 2022, KP-RETP targets households in PSC 0-34, with a focus on youth (50%) and women (25%). The project aims to improve rural incomes through climate-resilient agriculture and off-farm employment opportunities, benefiting 785,000 households or approximately 4.35 million individuals.

The project's total cost is PKR 30.264 billion (USD 179 million), with funding shared between IFAD (58%), the Government of Khyber Pakhtunkhwa

(15.56%), and beneficiaries (26.44%). Implemented from 2022 to 2028, KP-RETP covers all districts in Khyber Pakhtunkhwa, including merged districts, through five Agribusiness Clusters: Southern, Northern, Central, Eastern, and Chitral Natural. The project comprises three components: Agribusiness Development, Skills and Employment Promotion, and Project Management and Policy Support.

Community Engagement Programs:

Various NGOs operate grassroots initiatives aimed at empowering women in climate adaptation efforts. These include training programs on sustainable agricultural practices and awareness campaigns about climate change impacts. However, these programs often lack support from government bodies and are not systematically integrated into broader climate policies.
Organizations such as the Aga Khan Rural Support Program are working in the mountainous and far-flung northern regions of Pakistan. Their Program for Poverty Reduction (PPR) has been developed in light of the Indigenous Peoples Framework to protect the rights of indigenous people in Chitral.

He Kalashi people have socio-economic and cultural characteristics of indigenous people as defined by the World Bank Policy on Indigenous Peoples. This project is specifically working to address the needs of the Kalashi people by engaging them in project planning and implementation. So far, 13 community trainings benefiting 400 people have been conducted; 27 small community infrastructures have been developed; 12 government schools and 4 Kalash Community schools have received improvement support; and 4 government health centers and 7 bashalanis (Kalashi women maternity homes) have been established. Additionally, 131 ultra-poor households and 155 youth from poor households have received productive support assets and skills under the projects.

Under the Indus for All Programme, where 39 villages are being covered through nine community-based organizations, efforts are being made to reduce the pressure on natural resources by providing alternative livelihood resources to the community. WWF has supported the project titled Rehabilitation of Keenjhar Fishermen Communities through a participatory approach being implemented by the Keenjhar Fishermen Welfare Society. The project aims to improve the livelihood resources of fishing communities by releasing two hundred thousand fish seeds into the lake and raising awareness among fishermen regarding sustainable fishing practices.

The Sindh Rural Support Organization (SRSO) is a not-for-profit organization registered under Section 42 of the Companies Act 2017. The SRSO operates in 15 districts. Its mandate is to alleviate poverty by harnessing people's potential and undertaking development activities in Sindh, including climate mitigation, girls' education, and poverty reduction.

Khwendokor, a Peshawar-based NGO, focuses on the active involvement of communities, especially women and children. KK works in the villages of Khyber Pakhtunkhwa (KP) and New Tribal Districts, where health and wash, girls' education, civil rights and women's political participation, economic empowerment, humanitarian responses, and climate change projects have been initiated with local communities to create a conducive environment for women's development, access to opportunities, and the supportive role of stakeholders at different tiers.

Evaluation of Capacity, Coordination, and Effectiveness

Capacity:

he federal government possesses a relatively strong legal framework and a commitment to gender inclusion; however, its capacity to implement these frameworks is hindered by limited human and financial resources. The provincial government has made strides in climate policy but often struggles with resource constraints and inadequate staffing to address gender-specific needs effectively.

Coordination: Coordination between federal and provincial levels is often weak, with overlapping mandates and insufficient communication channels. This fragmentation hampers the development of cohesive strategies that comprehensively address both climate change and gender issues. Opportunities exist for collaboration among relevant ministries (e.g., Ministry of Climate Change, Ministry of Women Development) and local government bodies to improve integrated approaches.

Effectiveness: While policies exist, their effectiveness is compromised by inadequate enforcement mechanisms and a lack of accountability for gender inclusion in climate projects. There are effective grassroots initiatives led by NGOs that successfully engage women, but these efforts are often not supported or scaled by governmental institutions.

Legal Framework Analysis of Relevant Acts and Policies

Pakistan is facing a dual challenge: the pressing need to mitigate climate change impacts and the imperative of ensuring gender inclusion in this process. With significant vulnerabilities among marginalized communities, particularly women, the effectiveness of legal and institutional frameworks at both federal and provincial levels is crucial. This review critically assesses these frameworks, particularly in Khyber Pakhtunkhwa (KP), examining how they support or hinder efforts toward gender inclusion and cultural engagement in climate mitigation.

Federal Level

Constitution of Pakistan (1973):

1. Article 25: Ensures equality before the law and prohibits discrimination based on sex.
2. Article 35: Mandates the protection of family and the rights of women.
   While the Constitution provides a robust framework for gender equality, practical enforcement remains inadequate. Gender provisions often lack integration into climate policies, resulting in limited advocacy for women's rights in environmental governance.

