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Editorial

Climate change is upon us all and its impact is not gender neutral. The climate crisis exacerbates existing inequalities, disproportionately affecting vulnerable populations due to intersecting factors like gender, age, race, class and poverty. For instance, rising temperatures and rainfall patterns invariably affect everyone, though some people are more severely impacted due to their intrinsic vulnerabilities. Women especially those belonging to poor households and disadvantaged race and class face unique threats. Interestingly, women are at the forefront of facing the threats and taking climate action, but discriminatory power structures limit their representation in decision-making process.

Addressing gender and intersectionality concerning climate change is fundamental to realizing climate justice, which essentially requires fair and equitable distribution of the burdens and costs of climate change among individuals through inclusive policy framework and cohesive risk reduction planning. The Climate crisis has gradually become a global concern that created and deepened further the inequalities. Women and girls, in all their diversity, are often impaired by discrimination that express themselves in a gender-specific distribution of resources, representation, and rights. Therefore, women are insufficiently represented in local and national-level decision-making processes, especially among under-developed communities and countries.

The impact of climatic changes is generally unpredictable. Contemporary events have shown that a change in climate conditions poses a serious threat to humans, particularly risks to life, security, and livelihoods. Resource-poor families rely more frequently on ecosystem services, and a deteriorated environment adversely affects them. Thus, climate change has varying consequences for women due to differences in social responsibilities and access to economic resources in different communities. Literature highlights that women are the most vulnerable citizens of developing nations and, in most cases, face enormous challenges due to climate change and disasters. Several studies have shown mounting evidence that climate change effects are gendered, and women are highly prone during and after climatic disasters.

The role of women in climate action involves adaptation processes emanating from their societal responsibilities, such as their role in production,

reproduction, and various community services. Against this backdrop, women's participation at all tiers of decision-making and development planning is essential and can significantly improve the outcomes of climate projects and policies. Therefore, it is important to ensure that women have the necessary support and resources to participate fully in climate action. Hence, removing the systemic barriers and inequalities women face is significant, that resulted in limited access of women to resources, credit, technology, employment, and economic opportunities. Empowering women and disadvantaged groups may enable them to make a more significant contribution to addressing climate change upshots.

Recently, intersectionality has been a widely used term coined by Professor Kimberlé Crenshaw in 1989, which got social scientists' attention, especially concerning women's rights. The Oxford Dictionary defines intersectionality as "the interconnected nature of social categorizations such as race, class, and gender, regarded as creating overlapping and interdependent systems of discrimination or disadvantage". Intersectionality recognizes that everyone can have their own experiences of discrimination and oppression, and we must consider everything and anything that marginalizes people, such as gender, race, class, sexual orientation, and physical ability. Analyzing situations with the intersectional lens would help handle inequalities and injustice toward women. Gender justice is at the heart of an effective climate policy.

The project titled; "Gender, Intersectionality and Climate Change: From Scientific Evidence to Action" recognizes the Role of Gender in Climate Action. United Nations Organizations (UNOs) and other national-level organizations recognize the underlying issues of gender and intersectionality for climate change adaptation and human wellbeing in the processes and implementation of climate policies. It can be argued that promoting inclusive and fruitful development would result in more effective policies and strategies that consider the diverse perspectives and experiences of women and men, thus promoting gender equality and resilience to climate change. To mark the recognition of the role of gender in climate action and to better understand the gaps and interlinkages between climate and gender, the National University of Sciences & Technology (NUST) Islamabad worked together with a range of local as well as international institutions, experts, academicians, researchers, and policymakers to choose the thematic areas for a conference and launched a call for papers for oral as well as poster presentations. The invited papers were based on original research findings with a special focus on climate-induced gender issues in developing countries.

All climate actions aim to contribute to climate-resilient and sustainable development.

The International Conference on Gender, Intersectionality, and Climate Change on September 24-25, 2024, was hosted by the National University of Sciences and Technology (NUST), Islamabad, co-sponsored by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The scientific committee selected 18 papers for presentation in the technical sessions out of 93 abstracts and 39 short-listed full-paper submissions. Besides, a photo competition took place where 17 photos related to the conference themes were displayed. To share the findings of these studies with a broader group of stakeholders, GIZ and NUST jointly made efforts to bring out this Special Issue of NJSSH with the theme, "Gender, Intersectionality, and Climate Change". Although the invited papers for the conference were reviewed by the scientific committee comprising faculty from the School of Social Sciences and Humanities (S3H), the papers published in this special issue passed through a process of two (one local and one international) peer reviews. This special issue aims to bring together an exceptional collection of papers addressing the critical issue of gender and intersectionality in coping with the menace of climate change by employing innovative and scientifically rigorous methods and bring forth important policy and program recommendations which if acted upon, would improve the wellbeing of people of Pakistan. Given the breadth of topics covered in this Special Issue, the Editorial is to introduce the contents briefly rather than discuss a subject in-depth. This Special issue contains a policy perspective from one of our keynote speaker Professor Muhammad Sajjad who outlined strategies to fostering inclusive resilience building and enhancing strategies for a resilient Pakistan.

The first research article is by *Qadeer et al*., which analyzes Pakistan's energy system from mitigation standpoint highlighting the renewable and nonrenewable energy sources. The analysis provides valuable insights into the environmental consequences of different energy production methods. It suggests finding ways to increase the use of renewable energy through planning land use and implementing sustainable energy projects to mitigate climate change and associated risks. The second article by *Yasmin, Sherbaz and Irshad* finds that female labor force participation increases the household's ability to withstand climate change risk to its human security. The study recommends female labor force participation at the household level to enable them to play their profound role in combating climate change risk. The paper by *Batool, Zahra and Ishaq* analyze the status of knowledge, attitude,

and practice about extreme weather events and the findings reveal that majority of participants had good knowledge about extreme weather event and claim adopting good attitude to reduce risks of climate change and their threat. The study suggests that agencies should introduce environmental interventions and take pragmatic measures to raise awareness among participants to cope with extreme weather events.

Next few articles cover the topic of adaptation to cope with the challenge of climate change and need for a gender inclusive policy framework. *Batool and Zulfiqar* examine how climate change adaptation factors are linked with gender and maternal health. The study identifies physical, emotional, and psychological loads placed on pregnant women due to climate change and disasters including healthcare accessibility issues, emotional strain, and sociocultural stressors. This research suggests the importance of gender inclusion in climate adaptation measures and addressing maternal health in development policies. In the following article, *Khursheed and Bokhari* examines maternal health of women from a legal perspective in the context of climate change adaptation. The paper offers a comprehensive review of Pakistan's climatic policies and identifies challenges to policy design and implementation, including gender-based inequalities, inadequate healthcare infrastructure, and limited role of women in decision-making to strengthen women's resilience to climate change.