Pakistan Environmental Protection Act (1997):

The Pakistan Environmental Protection Act (1997) primarily focuses on protecting, conserving, and rehabilitating the environment, preventing pollution, and promoting sustainable development, but it doesn't explicitly address gender inclusion and cultural engagement for climate mitigation. The Act establishes the Pakistan Environmental Protection Agency to coordinate research and activities related to environmental protection. Overall, while not directly addressing gender and cultural engagement, it lays the groundwork for future climate change policies that do. It only provides that the Government shall make rules regarding the Convention Concerning the Protection of World Cultural and Natural Heritage; otherwise, not a single word is used regarding culture, gender-specific issues, and minorities.

National Climate Change Policy (2012 & 2021)

The National Climate Change Policy, 2021, prioritizes gender inclusion and cultural engagement for climate mitigation. The policy ensures gender mainstreaming in climate change decision-making processes and recognizes women's vulnerability to climate change, promoting gender-sensitive adaptation strategies. Additionally, it incorporates cultural preservation and community engagement in climate resilience efforts, aiming to enhance public awareness, education, and participation, including marginalized communities.

Clause 4.8.2 of Pakistan's National Climate Change Policy recognizes women as disproportionately vulnerable to climate change impacts, particularly in agriculture and natural resource management, and commits to empowering women through gender-responsive strategies, participation, and decision-making. Sub-clause (k) of Clause 4.6.4 of the policy measures stresses the need to identify vulnerable coastal areas that should be protected from any infrastructure construction or commercial activities and to notify the level of activities allowed in these areas.

Pakistan Climate Change Act (2017)

The Climate Change Act 2017 of Pakistan is federal legislation aimed at addressing environmental and climate challenges in the country. However, upon critical analysis, it's clear that the Act lacks specific provisions for gender inclusion in climate mitigation, sufficient focus on cultural engagement, and penal provisions against culprits.

Section 7, sub-section (3) of the Act provides that the authority shall ensure that all appointments are made in a transparent manner and that adequate and equal treatment is given to women, minorities, and disabled persons. Section 8(3) indicates consideration for gender equality and inclusivity in climate change and renewable energy initiatives. The word "vulnerability" is used only once in clause (o) of section 8(1), which refers to Pakistan's susceptibility to climate change impacts, assessing its exposure, sensitivity, and adaptive capacity to climate-related risks, and does not focus on the vulnerable segments of society.

National Adaptation Plan (2023)

The NAP 2023 prioritizes gender inclusion and cultural engagement through the Climate Change Gender Action Plan (ccGAP). The plan enhances women's participation in climate decision-making, promotes gender-sensitive adaptation strategies, and empowers rural women in climate-resilient agriculture. It also incorporates traditional knowledge, community-led initiatives, and cultural preservation in climate resilience efforts.

Clause 3.4 describes the vision and goals and stresses empowering vulnerable communities through gender-responsive approaches. Clause 4.6.1 focuses on gender and social inclusion, tackling the 23% female labor force participation. Empowering women, youth, and marginalized communities drives equitable climate resilience.

Provincial Level (Khyber Pakhtunkhwa)

KP Environmental Protection Act (2014):

Establishes a framework for environmental governance at the provincial level. The Khyber Pakhtunkhwa Environmental Protection Act primarily focuses on environmental protection, conservation, and sustainable development, without dedicated clauses addressing gender or cultural considerations. Similar to the federal act, this legislation does not address gender-specific impacts, hindering the ability to develop inclusive environmental policies that consider women's roles and experiences.

Khyber Pakhtunkhwa Climate Change Policy (2022):

The Khyber Pakhtunkhwa Climate Change Policy, 2022, prioritizes gender inclusion and cultural engagement for climate mitigation. It recognizes women's vulnerability, ensures participation in decision-making, and promotes gender-sensitive adaptation strategies. The policy also acknowledges traditional knowledge, encourages community-led initiatives,

and integrates cultural considerations. This inclusive approach aims to enhance climate resilience and social inclusion.

Clause 5.8.2 of the policy recognizes the unique vulnerability of poor, rural women to climate change due to limited access to education, opportunities, and decision-making processes. To address this, the policy aims to incorporate gender perspectives, ensure women's participation, and reduce their vulnerability through measures like gender-inclusive planning, education, and capacity building.

Khyber Pakhtunkhwa Climate Action Plan (2022):

The Khyber Pakhtunkhwa Climate Action Plan 2022 prioritizes gender inclusion and cultural engagement for climate mitigation. It aims to enhance women's participation in decision-making, incorporate gender perspectives, and reduce vulnerability through education and capacity building. The plan also supports inclusive policy dialogue, capacity development, and pilot projects for women, promoting a gender-sensitive approach to climate resilience.

Clause 2.11 provides for youth and gender development. Strategy 1.17 stresses the importance of gender-inclusive farming and awareness. Sr. no. 6 of strategy 6.1 describes the need for an awareness program for gender inclusiveness. Strategy 6.1 emphasizes the requirement for creating coherence among institutions dealing with climate change and gender. Strategy 1.17 stresses women's participation in the solid waste collection and management system.

Khyber Pakhtunkhwa Women Empowerment Policy (2017):

The Khyber Pakhtunkhwa Women Empowerment Policy, 2017, promotes gender equality and empowerment. It enhances economic opportunities, decision-making participation, and protection from violence. While not exclusively focused on climate mitigation, it indirectly supports climate resilience through women's empowerment.

The policy encourages sustainable livelihoods and resource management. Clause 3.3.2 provides for the social empowerment of women through education, health, and justice, whereas clause 3.3.4 stresses the need for the political empowerment of women and decision-making.

Khyber Pakhtunkhwa Social Protection Policy (2022):

The Khyber Pakhtunkhwa Social Protection Policy (2022) aims to promote gender equality and empower women through targeted programs. It recognizes the social inclusion and sustained livelihoods of vulnerable groups, including women, persons with disabilities, the elderly, minorities, and transgender persons. The policy also acknowledges the importance of cultural and social practices in shaping social protection and welfare. Clause 2.1 of the policy recognizes that women are facing a gender gap in the province. Clause 3.2.5 makes a comparison of literacy rates between women

and stresses the need to improve the literacy rate of women. Clause 4.5.3.3 advocates for a gender-sensitive approach.

Institutional Framework Analysis

Federal Level Ministry of Climate Change & Environmental Coordination (MoCC&EC):

MoCC&EC is responsible for the following six key elements:

1. Steering the NAP process at the national level.
2. Undertaking climate change research, vulnerability reduction assessment, and prioritization of climate actions.
3. Developing climate information systems.
4. Streamlining the planning process for the NAP and climate-proofing the development sector.
5. Mobilizing finance for climate change adaptation.
6. Developing and implementing monitoring, evaluation, and verification systems.

Ministry of Planning, Development & Special Initiatives (MoPD&SI):

The MoPD&SI serves as the focal point for planning and coordination with the provincial planning and development departments. The latter spearheads planning and investment portfolios, projects, and programs with sectoral ministries, departments, and line agencies. It is also the custodian of the budget-making process, in collaboration with the Economic Affairs Division (EAD) and the Ministry of Finance (MoF) and the MoPD&SI provincial counterparts. It plays an important role in mainstreaming climate change considerations into overall development planning and public financial management processes.

Provincial Level (Khyber Pakhtunkhwa)

KP Department of Environment:

a. **Role:** Implements environmental policies and programs in the province.

b. **Assessment:** The Department has made some strides in community engagement; however, the integration of gender perspectives in environmental initiatives remains weak. Capacity-building initiatives for staff on gender issues are lacking.

Women Development Department:

a. **Role:** Focuses on women's empowerment and promoting gender equality in KP.

b. **Assessment:** While the Department works to advance women's rights, its integration into environmental policies is minimal. Without a clear mandate to engage in climate policy, its effectiveness is limited.

Local Government Institutions:

a. **Role:** Engage with communities at the grassroots level.

b. **Assessment:** Local institutions are better positioned to understand cultural contexts but often lack the capacity, resources, and training needed to implement gender-inclusive climate initiatives effectively

SWOT & EETH Analysis of Existing Institutional Framework

Strengths

Established Legal Frameworks:

- Both federal and provincial governments have legal provisions supporting gender equality and climate action, including the Constitution and specific climate change policies.

Awareness of Gender Issues:

- Increasing recognition of the importance of gender inclusion in climate policies within governmental institutions and among stakeholders.

Community Engagement Initiatives:

- Various NGOs and community organizations actively engage in grassroots-level programs, promoting women's participation in climate resilience efforts.

Commitment to International Agreements:

- Pakistan is a signatory to several international agreements (e.g., the Paris Agreement), reflecting a commitment to gender-responsive climate action.

Weaknesses

Limited Capacity and Resources:

- Many institutions, especially at the provincial level, lack adequate human and financial resources to implement gender-inclusive climate strategies effectively.

Weak Coordination Mechanisms:

- Fragmented approaches among various departments and agencies lead to inefficiencies and a lack of coherent strategies.

Inadequate Training:

- There is a significant gap in training and capacity building for officials on integrating gender perspectives into climate initiatives.

Insufficient Monitoring and Evaluation:

- Existing frameworks lack robust monitoring and evaluation mechanisms to assess the impact of gender inclusion in climate actions.

Opportunities

Increased Funding for Climate Projects:

- Potential to secure funding from international organizations and climate funds (e.g., Green Climate Fund) to support gender-responsive climate initiatives.

Strengthening Partnerships:

- Opportunities to forge partnerships with civil society, academia, and the private sector to enhance community engagement and capacity building.

Leveraging Technology:

- Utilizing technology for data collection, monitoring, and community engagement can improve the effectiveness of climate initiatives.

Global Best Practices:

- Learning from successful international models for gender inclusion and cultural engagement can provide valuable insights for adapting strategies in Pakistan.

Threats

Political Instability:

- Frequent changes in government and policy priorities can disrupt ongoing initiatives and hinder long-term planning for gender-responsive climate action.

Cultural Barriers:

- Societal norms and traditional gender roles may limit women's participation in decision-making processes related to climate adaptation and mitigation.

Climate Change Impacts:

- The increasing frequency and intensity of climate-related disasters can overwhelm institutional capacities, diverting attention from gender inclusion efforts.

Resource Competition:

- Competing priorities for limited resources may lead to climate initiatives being deprioritized, particularly those focusing on gender inclusion.