In the next article, *Ahmad et al.* develop the dynamic nexus among climate change adaptation policies, gender-inclusive socio-demographic characteristics, and climate swap funding. The study finds that women empowerment is crucial in climate change adaptation policies. In the succeeding article, *Mushtaq and Afzal* analyzes the impact of women's empowerment on green economic growth and vulnerability to climate change in South Asia. The effect of women empowerment on green economic growth is most evident by women's leadership, mentoring, networking in multidisciplinary activities, and female human capital utilization through women's entrepreneurial skills. In the final article, *Ogunsakin and Ilemikun* examine the role of gender inclusion and partnerships to reduce the impacts of climate change in Northern Nigeria - prone to desertification, heat waves, and extreme rainfalls. The study indicates that gender inclusion and partnership are essential for successfully implementing the national government policy. Therefore, it highlights the gender-responsive, inclusive, and synchronized policy framework with other policies for reducing the impacts of climate change in Northern Nigeria. The final article by Lakhiar et al. studied the impact of knowledge and resources among the 'Climate Champions' selected

and trained by Pathfinder International under the *Surmi* project implemented in selected districts of Sindh. The study shows that climate champions can be the change agents in climate affected communities through advocating for equitable health services and to combating harmful gender norms, including gender-based violence.

Finally, I am grateful to all authors, Dr. Wajiha Haq, Dr Sumara and Ms. Rabia Zaid for their contributions to this Special Issue of NJSSH. I am greatly indebted to the support of our reviewers who gave invaluable suggestions for improving the quality of research published in this Special Issue.

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Policy Perspective

Envisioning a Resilient Pakistan: Gender, Intersectionality and Disaster Risk Reduction

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According to the United Nations Office for Disaster Risk Reduction (UNDRR), approximately 90% of climate-related deaths occur in poorer/developing countries, underscoring the urgent need for effective adaptation and risk reduction efforts (UNDRR, 2021). Adversities of climate change in Pakistan—a nation in south Asia with ~241 million people—are not a news now! Pakistan, frequently hit by several natural hazards including floods, droughts, earthquakes, and extreme heatwaves, is a country that is highly vulnerable to various disasters (Khoshnazar et al., 2023). The country's geographical diversity also contributes to its vulnerability to natural hazards. Consequently, the nation is often cited to be among the top ten countries most vulnerable to climate change, frequently experiencing devastating damage in terms of social impacts, economic adversities, and long-lasting infrastructural disruptions. For instance, the catastrophic floods of 2022 displaced millions and caused extensive damage to infrastructure and livelihoods across Pakistan (Akhtar et al., 2023). Historical events, including the 2005 earthquake and the 2010 floods, have further exposed systemic vulnerabilities in disaster preparedness and response in Pakistan.

Notably, the situation of climate-related threats is exacerbated by Pakistan's socio-economic context. Poverty, weak infrastructure, and a lack of resources hinder effective disaster response. The socio-economic impacts of such frequent and large-scale disasters are profound, particularly for marginalized groups, including women and other inter-sectionally disadvantaged communities. Moreover, there is a significant gap in high-

resolution disaster risks and resilience information at both national and sub-national levels, which impedes informed planning and decision-making. Given such circumstances, high-resolution investigations looking at spatial-temporal patterns of hazards, vulnerabilities, and risks are imperative to assure effective disaster risk reduction (DRR) efforts. Connectedly, understanding the interplay of gender and intersectionality in DRR planning is also essential for fostering resilience in Pakistan. As highlighted by Sajjad (2021), building disaster-resilient communities requires inclusive as well as operative resilience frameworks that enable factual decision-making and resource allocation across various scales. However, despite the onset of frequent extreme disaster events in Pakistan, there is a notable lack of comprehensive disaster resilience assessments at both national and sub-national levels, hindering effective planning and resource allocation in the context of disaster risk management.

Role of intersectionality and gender in disaster scenarios

Intersectionality is a critical framework for understanding how various social identities—such as gender, class, ethnicity, and disability—intersect to create unique experiences of disadvantage in disaster contexts (Kadetz and Mock, 2018). Marginalized groups often face compounded risks due to systemic inequalities. Women, children, the elderly, and people with disabilities are disproportionately affected by disasters due to pre-existing social inequities. For instance, women with disabilities encounter significant barriers when accessing emergency services or shelters during disasters (Gartrell et al., 2020). Cultural restrictions may further limit their mobility or decision-making power within households. Additionally, socio-economic factors play a crucial role; women from lower-income backgrounds often lack the financial resources necessary for effective disaster preparedness. Engaging women and marginalized groups in the planning and implementation of DRR initiatives ensures that their voices are heard, and their needs are met.

Community-based disaster risk management programs have demonstrated success by involving local populations in identifying risks and developing response plans tailored to their specific contexts. Similarly, empowering women through training in disaster preparedness and response can significantly enhance community resilience. Programs designed to build leadership skills among women have proven effective in improving community responses during disasters. Women leaders often advocate for the needs of marginalized groups, ensuring equitable distribution of resources.

Gender plays a critical role in shaping individuals' experiences during

disasters. Women often face heightened risks due to pre-existing socio-economic inequalities, cultural norms, and limited access to resources. For instance, women are frequently excluded from decision-making processes related to disaster management, which affects their ability to recover post-disaster. From another point of view, disasters further exacerbate gender inequalities; women often suffer more from loss of livelihoods and increased domestic burdens post-disaster. They frequently manage household tasks under challenging conditions while caring for children and the elderly. Gender roles can further limit women's access to resources and decision-making in disaster management. Women face significant barriers in accessing food, markets, and relief services during disasters, as access to local markets diminishes sharply during emergencies. Being an integral part of community, women struggling with such barriers compromise overall community resilience to disasters.

Fostering inclusive resilience building and enhancing strategies for resilient Pakistan

To effectively address the existing challenges, it is essential to adopt inclusive strategies that integrate gender and intersectional perspectives into DRR planning. As noted by Sajjad et al. (2023), community disaster resilience varies significantly across regions in Pakistan. Their study identifies spatial disparities in resilience during the period from 2004 to 2014, revealing that certain areas have become less resilient over time. This highlights the necessity for a gender-sensitive approach to DRR that acknowledges these disparities. Hence, developing policies that explicitly address the needs of diverse groups is crucial. This includes ensuring representation of women and marginalized communities in decision-making processes at all levels. Integrating gender perspectives into DRR policies must explicitly incorporate gender analysis at all levels (Smyth and Sweetman 2015). One potential way of doing so could be developing indicators that reflect the diverse experiences of affected populations and ensuring that women participate in decision-making processes related to disaster management. However, achieving this necessitates collecting and analyzing data disaggregated by gender, age, disability, and other relevant factors, which could inform targeted interventions and resource allocation.

From this perspective, investing in research that disaggregates data by gender and other intersecting factors of communities could progressively assist in understanding the underlaying vulnerabilities. Such data can further

inform targeted interferences that address the specific needs of marginalized communities during disasters, and could include:

Community-Based Approaches: Empowering local communities through education, training, and resources, which will help build resilience from the ground up. Furthermore, recognizing indigenous knowledge and practices is also essential for sustainable DRR.

Capacity Building: Conducting gender-sensitive training for disaster management personnel will raise awareness about the unique needs of marginalized groups during disasters.

Collaborative Efforts*:* Fostering partnerships between government agencies, non-governmental organizations (NGOs), academic institutions, and international bodies will create a cohesive DRR strategy.

The importance of the above-mentioned strategies is reinforced by findings from Sajjad et al. (2024), which highlight significant gaps in health facilities across districts in Punjab during emergencies like COVID-19. The study demonstrates that approximately 45% of indicators related to health systems achieve below-average scores, indicating a lack of essential services during crises. Hence, focusing and addressing those low performing indicators and incorporating intersectionality into action plans could help enhance the overall community resilience.