EETH Analysis

E: Enhancement of Strengths

- **Leverage Established Legal Frameworks:** Utilize existing constitutional provisions and national policies that support gender equality and climate action as a foundation for advocacy. This can involve organizing stakeholder meetings to ensure all relevant parties understand these frameworks and how to use them effectively.
- **Promote Awareness:** Implement targeted campaigns and workshops to increase awareness among government officials and stakeholders about the importance of gender inclusivity in climate policy. This can involve collaboration with NGOs and academic institutions to create tailored training modules that highlight successful case studies and best practices.

E: Elimination of Weaknesses

- **Capacity Building:** Develop comprehensive training programs focusing on integrating gender perspectives into climate strategies. This could include modules on gender analysis, project management, and monitoring and evaluation techniques tailored for officials at all levels of government.
- **Improve Coordination:** Establish a centralized coordination body to enhance inter-departmental collaboration. This body could facilitate regular meetings and communication channels to ensure all relevant departments are aligned on goals and strategies, fostering a more cohesive approach to policy implementation.

T: Taking Advantage of Opportunities

- **Secure International Funding:** Actively seek and apply for funding from international organizations, climate funds, and development partners. This could involve creating a dedicated task force responsible for identifying funding opportunities and developing compelling proposals that emphasize the integration of gender perspectives.
- **Foster Partnerships:** Build strategic partnerships with civil society organizations, academic institutions, and the private sector to leverage their expertise and resources. Collaborative projects could focus on community-level initiatives that promote women's

involvement in climate resilience and adaptation strategies, ensuring broader engagement.

H: Hedging Against Threats

- **Political Stability Strategies:** Develop adaptable plans that allow for flexibility in response to political changes. This could involve creating pilot projects that can be scaled up or modified based on shifting political priorities, ensuring that gender-responsive initiatives can continue regardless of the political landscape.
- **Address Cultural Barriers:** Engage local community leaders, influencers, and women's groups in discussions aimed at challenging and reshaping traditional gender roles. This could involve awareness campaigns that highlight successful female leaders in climate action and promote gender equality as a community benefit, thereby fostering a supportive environment for women's participation.

By focusing on these areas, stakeholders can create a more effective and sustainable framework for integrating gender considerations into climate initiatives, ultimately leading to improved outcomes for both communities and the environment, and enhancing the overall effectiveness of gender-inclusive climate initiatives.

PESTLE Analysis of Gender Inclusion and Cultural Engagement for Climate Mitigation

People who are socially, economically, culturally, politically, institutionally, or otherwise marginalized are especially vulnerable to climate change and to some adaptation and mitigation responses. This heightened vulnerability is rarely due to a single cause. Rather, it is the product of intersecting social processes that result in inequalities in socioeconomic status and income, as well as exposure. These social processes include, for example, discrimination based on gender, class, ethnicity, age, and (dis)ability (IPCC, 2014).

Political

- **Government Commitment:** Increasing political will to address climate change and gender issues, evidenced by the ratification of international agreements.
- **Political Stability:** Frequent changes in government may disrupt continuity in climate policies and initiatives, affecting long-term strategies.
- **Policy Fragmentation:** Lack of coherent policies across different levels of government leads to inconsistent implementation of gender-responsive strategies.

Economic

- **Funding Availability:** Limited financial resources at both federal and provincial levels hamper the implementation of gender-inclusive climate initiatives.
- **Economic Dependency:** Reliance on agriculture and traditional industries may restrict investment in sustainable practices and climate resilience.
- **Job Creation:** Opportunities for job creation in green sectors are significant, but often do not prioritize women's participation or benefit marginalized communities.

Social

- **Cultural Norms:** Traditional gender roles and societal attitudes can hinder women's involvement in climate decision-making and adaptation strategies.
- **Awareness and Education:** Limited awareness of climate change impacts and gender issues at the community level affects engagement and participation.
- **Community Resilience:** Social structures can enhance community resilience but may exclude women's voices from critical discussions.

Technological

- **Access to Technology:** Limited access to technology and information for women, especially in rural areas, restricts their ability to engage in climate mitigation efforts.
- **Innovative Solutions:** Advances in technology (e.g., renewable energy, information systems) can promote gender inclusion but require targeted training and capacity building.
- **Data Collection:** Lack of gender-disaggregated data on climate impacts limits effective policymaking and resource allocation.

Legal

- **Legal Frameworks:** Existing laws support gender equality and climate action; however, implementation is often weak.
- **Enforcement Mechanisms:** Insufficient enforcement of gender-responsive policies leads to inadequate accountability in climate initiatives.

- **Rights and Protections:** Gaps exist in legal protections for women in climate-related sectors, impacting their ability to participate fully.

Environmental

- **Climate Vulnerability:** Women are disproportionately affected by climate change impacts, particularly in rural and marginalized communities.
- **Resource Management:** Environmental degradation affects traditional livelihoods, necessitating a focus on sustainable practices that include women's roles.
- **Biodiversity and Conservation:** Integrating cultural practices in environmental conservation can enhance climate resilience but requires inclusive approaches.

The PESTLE analysis reveals several internal and external factors impacting gender inclusion and cultural engagement for climate mitigation in Pakistan. Political instability, limited economic resources, cultural barriers, and inadequate technological access are significant challenges. Meanwhile, legal frameworks exist but lack enforcement, and environmental vulnerabilities disproportionately affect women.