As noted, while women play crucial roles in community resilience and recovery efforts, their involvement is essential for effective DRR strategies. Policies that empower women along with other intersectional aspects contribute not only to overall community resilience but also lead to better outcomes for all community members (Le Masson 2016). Hence, effective disaster resilience strategies must integrate gender and intersectional perspectives to address the unique needs of diverse populations. Taking a *"System-of-Systems"* approach towards resilience ensures that intersectionality is considered in assessments and interventions. By recognizing how different identities interact with existing vulnerabilities, policymakers can develop more effective and efficient DRR strategies that empower marginalized groups.

As we envision a resilient Pakistan capable of withstanding future disasters, it is essential to prioritize intersectionality and gender equity within disaster risk reduction frameworks. By recognizing the unique challenges faced by marginalized groups and integrating their perspectives into planning processes, we can build a more inclusive society better prepared for the impact of climate change. In conclusion, incorporating gender and intersectionality into DRR efforts will enhance Pakistan's resilience against

disasters while ensuring that no one is left behind. It is only through such inclusive strategies that we can envision a truly resilient Pakistan capable of facing future challenges head-on.

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Evaluating the impact of Renewable and Non-Renewable Resources on CO2 Emissions and Sustainability

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Abstract

This study analyzes Pakistan's energy system, distinguishing between renewable and non-renewable energy sources. We examine energy production decisions as Pakistan's energy sector faces significant challenges including environmental concerns due to carbon emissions related to nonrenewable energy generation methods using historical data and analytical tools. In essence, we evaluate the relationship between renewable and nonrenewable supplies alongside GDP, trade, and population quantifies changes in land use and counts related carbon emissions. This analysis will provide valuable insights into the environmental consequences of different energy production methods in Pakistan. Regression analysis will be used in the study to demonstrate how the above-mentioned variables affect CO2 emissions using data from 1990 to 2020. Additionally, ARDL test is used for accurate results and cater for unit roots and lag variables. According to previous research, non-renewable energy sources directly correlate with CO2 emissions, but renewable energy sources have a negative effect on CO2 emissions. While we can't be certain of the details until we've crunched the figures, we want to contribute to Pakistan's adoption of wiser energy policies. Consider ways to increase the use of renewable energy, better plan the use of land for sustainable energy projects and reduce carbon emissions in keeping with regional and global environmental objectives. Finding the right course of action for a cleaner, greener energy future is what we're all about in the end. Essentially, climate change, being a global threat, is becoming a serious threat, so to accommodate this concern, a sustainable approach needs to be studied and applied accordingly.

Keywords: Renewable energy, non-renewables, land use, ARDL, sustainability

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1. INTODUCTION

Energy is a fundamental requirement for human development, but sadly, the world's energy reserves vary greatly from nation to nation. The global energy crisis has the greatest impact on Pakistan's social, economic, and environmental well-being of any given problem. This study aims to explore the relationship between various energy sources in terms of cost, yield, and other factors. and examining the impact of energy sources on Pakistan's climate. Pakistan is diverse in that its social, environmental, and climatic traits vary from one area to another. Pakistan is severely affected even though it contributes very little to CO2 emissions. Pakistan's climate change vulnerability is attributed to several factors, including its generally warm climate, location in an area where temperature increases are predicted to be higher than the global average, and the country's mostly arid and semi-arid land area (with 60% receiving less than 250 mm of annual precipitation and 24% receiving between 250 and 500 mm).

Additionally, Pakistan's rivers are primarily fed by the Hindu Kush-Karakoram Himalayan glaciers, which are predicted to recede rapidly due to global warming; finally, Pakistan's primarily agrarian economy makes it particularly vulnerable to climate change. A necessary commodity for modern economies is energy. Consequently, the technologies that are used in its manufacturing and consumption are becoming more and more significant. Energy security and sustainable development are closely related to the availability of a clean, reasonably priced, and consistent supply of energy in a variety of forms. One of Pakistan's biggest concerns is climate change. Pakistan is highly reactive to changes in climate. Pakistan's climate has altered over the past few decades, having a major impact on both the environment and people, much like the rest of South Asia. The Himalayan glaciers are melting due to heat, drought, and other harsh weather, which is raising the water level in the Pakistani river. Pakistan was in fifth place among the nations afflicted by climate change-related extreme weather between 1999 and 2018.

Numerous natural calamities, such as cyclones, floods, droughts, heavy rains, and earthquakes, can occur in Pakistan. Scientific studies indicate that climate change was a major factor in the catastrophic floods of 2022, which directly affected over 30 million people in Pakistan and caused property destruction, fatalities, and home displacement. Climate change is a serious threat to Pakistan's security and economy. With 2 tons of emissions annually per person, Pakistan emits fewer greenhouse gases (GHGs) per

person than half of the world average. Pakistan's GHG emissions account for less than 1% of worldwide emissions. In Pakistan, energy-related activities such as burning fuel for heat, powering transportation, and producing electricity accounted for 43% of the country's 408 million tons of CO2 equivalent in GHG emissions in 2015.

Pakistan's energy sector is currently in a transition period, trying to resolve the dual task of supplying growing energy needs and addressing climate change. Given the increasing understanding of the negative environmental impact of energy production, it is increasingly important to determine whether different energy sources have an effect on the amount of CO2 emissions. The present research explores the complex relationship among various elements of Pakistan's power sector with a special emphasis on renewable versus non-renewable resources and their impact on carbon emissions. Some of the previous research has made it very clear that transitioning to the use of renewable energy sources is one way through which we can help curb climate change effects. On the other hand, new forms of green energy like solar, wind, and hydropower appear to be promising alternatives that can be used to mitigate carbon emissions while also promoting environmental sustainability.

In this study, to define the relationship between renewable and non-renewable energy to the emissions of carbon, we run The Augmented Dickey-Fuller (ADF) test assesses whether variables are stationary or non-stationary. P- values below 5% or 10% indicate stationarity. Variables like CO2, FFCp, RECp, and GDP are stationary.To address autocorrelation, we used the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). A Correlogram is used to visualize autocorrelation portions. The Autoregressive Distributed Lag (ARDL) model is used to analyze relations in time series data. It accommodates non-stationary variables without differencing and aids in policy exploration and forecasting.

Overall, the findings of this study are expected to help policymakers, experts and stakeholders who play a key role in shaping the energy policy in Pakistan. Specifically, by activating the research on the environmental consequences of the various methods of energy production, this study intends to help draft policies that promote expansion of renewables, efficient use of land for sustainable impact energy projects, and carbon dioxide emissions cuts in line with regional and global environmental goals. In conclusion, Given the growing threat of climate change, there has never been more need to prioritize a sustainable approach to energy production. While we may face several challenges in Pakistan's energy space there are indeed greener and cleaner

ways forward. This study overall seeks to provide evidence and recommendations to facilitate decision-making and help generate a more sustainable and reliable energy sector in Pakistan.

2. LITERATURE REVIEW

The world's energy landscape is undergoing a fundamental transition as countries look for ecologically friendly and sustainable solutions to meet their energy needs. Modern countries rely on energy to sustain economic growth, raise living standards, and improve people's quality of life. The regular dependence on non-renewable energy sources, such as coal, natural gas, and fossil fuels, has generated questions about their limited availability and negative environmental effects, particularly the atmospheric release of greenhouse gases like carbon dioxide (CO2). Researchers have repeatedly found that using non-renewable energy sources like fossil fuels (coal, oil, and natural gas) has a negative impact on the climate.

There is a persistent increase in CO2 emissions because of population growth, GDP growth, and industrialization which poses an alarming situation for the country. The repercussions of these increasingly unpleasant activities have ignited a surge in greenhouse gas emissions, which eventually give rise to drastic climate change. Such worrying situations prevailed across the globe (Gallo Cassarino et al., 2018). Since energy demand is rapidly growing, and these energies are extracted from conventional energy sources like fossil fuels, carbon-generated energies, petroleum crude, and many others, there is gradual suffering from the adoption of conventional methods (Nayyar et al., 2014).

On a worldwide basis, it is extremely important to figure out a balance between the need to reduce CO2 emissions and the rising demand for power. The focus of the study, which is on CO2 emissions from Pakistan's energy resources, is thus one of the principal focal points of this study (Raza & Lin, 2019). Global warming, environmental pollution, and energy scarcity are becoming problems for everyone on earth. The increase in global industry and excessive energy use is the main contributor to CO2 emissions. The use of fossil energy has caused climate change by emitting GHGs, including CO2 (Callan et al., 2009) (Wu & Chen, 2017).

The methodology is described as using the Logarithmic Mean Division Index (LMDI) approach. This method can give important insights into the underlying elements and is frequently used to analyze variations in CO2 emissions (Raza & Lin, 2019). The benefit of the LMDI method is that it may be used to break out variations in CO2 emissions. The forecasting of the emissions connected to fossil fuels follows the usage of analysis components (Lin & Ahmad, 2017).

By analyzing the trade-offs between energy supply and priority ecosystem services, Martnez-Martnez's study reveals regions in South-Central Chile that are appropriate for developing renewable energy sources. Limited capacity for biomass, solar, and wind energy as well as medium-to-low capacity for cultural services were found after expert discussions. He concluded that more than half of potential hydropower plants can be positioned in areas with high capacity for regulation and maintenance and medium capacity for service supply. Planning for land-based renewable energy is aided by this information, which also lessens social and environmental tensions (Martínez et al., 2022). In his research, Abraham Deka examined the role that renewable energy, energy efficiency, and forest resources play in halting environmental degradation. He makes use of data from 1990 to 2020 from nations in the European Union. According to the findings, increasing GDP by 1% causes a short-term increase in carbon emissions of 5.62% and a long-term increase of 2.93%. Emissions decreased by 0.03 units and 0.098 units, respectively, by energy efficiency and renewable energy. However, the carbon emissions of European countries are not significantly impacted by forest resources (Deka et al., 2023).

The study by Wang Long looks at the relationship between the use of renewable and non-renewable energy sources, climate change, and economic growth in five developing Asian nations between 1975 and 2020. According to the findings, using renewable energy slows global warming while using non-renewable energy accelerates it. In these nations, urbanization, transportation infrastructure investment, and GDP all contribute to climate change. The study supports the inverted U-shaped EKC hypothesis for developing Asian economies and contends that switching from non-renewable to renewable energy sources is the most effective strategy for mitigating climate change (Wang et al., 2023). In his paper, Muhammad Asif examines the relationship between various energy sources, putting a particular emphasis on the cost, yield, and other factors. It concludes that nuclear energy and renewable energy derived from agricultural waste are the most well-liked sources because of their accessibility and long-term viability. A viable alternative for domestic and industrial energy production and consumption, bioenergy produced from agricultural waste is environmentally friendly and emits less pollution than nuclear energy (Asif et al., 2022). Mudassar Hussain in his study compared the costs and environmental effects of different energy sources, including diesel generators, non-renewable sources, and hybrid solar systems (WAPDA). According to the study, installing hybrid solar systems can cut carbon dioxide emissions by up to 8,446.6 kg of CO2 and 6,131.725

kg over the span of the next twenty-five years. With its low cost per electric unit, renewable energy can pay for its entire installation in just 8 years, saving $4,936.4375. Pakistan's unique geographic characteristics and year-round access to sunlight make it a prime candidate for the effective use of solar energy to cut CO2 emissions and costs (Hussain et al., 2022). In his paper, Irfan Ullah emphasizes how Pakistan's industrialization and energy crisis have made alternative energy sources, CO2 emissions, and health-related issues more prominent. The use of renewable energy sources can satisfy energy needs while promoting environmental health. This study, using data from 1998 to 2017, increased trade volume results in higher CO2 emissions and health care costs. However, renewable energy has a negative correlation with CO2 emissions and health spending, highlighting its significance in improving environmental quality and lowering health spending. The results imply that Pakistan's government requires appropriate policy guidelines for the adoption of renewable energy in the industrial sector (Ullah et al., 2020).

This analysis discovered that a different scenario may assist Pakistan in meeting its emissions reduction goal and provide customers with a 23% yearly savings. The electrical industry in Pakistan is confronted with issues such demand-supply imbalances, frequent power outages, and growing fuel import costs. Pakistan has put in place incentives to produce renewable energy. But now, the sector accounts for almost 63% of the electrical supply. The interconnections between generation technologies, fuel resources, demand, capital investments, CO2 emissions, production costs, and electricity pricing were examined using a dynamic model (Qudrat-Ullah, 2022).

The driving variables for CO2 emissions from power generation in Pakistan from 1990 to 2019 are examined in this study. For measuring CO2 emissions and their correlation with economic development, it makes use of the logarithmic mean Divisia index and Tapio's decoupling indicator. The findings indicate that activity and population are the main causes of increased CO2 emissions, with only a slight buffering in the immediate future. The paper advises encouraging energy-saving technology and changing the industrial structure to reduce CO2 emissions (Lin, 2022).

Finding sustainable energy sources for Pakistan's economy is the primary objective of this research endeavor, which also aims to secure energy supply and create jobs. The report recommends renewable energy technology with low operating and external costs as a way to wrap things up. The Pakistani government ought to encourage technical advancement and renewable energy sources. Pakistan aims to produce green hydrogen utilizing its plentiful renewable energy sources as a sustainable and secure energy

source in the future. While geothermal energy has not yet fulfilled its potential for producing hydrogen, wind and biomass are effective renewable sources (Umar et al., 2022).

The study evaluates Pakistan's conventional and renewable energy scenarios and finds that renewable energy only makes up a small portion of the country's overall conventional energy supply. Data on renewable energy installations, activities, projects, planning, and accomplishments of public sector organizations are highlighted. It offers recommendations for efficient resource management and technological application, which is helpful for Pakistan and developing nations (Sheikh, 2010).