Comparative Analysis with Global Best Practices

UN Women's "Gender and Climate Change" Initiative:

This initiative emphasizes integrating gender perspectives into climate policies globally, advocating for women's participation in climate governance. It includes training programs for women in leadership roles related to climate adaptation and ensures that women have equal access to financial resources, technology, and information necessary for climate resilience. Pakistan could adopt similar capacity-building programs targeted at women in rural areas to enhance their roles in climate action.

The Adaptation Fund's Gender Policy:

This policy requires gender assessments in all funded projects, ensuring that gender considerations are central to climate adaptation initiatives. Projects must demonstrate how they address gender disparities while establishing mechanisms to track gender-specific outcomes. Implementing mandatory gender analyses for climate projects in Pakistan could help identify and address gender-specific vulnerabilities effectively.

Sustainable Agriculture Practices (India):

Programs like the National Mission for Sustainable Agriculture focus on promoting sustainable agricultural practices.

- **Organic Farming:** Encouraging practices that reduce chemical inputs and enhance biodiversity.

- **Women's Cooperatives:** Engaging women in sustainable agriculture through cooperatives to improve livelihoods and resilience. Promoting sustainable agriculture practices through women's cooperatives can enhance food security and empower women economically.

Energy Transition Initiatives (Germany):

Germany's Energiewende focuses on transitioning to renewable energy sources while ensuring public participation.

- **Community Renewable Projects:** Local communities are involved in renewable energy projects to foster acceptance and participation.
- **Education and Awareness:** Comprehensive programs to educate citizens on renewable energy benefits. Developing community-led renewable energy projects can improve energy access and resilience while promoting local ownership.

The Indigenous Peoples' Climate Change Assessment (Canada): This cultural engagement model involves Indigenous communities in climate change assessments, recognizing their traditional knowledge and practices.

- **Community-Led Assessments:** Indigenous communities lead assessments, ensuring their cultural practices and knowledge inform climate strategies.
- **Respect for Traditional Knowledge:** Integrating traditional ecological knowledge into policymaking. Engaging local communities and integrating traditional knowledge in climate adaptation strategies could enhance cultural relevance and community buy-in in Pakistan.

The Green Climate Fund's Engagement Strategy:

The Fund, designed for cultural engagement, promotes stakeholder engagement, emphasizing the inclusion of marginalized groups in decision-making. In Mauritius, UNDP, with funding from the Green Climate Fund, has supported the government in installing battery energy storage capacity that has enabled 50 MW of intermittent renewable energy to be connected to the grid, helping to avoid 81,000 tonnes of carbon dioxide annually.

- **Participatory Processes:** Ensuring that vulnerable groups, including women and local communities, have a voice in climate projects.
- **Building Partnerships:** Collaborating with civil society organizations to enhance community engagement. Strengthening participatory processes in Pakistan's climate initiatives can lead to more equitable and effective outcomes.

Indonesia:

In Indonesia, UNDP has been working with the government for over a decade to support sustainable palm oil production. In 2019, the country adopted a National Action Plan on Sustainable Palm Oil, which was collaboratively developed by government, industry, and civil society representatives. The plan increased the adoption of practices to minimize the adverse social and environmental effects of palm oil production and to protect forests. Since 2015, 37 million tonnes of direct greenhouse gas emissions have been avoided, and 824,000 hectares of land with high conservation value have been protected.

Green City Labs:

In Moldova and Paraguay, UNDP has helped set up Green City Labs that are helping to build more sustainable cities. This is achieved by implementing urban land use and mobility planning, prioritizing energy efficiency in residential buildings, introducing low-carbon public transport, implementing resource-efficient waste management, and switching to renewable energy sources.

Comparative Analysis with Pakistan's Strategies

Aspect	Global Best Practices	Pakistan's Current Strategies	Gaps/Opportunities
Gender Analysis	Mandatory gender assessments for projects	Limited gender analyses in climate policies	Implement mandatory gender assessments in climate initiatives.
Capacity Building	Training programs for women in climate leadership	Minimal focus on capacity building for women	Establish targeted training programs for women in rural areas.
Community Engagement	Indigenous-led climate assessments	Some community engagement, but often top-down	Foster community-led approaches and integrate local knowledge.
Participatory Processes	Stakeholder engagement and collaboration	Fragmented engagement with local communities	Develop robust participatory frameworks for decision-making.
Monitoring and Evaluation	Gender-specific outcomes tracking	Weak monitoring mechanisms for gender impacts	Create frameworks to monitor gender-specific outcomes.

GAP Analysis

GAP Analysis for Gender Inclusion and Cultural Engagement in Climate Mitigation

Policy Gaps

- **Lack of Integrated Policies:** There is a lack of coherent policies that effectively integrate gender and climate action at both the federal and provincial levels.
- **Inadequate Gender Mainstreaming:** Policies do not consistently include gender analysis or gender-responsive strategies in climate initiatives.

Regulatory Gaps

- **Weak Enforcement:** While legal frameworks exist, enforcement mechanisms for gender inclusion in climate policies are insufficient, leading to ineffective implementation.
- **Insufficient Regulatory Frameworks:** There is a need for specific regulations that address the unique impacts of climate change on women and marginalized groups.

Operational Gaps

- **Limited Capacity Building:** Insufficient training programs for government officials and community leaders on gender-responsive climate action.
- **Fragmented Implementation:** Disjointed efforts among various agencies and departments hinder the effective operationalization of gender-inclusive climate initiatives.
- **Lack of Monitoring and Evaluation:** Inadequate mechanisms to monitor and evaluate the impact of gender inclusion in climate policies limit accountability and improvements.

The GAP analysis highlights critical policy, regulatory, and operational gaps, such as the need for integrated policies, effective enforcement mechanisms, and capacity-building initiatives. Addressing these gaps is essential for enhancing the effectiveness of gender-inclusive climate strategies, ensuring that women play a vital role in climate resilience efforts. By focusing on these areas, Pakistan can create a more equitable and sustainable response to climate change.

Issues and Challenges

The institutional landscape for addressing gender inclusion and cultural engagement in climate mitigation in Pakistan, particularly in Khyber Pakhtunkhwa, presents a mixed picture. Strengths in legal frameworks and community engagement are overshadowed by weaknesses in capacity, coordination, and effectiveness. The main challenges faced by the government in climate mitigation that harness gender inclusion and cultural mainstreaming are as follows:

A. **Lack of Specific Frameworks for Cultural Engagement:** There are limited guidelines for incorporating diverse cultural practices into climate action, which may restrict meaningful community involvement.
B. **Lack of Specific Targets:** There are few concrete targets or indicators to measure progress on gender inclusion, making it difficult to assess effectiveness over time.
C. **Underrepresentation of Indigenous Voices:** Indigenous populations, who often have unique insights and practices for environmental stewardship, may not be adequately represented in the policy decision-making processes.
D. **Insufficient Training and Capacity Building:** There are limited training programs aimed specifically at empowering women and enhancing their roles in disaster management, which can hinder their effective participation.
E. **Lack of Gender-Disaggregated Data:** There is a shortage of gender-disaggregated data on disaster impacts and responses, making it difficult to tailor interventions to the specific needs of women and marginalized groups.
F. **Monitoring and Evaluation Challenges:** There is often a lack of mechanisms to evaluate the effectiveness of culturally engaged strategies, hindering adaptive learning and improvement.

By leveraging opportunities for funding, partnerships, and best practices while addressing threats from political instability and cultural barriers, institutions can enhance their ability to create resilient and inclusive climate strategies. A focused effort on building capacity and improving coordination will be essential for achieving meaningful progress in gender-responsive climate action.

Conclusion

Climate change is one of the most pressing global challenges, characterized by rising temperatures, extreme weather events, and shifting ecosystems. Its effects are not felt evenly; vulnerable populations—including women, indigenous communities, and low-income groups—often bear the brunt of climate impacts. These communities face heightened risks due to existing social inequalities, limited access to resources, and a lack of representation in decision-making processes. As a result, they may experience more severe economic, health, and environmental consequences, exacerbating pre-existing vulnerabilities.

The legal and institutional frameworks governing gender inclusion and cultural engagement in climate mitigation in Pakistan, especially in Khyber Pakhtunkhwa, show both promise and significant challenges. While there are strong legal foundations and progressive frameworks, their effectiveness is undermined by weak implementation, insufficient resources, and a lack of integration between gender and climate strategies.

Addressing climate change effectively requires a holistic approach that prioritizes gender inclusion and cultural engagement. Women, who are often key stakeholders in resource management and community resilience, have unique perspectives and solutions that can enhance climate mitigation efforts. Cultural engagement ensures that local knowledge and practices are integrated into climate strategies, fostering ownership and sustainability.

Pakistan stands at a critical juncture in addressing the intertwined challenges of climate change and gender inequality. By drawing on global best practices and adapting successful models to its unique context, Pakistan can enhance its climate resilience while promoting gender inclusion and cultural engagement. A more integrated approach that prioritizes gender-responsive strategies and community engagement will not only empower women but also foster sustainable development, ultimately contributing to a more resilient and equitable future.

Recommendations

Based on the comprehensive analyses, the following strategic recommendations aim to address the challenges identified in the PESTLE and GAP analyses. These recommendations focus on enhancing policy coherence, strengthening institutional capacity, fostering inter-agency collaboration, and integrating innovative approaches into the national framework.

Enhance Policy Coherence

a. **Integrated Gender-Climate Policies:** Formulate comprehensive policies that explicitly integrate gender considerations into climate action plans at both federal and provincial levels. This should include specific targets

and accountability mechanisms to ensure effective implementation. It should be ensured that all climate projects undergo gender assessments to identify and address specific vulnerabilities.

b. **National Gender-Climate Action Framework:** Create a framework that outlines clear guidelines for incorporating gender perspectives in all climate-related policies, ensuring consistency across various sectors and levels of government.

c. **Regular Policy Reviews:** Implement a system for periodic reviews of gender-inclusive climate policies to assess their effectiveness and adapt to emerging challenges, ensuring they remain relevant and impactful.

d. **Monitor Gender-Specific Outcomes:** Develop monitoring frameworks to track the gender impacts of climate initiatives, allowing for adjustments and improvements over time.