For the study of Pakistan, low emission analysis platform (LEAP) software is being used to create scenarios for green energy policies (GEPs). To achieve 100% renewable energy supply by 2050 would be a challenging endeavor or an impossible one, but it is viable with GEP model scenario (Raza et al., 2022). Meanwhile, the dependence of global energy systems (GESs) on fossil fuels is quite high. Due to the energy system's (ES) significant economic expansion over the last century, the world's need on clean energy has increased due to the depletion of fossil fuels, environmental degradation, and geographical imbalance (Afsharzade et al., 2016). Essentially, the Environmental Kuznets Curve (EKC) model holds true for Pakistan in terms of the importance of using renewable and non-renewable energy sources. For the years 1970 to 2012, a variety of econometric methods are employed. Strong evidence is shown by the findings to support the existence of the EKC in Pakistan's situation. The findings indicate that nonrenewable energy use is mostly responsible for boosting carbon dioxide emissions, whereas renewable energy plays a significant role in lowering carbon dioxide emissions (Danish et al., 2017).

The influence of carbon dioxide emissions on Pakistan's forestry, agriculture, livestock, energy usage, population expansion, rainfall, and temperature is investigated in this study. According to the findings, agricultural production, livestock, energy consumption, and population expansion have a negative impact on carbon dioxide emissions, whereas forestry output, rainfall, and temperature have a favorable impact. Emissions are negatively impacted by the use of energy. According to the report, Pakistan's government should implement fresh regulations to raise agricultural output and combat climate change by concentrating on industries including forestry, livestock, agriculture, and energy. Pakistan must play a significant part in combating climate change because of its lower greenhouse gas emissions (Abdul et al., 2021).

Due to a shortage of fossil fuel resources and struggling economy, Pakistan is experiencing an energy crisis. The nation has to enhance its domestic energy resources, such as hydropower, solar power, and wind power, to meet this. The high solar insulation of the nation may be used to produce power as well as other things like solar water heaters and cookers. The paper covers the current state and prospects of solar energy consumption in Pakistan, emphasizing the contribution of R&D organizations to the advancement of solar technology (Umar K Mirza, 2003). The author uses spatial-temporal decomposition data from 2006 to 2016 to examine Pakistan's performance in energy saving and CO2 emissions reduction. The findings indicate that while the GDP gap impact is still below average, the industry sector's economic efficiency and energy consumption efficiency are both above average. While the service sector exhibits a range of results, the agriculture sector performs averagely in terms of structure and intensity impacts (Muhammad Azam, 2021).

3. DATA AND VARIABLES

This study uses data from a variety of credible sources, including the World Bank, the Pakistan Bureau of Statistics, and surveys like the Household Income Consumption Survey. Energy-related data is gathered from a variety of sources, including the Ministry of Energy's yearly reports and the Pakistan Energy Information Portal (PEIP), an online resource created by the Pakistani government. PEIP provides detailed information about energy reserves, production, consumption, and renewable energy sources. Additional data from prestigious international organizations such as the International Energy Agency (IEA) and the United Nations Environment Program (UNEP) enhances the analysis, providing a more comprehensive view of global energy trends. In addition, insights from academic research papers and industry publications are used to provide a more in-depth understanding of various aspects of Pakistan's energy sector. This comprehensive approach ensures a complete assessment of Pakistan's energy dynamics, which aids in comprehending the country's energy issues and potential. Our study is based on the time series data from the year 1980 to 2020. Table 1 indicates key parameters such as mean, median, and standard deviation for the variables under consideration.

Table 1 : Descriptive Statistics

Variables	Description	Mean	Median	Standard Deviation
CO_2	Level of Carbon- di-Oxide (Total CO2 Emissions) in Pakistan	5.02	4.80	4.96
FFCP	Fossil fuel Consumption (Growth rate)	1.05	0.65	2.05
Forest	Forestation (Growth rate of plantation)	5.87	5.85	0.64
GDP	GDP Growth rate	4.73	4.46	2.26
Pollution	Growth rate of pollution in Pakistan	2.63	2.63	0.83
RECP	Renewable energy consumption (Growth Rate)	0.19	-0.40	3.82
Trade	Trade as a percent of GDP	31.49	32.41	4.45

4. MODEL SPECIFICATION AND METHODOLOGY

This paper uses different techniques to reach the final outcomes. Initially we use Augmented Dickey–Fuller test (ADF) tests to distinguish between stationary and non-stationary variables. we will also use Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF). In time series analysis, the ACF and PACF are critical for understanding the temporal connections within a dataset. The ACF calculates the correlation between a time series and its lagged variants, demonstrating the level of self-similarity at various time lags. It helps in the identification of autocorrelation patterns, revealing how previous values influence current ones (Time Series, Ahmed, 2023). In contrast, the PACF quantifies the direct link between observations at various lags, removing the effects of intervening variables. This makes it valuable for determining the direct influence of previous data on current ones, which helps to identify the right lag structure for time series models such as the Autoregressive Distributed Lag (ARDL) model in econometrics. Analysts can detect the presence of autocorrelation and partial autocorrelation by examining ACF and PACF plots, which aids in model selection and diagnostic procedures to ensure robust analysis of time series data (Ahmed, 2023).

As discussed earlier we have mixed variables in our model, therefore we will use Autoregressive Distributed Lag (ARDL) model to carry out our

analysis. The Autoregressive Distributed Lag (ARDL) model is a strong econometric method widely used for analyzing the interactions between variables in time series data. It combines autoregressive (AR) and distributed lag (DL) models to investigate both short- and long-term dynamics among variables. This model may accommodate a wide range of data kinds and relationships, including non-stationary variables and mixed frequencies, without the need for differencing. It captures dynamic interactions by integrating lagged variable values, making it appropriate for analyzing economic time series with non-stationary behavior. Furthermore, the ARDL model supports causal analysis, allowing for the exploration of directional relationships and their magnitudes using model coefficients. The ARDL model is widely used in policy research and forecasting to examine the impact of policy changes or external shocks on economic variables. Overall, the ARDL model emerges as a versatile and necessary econometric tool, recognized for its capacity to reveal complex linkages and dynamics within time series data, particularly in economic and financial research (What Is ARDL Model | IGI Global).

In ARDL modelling, researchers frequently use varied lag durations for dependent and independent variables. They may also use distinct sets of independent variables in the model. AIC aids in the selection of the ideal ARDL model specification by providing a measure of each specification's relative goodness of fit while also taking into account the model's parameter count (What Is Akaike Information Criterion (AIC)? | Built In.). Lower AIC values suggest a better balance of model fit and complexity. As a result, in ARDL modelling, researchers often choose the specification with the lowest AIC as their preferred model. This helps to avoid overfitting while also ensuring that the model accurately represents the underlying relationships in the data.