Strengthen Institutional Capacity

a. **Training and Capacity Building:** Develop and implement targeted training programs for government officials, local leaders, and community organizations on gender-responsive climate action, emphasizing practical skills and knowledge necessary for effective policy implementation. Targeted training should be designed for women, focusing on leadership in climate resilience and sustainable practices.

b. **Enhanced Resource Allocation:** Allocate dedicated financial resources to gender-responsive climate initiatives, ensuring that both federal and provincial governments can effectively implement and monitor relevant programs.

c. **Recruit Gender Experts:** Integrate gender experts into climate-related departments and agencies to provide specialized knowledge and guidance on gender issues within the context of climate action.

Foster Inter-Agency Collaboration

a. **Multi-Stakeholder Committees:** Create committees that include representatives from various government agencies, civil society, and local communities to facilitate collaboration and share best practices in gender-inclusive climate initiatives.

b. **Joint Action Plans:** Encourage inter-agency partnerships by developing joint action plans that outline collaborative strategies for addressing gender inclusion and climate change at both federal and provincial levels.

c. **Cross-Sectoral Coordination Mechanisms:** Strengthen communication and coordination among relevant ministries (e.g., Ministry of Climate Change, Ministry of Women Development,

Ministry of Agriculture) to ensure a unified approach to gender and climate issues.

Integrate Innovative Approaches

a. **Technology for Data Collection and Monitoring:** Utilize digital tools and platforms for collecting gender-disaggregated data on climate impacts, enabling more effective monitoring and evaluation of gender-inclusive policies and initiatives.

b. **Community-Led Innovations:** Encourage community-driven solutions by providing support and resources for local initiatives that incorporate traditional knowledge and practices in climate resilience efforts.

c. **Social Media and Communication Campaigns:** Launch awareness campaigns using social media and other communication platforms to educate communities about the importance of gender inclusion in climate action and promote successful local initiatives. Additionally, include climate mitigation awareness and gender-inclusive climate change responses in school syllabi.

Address Cultural Barriers

a. **Conduct Awareness Programs:** Launch programs aimed at changing societal attitudes and breaking down cultural barriers that limit women's participation in climate decision-making processes.

b. **Engage Men as Allies:** Develop initiatives that actively involve men and boys in promoting gender equality in climate initiatives, fostering a supportive environment for women's engagement.

c. **Highlight Success Stories:** Share and promote success stories of women and communities that have effectively engaged in climate resilience initiatives, serving as role models and inspiration for broader participation.

Practical Action Plan using Log Frame Matrix

The following logical framework (log frame) matrix outlines a detailed action plan to address the challenges identified in previous analyses. This plan includes specific objectives, activities, timelines, roles, and responsibilities to ensure effective implementation and long-term success in enhancing gender inclusion and cultural engagement in climate mitigation efforts.

Objective	Activities	Timeline	Roles & Responsibilities	Indicators of Success
1. Develop Integrated Gender-Climate Policies	a. Conduct stakeholder consultations to identify key policy gaps. b. Draft comprehensive gender-climate policy framework. c. Validate and finalize the policy with stakeholders.	Months 1-6	- Ministry of Climate Change (MoCC) - Ministry of Women Development (MoWD) - Local NGOs	- Number of consultations held - Policy framework drafted and validated
2. Strengthen Institutional Capacity	a. Design training programs for government officials on gender-responsive climate action. b. Implement training sessions across provinces. c. Create resource materials and toolkits for ongoing use.	Months 7-12	- MoCC - MoWD - Training institutes - Local NGOs	- Number of training sessions conducted - Participant feedback on training effectiveness
3. Foster Inter-Agency Collaboration	a. Establish multi-stakeholder committees focused on gender and climate issues. b. Develop joint action plans with clear roles and responsibilities. c. Hold regular inter-agency meetings to review progress.	Months 1-3 (ongoing)	- MoCC - MoWD - Other relevant ministries - Community representatives	- Number of committees formed - Joint action plans developed and implemented

Objective	Activities	Timeline	Roles & Responsibilities	Indicators of Success
4. Integrate Innovative Approaches	a. Identify and implement digital tools for data collection. b. Support community-led climate resilience initiatives. c. Launch awareness campaigns utilizing social media platforms.	Months 4-12 (ongoing)	- MoCC - Technology partners - Community organizations - Marketing teams	- Number of digital tools deployed - Engagement metrics from awareness campaigns
5. Address Cultural Barriers	a. Develop awareness programs targeting societal attitudes. b. Engage men and boys in promoting gender equality initiatives. c. Share success stories through media and community events.	Months 5-12 (ongoing)	- MoWD - NGOs - Media partners	- Number of awareness programs conducted - Increase in community participation metrics
6. Monitor and Evaluate Progress	a. Develop a monitoring and evaluation framework to track progress. b. Conduct annual evaluations of gender-inclusive climate policies. c. Use findings to adjust strategies and improve effectiveness.	Months 12+ (ongoing)	- MoCC - MoWD - External evaluators	- Completion of annual evaluations - Number of policy adjustments made based on findings

By focusing on these prioritized objectives and activities, the action plan aims to leverage the 80/20 principle to achieve significant improvements in gender inclusion and cultural engagement for climate mitigation in Pakistan. This strategic approach will enhance overall effectiveness and ensure that resources are utilized efficiently to produce the greatest impact.