4.1. Empirical Model

After doing ADF testing we are going to estimate linear regression equation which is as under:

$$CO_2 = f(GDP, Trade, Pollution, Foreset, RECP, FFCP)$$

We can represent the ARDL model equation as:

$$CO_{2t} = \beta_0 + \beta_1 CO_{2t-1} + \beta_2 CO_{2t-2} + \beta_3 CO_{2t-3} + \beta_4 CO_{2t-4} + \beta_5 FFCP_{t-1} + \beta_6 FFCP_{t-2} + \beta_7 FFCP_{t-3} + \beta_8 FFCP_{t-4} + \beta_9 Forest_{t-1} + \beta_{10} Forest_{t-2} + \beta_{11} Forest_{t-3} + \beta_{12} Forest_{t-4} + \beta_{13} GDP_{t-1} + \beta_{14} GDP_{t-2} + \beta_{15} GDP_{t-3} + \beta_{15} GDP_{t-4} + \beta_{16} Pollution_{t-1} + \beta_{17} Pollution_{t-2} + \beta_{18} Pollution_{t-3} + \beta_{19} Pollution_{t-4} + \beta_{20} RECP_{t-1} + \beta_{21} RECP_{t-2} + \beta_{21} RECP_{t-3} + \beta_{22} RECP_{t-4} + \beta_{23} Trade_{t-1} + \beta_{24} Trade_{t-2} + \beta_{25} Trade_{t-3} + \beta_{24} Trade_{t-4} + \epsilon_t$$

Where:

- CO2t is the level of CO2 emissions at time t (dependent variable).
- FFCp, $Forest_t$, GDP_t, $Pollution_t$, $RECP_t$, and $Trade_t$ are the independent variables at time t.
- β_0, β_1, β_2..., β_{18} are the coefficients to be estimated.
- ϵ_t represents the error term

4.2. Augmented Dickey-Fuller test

In the ADF test we set our null hypotheses that variables have unit root test and hence the are non-stationary. While our alternate hypotheses say that our variables are stationary. We accept or reject our null hypothesis based on the P-values of ADF test. If these are less than the threshold of 5% (0.05) or 10% (0.10) then we reject the null hypothesis and our variables are stationary else, we fail to reject the null hypothesis. Based on the results, we infer from the table that Forest, Trade, and Pollution are non-stationary variables.

Table 2: Augmented Dickey-Fuller Test for Unit Root

Variables	T-stats	P-value	Results
CO2	-5.237673	0.00010	Stationary
FFCp	-6.273512	0.00000	Stationary
Forest	0.042436	0.95650	Non-Stationary
Trade	-1.899565	0.32920	Non-Stationary
RECp	-6.93761	0.00000	Stationary
GDP	-3.413404	0.01630	Stationary
Pollution	-2.425974	0.14140	Non-Stationary

From Table 2 we can infer that we have mixed variables. Some are stationary and some depicts non-stationary pattern. Stationary data is a time series dataset in which statistical features such as mean, variance, and

covariance are consistent over time. In other words, the data's behavior shows no major trend or seasonality, and its statistical properties are stable over time periods. Stationary data is essential for many statistical analysis and forecasting models because it allows for accurate forecasts based on past trends. Non-stationary data, on the other hand, shows changes in statistical features over time, which are frequently characterized by trends, seasonality, and irregular fluctuations. Non-stationary data presents issues for analysis and forecasting since the underlying patterns might shift unexpectedly, making it impossible to draw meaningful conclusions or make accurate forecasts.

4.3. Regression Analysis

Table 3 represents the linear regression model of our variables. We can infer from the table that *RECp*, FFCp and Trade variable are insignificant. R-squared of this model is also very less equal to 0.447 which means only 44.7 percent of the variation in dependent variable is explained by the given independent variables.

Table 3: Regression Model Estimation Results

Variables	**CO_2 (Dependent variable)**
GDP	0.706*
	(0.358)
Trade	-0.244
	(0.183)
Pollution	-4.092*
	(2.217)
Forest	7.427**
	(3.298)
RECP	-0.183
	(0.170)
FFCP	0.446
	(0.355)
Constant	-23.93
	(12.02)
Observations	41
R-squared	0.448

*** p<0.01, ** p<0.05, * p<0.1

4.4. Autocorrelation:

A Correlogram, also known as an autocorrelation plot or autocorrelation function plot, depicts the autocorrelation function (ACF) of a time series. It

displays the correlation coefficients between the observations of a time series and their lagged values at various time intervals. With the x-axis representing lag values and the y-axis indicating correlation coefficients, each bar or point on the figure represents the autocorrelation coefficient at a certain lag. By evaluating the patterns and magnitudes of these coefficients, analysts can detect the presence of autocorrelation in the data, which aids in the discovery of underlying temporal structures such as seasonality or trends. Correlogram are useful tools in time series analysis, assisting with model selection and diagnostics by revealing temporal correlations within the data. Correlogram of variables CO2, FFCP, Forest and Pollution is represented below. For other variables see Appendix Table 1.

4.5. ARDL Model

As we have mixed variables, we will use the ARDL model. We used Akaike Information Criteria to identify the best model. The Akaike Information Criterion (AIC) is a statistical measure used to pick a model from a set of candidates. It balances the model's goodness of fit against its complexity, penalizing too complicated models. In the context of the Autoregressive Distributed Lag (ARDL) model, AIC can be used to compare different model specifications, such as lag lengths or variable inclusion.

Table 4 displays the results of the ARDL model. The interpretation is as follows. The R-squared value in this model is 0.97, indicating that the independent variable accounts for 97 percent of the variation in the dependent variable. The consumption of renewable and nonrenewable energy sources has a significant impact on Pakistan's CO_2 levels. Aside from this, other variables have a substantial impact on the CO_2 level in Pakistan.

The variable of Fossil fuel consumption (FFCP) has a p-value equal to 0.06 which is less than 0.1. This implies that FFCP is significant at the level of 10 percent, and it shows that if growth rate of consumptions of fossil fuels such as Coal, oil, and natural gas increases then carbon dioxide growth rate increases by 0.69 units. Whereas if rate of plantation (variable Forest) has a p-value equal to 0.04 which is also lower than 0.10 which means at the significant level of 10 percent if Forest increases then it would result a decrease of 64.49 units in the carbon dioxide growth rate. GDP also affects the carbon dioxide growth rate. Our analysis shows that if GDP increases then carbon dioxide growth rate also increases by 0.06 units at the significant level of 5 percent. Pollution and trade have a positive effect on carbon dioxide growth rate at the significant level of 10 percent and 5 percent respectively. When Pollution and trade increases then carbon dioxide growth rate also

increases by 14.37 and 1.03 units respectively. Lastly, if rate of consumption of renewable energy sources (RECP) increases then carbon dioxide growth rate decreases by 0.68 units at the significant level of 5 percent because p-value of RECP is 0.01 which is less than the threshold of 0.05.

The ARDL model helps us understand how various factors influence the amount of CO2 in Pakistan's atmosphere. Consider CO2 to be the undesirable byproduct of burning coal, oil, and gas. When we burn these things for energy, we emit CO2 into the atmosphere, which is bad for the environment. The model tells us that 97 percent of the time, the amount of CO2 in the air is explained by things like how much energy we consume and other variables. One major factor influencing CO2 levels is the fuels we use for energy, such as coal, oil, and gas. When we utilize more of these, CO2 levels rise. However, planting additional trees (known as forestation) can reduce CO2 levels. Trees are nature's cleansers, taking up CO2 and purifying the air for us. So, planting more trees helps to reduce CO2 levels in the air.
Another factor influencing CO2 levels is a country's gross domestic product (GDP). When a country's GDP rises, it usually signifies that people are purchasing and utilizing more goods, which often takes energy and might result in greater CO2 emissions. So, as GDP rises, so may CO2 levels. Then there is pollution and trade. Pollution occurs when dangerous substances enter the air, such as smoke from factories or exhaust from cars. When there is more pollution, CO2 levels rise. Trade occurs when countries buy and sell goods with one another. When trade increases, more commodities are produced and shipped, which can result in more CO2 being released into the atmosphere. But there's some good news: adopting more renewable energy sources, such as wind or solar power, can help cut CO2 emissions. When we use more renewable energy, we are generating cleaner power that emits less CO2 into the atmosphere. So, according to the model, using more renewable energy can help to reduce CO2 levels. Understanding how these factors influence CO2 levels is critical for making decisions about how we use energy and protect the environment. By planting more trees, using cleaner energy sources, and being careful of our pollution and trade, we can contribute to a healthy planet with cleaner air for everyone to breathe.

Table 4: ARDL model Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
FFCP	0.69	0.34	2.01	0.06
FOREST	-64.96	12.97	-5.01	0.04
GDP	0.06	0.02	0.23	0.41
POLLUTION	14.37	8.46	1.70	0.08
RECP	-0.68	0.07	-9.81	0.01
TRADE	1.03	0.15	6.83	0.02
C	-118.81	14.92	-7.96	0.02
		LAGS		
CO2(-1)	-0.49	0.07	-6.64	0.02
CO2(-2)	-0.17	0.05	-3.46	0.07
CO2(-3)	0.08	0.12	0.67	0.57
CO2(-4)	-0.56	0.13	-4.46	0.05
FFCP(-1)	0.18	0.24	0.77	0.52
FFCP(-2)	1.86	0.22	8.33	0.01
FFCP(-3)	1.81	0.22	8.08	0.02
FOREST(-1)	-16.50	14.61	-1.13	0.38
FOREST(-2)	112.26	13.94	8.05	0.02
FOREST(-3)	-60.81	7.63	-7.97	0.02
GDP(-1)	0.01	0.22	0.05	0.96
GDP(-2)	0.46	0.23	2.05	0.18
GDP(-3)	-1.83	0.27	-6.84	0.02
GDP(-4)	0.90	0.20	4.41	0.05
POLLUTION(-1)	-3.86	2.13	-1.81	0.21
POLLUTION(-2)	-9.10	2.19	-4.16	0.05
POLLUTION(-3)	7.19	2.03	3.55	0.07
POLLUTION(-4)	-9.02	1.24	-7.28	0.02
RECP(-1)	-0.13	0.05	-2.42	0.14
RECP(-2)	-0.07	0.06	-1.12	0.38
RECP(-3)	0.13	0.07	1.79	0.21
RECP(-4)	0.29	0.06	4.88	0.04
TRADE(-1)	0.25	0.11	2.26	0.15
TRADE(-2)	-0.03	0.12	-0.23	0.84
TRADE(-3)	0.05	0.13	0.39	0.73
TRADE(-4)	-0.65	0.14	-4.80	0.04
R-squared	0.97			
F-stats	83.94			

5. CONCLUSION

In conclusion, since the result adheres to the R-squared value in the model stands at 0.97, indicating a strong correlation where 97 percent of the variance in Pakistan's CO2 levels can be explained by various factors, primarily energy consumption. Fossil fuel consumption, with a p-value of 0.06, shows significance at the 10 percent level, meaning an increase in fossil fuel usage leads to a corresponding rise in CO2 emissions. Conversely, variables like plantation (p-value of 0.04) and consumption of renewable energy sources (p-value of 0.01) exhibit significance at varying levels, demonstrating their potential to reduce CO2 levels. The ARDL model helps elucidate the complex relationship between energy consumption, economic variables like GDP, and environmental factors like pollution and trade, highlighting avenues for mitigating CO2 emissions. Through measures such as increasing forestation and transitioning to renewable energy sources, Pakistan can work towards curbing CO2 levels, thus contributing to environmental sustainability. to adequately respond to the challenges of climate change and make a transition to a more sustainable energy sector, Pakistan should implement the following set of policy measures:

Firstly, the country should develop a strategy that would prioritize the targeted support of investments into renewable forms of energy. In particular, the country should stimulate investments in solar, wind, or new hydropower plants through a combination of tax breaks, subsidies, and improved regulatory circumstances. Meanwhile, the country should gradually remove the subsidies from such energy sources as coal or oil to make them more expensive and ease the market’s transition towards cheaper forms of energy.

Equally important, Pakistan must establish comprehensive renewable energy policies that have challenging goals for the production and utilization of renewable energy; policies that are robust enough to explain how it would increase the amount of power generated from this source in overall national energy mix and facilitate its integration into national grid. Additionally, Pakistan should focus on investments in research and development (R&D) programs aiming at improving efficiency, cost effectiveness as well as quality of renewable energy technologies. Such support includes development of innovative solutions for storing electrical energies, technologies for connecting grids with these sources as well as specific types of renewable

systems that match geographical attributes and weather patterns unique to Pakistan.

Pakistan has good solar insulation and abundant solar resources, making it ideal for both PV and thermal power uses. Solar radiation is most concentrated in the South, Quetta Valley, and Central Punjab. The Annual Direct Normal Solar Radiation for CSP in Balochistan ranges from 7 to 7.5 KWh/m2/day in some areas and 6.5 to 7 KWh/m2/day others.

Pakistan is developing solar power projects in Azad Kashmir, Punjab, Sindh, and Balochistan. The program is being developed by the International Renewable Energy Agency, China and Pakistan's private sector. Pakistan aims to increase renewable energy us by 5% (approx. 10,000 MW) by 2030. Additionally, 10% of diesel fuel will be replaced with biodiesel by 2025(see appendix figure 1). A GIS wind speed map of 100 meters including wind measurement stations. The data clearly shows that Sindh and Baluchistan have more wind potential than other provinces. According to Harijan (2008), Pakistan has around 346 GW of gross wind energy resources available. According to an assessment conducted by the Pakistan Metrological Department (PMD), the Sindh-Gharo Wind Corridor has a vast wind power potential of approximately 44 GW, of which 11 GW is exploitable and may be connected to the grid (see appendix figure 2).

Additionally, for hydropower, Pakistan's current installed capacity is approximately 19,845 MW, with hydroelectric power accounting for roughly 20%. Much of the remainder is thermal, powered primarily by petrol and oil. According to a 2006 US Department of Energy analysis, the country's per capita energy consumption is predicted to be 14 million Btu, which is almost the same as India's but a fraction of other industrializing economies in the region such as Thailand and Malaysia. Furthermore, Pakistani government should also establish capacity building and workforce development programs for the locals where people of areas could be trained in skills needed for participating in solar energy development. For instance, training in forms of technicians and engineers as well as policy makers to assist them in the planning, installation and undertaking required maintenance of solar energy system throughout Pakistan would be good choice (see Appendix figure 3).

To sum up, by following this policy recommendation, Pakistan can certainly decrease the carbon emission and dependence on fossil fuels which are the major causes for the current energy insecurity. This will also lead to a sustainable energy future to maintain environmental security and improved energy security for coming generations.