Prioritized Action Plan Using the 80/20 Principle

Based on the previous analyses and focusing on the most critical areas that will yield the greatest impact, this action plan uses the logical framework approach.

Objective	Activities	Timeline	Roles & Responsibilities	Indicators of Success
1. Establish Integrated Gender-Climate Policies	a. Conduct targeted consultations with key stakeholders to identify critical policy gaps. b. Draft a high-impact gender-climate policy framework focusing on core issues (e.g., women's participation in decision-making, resource access). c. Validate the policy with stakeholders and initiate implementation.	Months 1-4	- Ministry of Climate Change (MoCC) - Ministry of Women Development (MoWD) - Key NGOs	- Policy framework drafted and validated - Implementation initiated within 4 months
2. Strengthen Institutional Capacity for Effective Implementation	a. Design and deliver focused training programs for key government officials on gender-responsive climate action. b. Develop practical toolkits for use in training and implementation.	Months 5-8	- MoCC - MoWD - Training institutes	- Number of officials trained - Toolkits distributed and utilized

Objective	Activities	Timeline	Roles & Responsibilities	Indicators of Success
	c. Establish a mentorship program for ongoing support.			
3. Foster Inter-Agency Collaboration for Greater Impact	a. Form a high-level inter-agency task force to drive the gender-climate agenda. b. Create a joint action plan that outlines specific roles, responsibilities, and timelines. c. Schedule regular meetings for progress assessment and strategy adjustments.	Months 1-3 (ongoing)	- MoCC - MoWD - Other relevant ministries	- Task force established - Joint action plan created and being executed
4. Implement Innovative Approaches for Data-Driven Decisions	a. Deploy technology tools for real-time data collection on gender impacts in climate initiatives. b. Support community-led projects that highlight women's roles in climate resilience. c. Launch targeted awareness campaigns on social media to educate the public on gender issues in climate action.	Months 4-12 (ongoing)	- MoCC - Tech partners - Community organizations	- Data collection tools implemented - Engagement metrics from campaigns

Objective	Activities	Timeline	Roles & Responsibilities	Indicators of Success
5. Monitor, Evaluate, and Adjust Strategies	a. Develop a streamlined monitoring and evaluation framework focusing on key indicators of gender inclusion and climate action. b. Conduct bi-annual evaluations to assess policy impact and community engagement. c. Use evaluation findings to refine strategies and improve program effectiveness.	Months 12+ (ongoing)	- MoCC - MoWD - External evaluators	- Completion of evaluations - Number of strategy adjustments based on findings

Focus Areas Based on the 80/20 Principle

1. **Policy Integration:** Prioritizing the establishment of integrated gender-climate policies ensures that all subsequent actions align with a coherent framework, addressing the most pressing needs and maximizing impact.
2. **Capacity Building:** Strengthening institutional capacity through targeted training and support will empower key stakeholders to implement policies effectively, leading to sustainable changes.
3. **Collaboration:** Fostering inter-agency collaboration will enhance coordination and resource sharing, amplifying the effects of initiatives across different sectors and levels of government.
4. **Data-Driven Approaches:** Implementing innovative technological solutions for data collection and community engagement will ensure that policies are informed by real-time insights, leading to more responsive and effective strategies.
5. **Monitoring and Evaluation:** Establishing a robust framework for monitoring and evaluation will ensure accountability and allow for continuous improvement of gender-inclusive climate initiatives.

Annexures

Interview Questionnaire for Government Departments

1. What is the role of the Environmental Protection Agency in the province, and under which law has it been established?
2. What is the mechanism of coordination between the Environmental Protection Agency of Pakistan and that of Khyber Pakhtunkhwa?
3. You are aware of the Prime Minister's Task Force on Climate Change. How are the recommendations implemented in Khyber Pakhtunkhwa? How is the task force following up on this in the province?
4. How does the EPA address mitigation and adaptation efforts to combat climate change?
5. How is the EPA coordinating with other departments, e.g., the Forest Department or the Industries Department, in order to implement the policy?
6. What progress has been made in implementing the National Climate Change Policy since its update in 2021?
7. What are the major challenges hindering effective implementation, and how are they being addressed?
8. What mechanisms are in place for reviewing and updating the policy, and what feedback has been shared by provinces during the previous three years in order to update the policy?
9. Have the budgetary allocations by developed countries for developing countries under the Paris Agreement yielded any results? What are the avenues and modes through which the budget is spent in the country?
10. What are the major achievements of the EPAs in the provinces?
11. How is the province monitoring and evaluating the policies implemented by the PM Task Force?
12. There is a major focus on afforestation under the National Forest Policy 2017, and forests have a major role in controlling emissions. How is the EPA coordinating with the Forest Department for implementation, and has the Forest Department been able to achieve the targets?
13. Major sources of CO and CO2 emissions are vehicles and brick kilns. Has the province acted in this regard with coordination from the Transport and Industries Departments to control the smoke emissions?
14. As the head of the department, do you feel that the agency is moving in the right direction as defined by the PM Task Force under international obligations?

In your opinion, what more could be done to align Pakistan's climate change policies with international standards and agreements?

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