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Role of Female Labor Force Participation on Climate Change Risk and Human Security in Selected Districts of Punjab

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Abstract

Our study aims to assess the impact of climate change risk on human security of households in selected districts of Punjab, Pakistan namely, Rawalpindi, Lahore, Bahawalpur and Sialkot. We further, aim to ascertain if female labor force participation in the household leads to increase in household's ability to withstand climate change risk to its human security. By incorporating people's perception of climate change, the study is based on the data collected from 1000 households of the four districts of Punjab with an equal representation of rural and urban areas. Regression analysis shows climate change as a major security risk and consistently yields deteriorating effect on human security. While incorporating female labor force participation in the model, results show a positive impact of female labor force participation on human security. Further, the interaction term between climate change risk index and female labor force participation depicts varying but insightful outcomes for human security and its constituents i.e. health, food and economic security. Our data depicts that only 328 out of 1007 households had female earners while the average proportion of female earners was about 16% in the households, which may account for the possibility of a few statistically insignificant coefficient. Though consistently positive sign of the coefficient makes a strong case for female labor force participation in enhancing human security of households via tackling climate change risk effectively. These results highlight the need for removal of barriers to female labor force participation at the household level to enable them to play their profound role in combating climate change risk and its repercussions for human security.

Keywords: Climate change, human security, female labor force, participation, Punjab

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1. INTODUCTION

Human security, defined as "*a condition that exists when the vital core of human lives is protected and when people have the freedom and capacity to live with dignity* (Adger et al., 2014, pp. 759), is a fundamental human right. It encompasses various aspects of human life, such as livelihood, nutrition, and health. A lack of security in these areas leads to stress and

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suffering. At the household level, human security involves food security, health security, and economic security. These are influenced by demographic and macroeconomic factors, and most importantly, the climate change.

Climate change poses a severe threat to human security, affecting nutrition, water quality, the emergence of diseases and loss of livelihood. Pakistan is notably vulnerable, ranked 8th globally for climate change risk (Germanwatch, 2021). The country has experienced frequent natural disasters, leading to significant economic and human losses. Projections indicate worsening food insecurity and health outcomes, with substantial impacts on the population's well-being and GDP.

Female labor force participation can potentially enhance a household's resilience to climate change. By diversifying income sources (Dey et al., 2018), it reduces economic vulnerability, ensuring a steadier flow of resources even when climate and related shocks occur. Women's employment can also lead to improved household decision-making, promoting adaptive strategies such as better resource management and investment in sustainable practices (Kim, 2022; Wang and Zhang, 2020). Furthermore, increased financial independence for women can bolster education and health outcomes for the entire family, enhancing overall well-being. Thus, female labor force participation not only strengthens household economic stability but also fosters a more adaptive and resilient response to climate change challenges.

This study focuses on assessing the role of female labor force participation in moderating the impact of climate change on human security of households in Punjab, Pakistan. By collecting data from diverse districts, namely, Rawalpindi, Sialkot, Bahawalpur and Lahore, we aim to understand perceptions of climate risk and its effects on human security. Our approach highlights the importance of integrating gender-focused economic policies to enhance household adaptability and resilience against climate change risks.

2. LITERATURE REVIEW

Climate change and related calamities affect various dimensions of human security in multiple ways. The impact of climate change on food security is transmitted primarily through three sources: soil, water and crops. Further, when crops fail due to climate-related disasters it renders farmers unable to support their families (McGuire, 2015). The reduction in food production owing to climate-related disasters may also translate into food insecurity by pushing-up the price of food (Islam & Wong, 2017). Climate change also reduces the nutritional value and variety of food available by disrupting trade, affecting soil quality and destroying crops (St. Clair & Lynch, 2010). The empirical work also

proves that climatic shocks adversely affect the quantity as well as the quality of food and hence may lead to food insecurity (Dhimal et al., 2021; Oduniyi, 2018; Oduniyi, 2018; Poudel et al., 2017; Vaghefi et al., 2016; Geffersa, 2014; Lake et al., 2012)

Compounding the impact of climate change risk on food are its implications for human health. Climate related natural disasters may result in contamination of water sources used for hydration as well as agricultural practices (IPCC, 2013). Heat and extreme events cause mortality due to exposure. Poor air quality results in chronic respiratory issues while diminished food production causes malnutrition. Extreme heat elevates risks of heat exhaustion, heat stroke, and death, particularly for people who must work outside (IPCC, 2014). In urban areas climate change has instigated a state of perpetual threat of injury and loss which may create chronic stress (Portier et al., 2010). Chadwick (2016) and IPCC (2014) identify that health effects of climate change are a composite of sensitivity and exposure to climate-related dangers. Further, sensitivity to climate change risks is unevenly distributed (IPCC, 2014). These arguments have been supported by the empirical literature carried out in various economies around the globe (Babar et al., 2021; Abedin et al., 2019; Ajaz & Majeed, 2018; Leyva et al., 2017; Paavola, 2017; Kabir et al., 2016; Haque et al., 2012).

Climate change risk can be considered as shock that can affect both demand and supply side of the economy including infrastructure, transportation, telecommunication, tourism, financial services (Defra et al., 2012; Arent et al., 2014). Global warming and higher temperatures can also lead to economic losses by reducing labor productivity and agriculture output (Dell et al., 2014). Similarly, on the demand side, the extreme weather events (e.g. storms and floods) can adversely affect households' wealth and hence consumption. There is a vast body of literature that empirically proves the harmful economic effects of climate change e.g. Dellink, Lanzi & Chateau (2019); Bosello et al. (2012); Dell et al. (2012); Gasper et al. (2011); Gassebner et al. (2010); Oh & Reuveny (2010); Kumar & Parikh, (2001) among others.

The ability of societies to cope with climate change depends upon a number of factors. Among these, women's active economic role is considered to be an important factor in formulating a response to climate change. Financially independent women have been proven to be more likely to invest in sustainable and climate resilient practices and infrastructure (UNDP, 2019; UNEP, 2019). Additionally, economically active women have a say in decision making and are likely to advocate climate friendly policies (WEDO, 2018). Women have also been empirically proven to be an important agent in climate change adaptation

process (Matinda, 2010; Mitchell et al., 2007; Al-Naber & Shatanawi, 2004). Studies have also shown that women's active role in the labor force contributes towards reducing harmful effects of climate change on household's well-being. Increased income because of increased female participation in labor force helps in household's energy transition (Burke & Dundas, 2015).

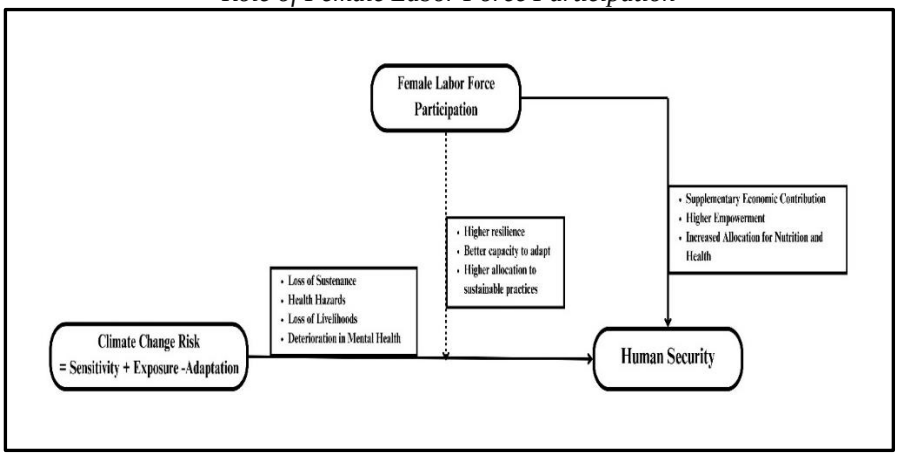
3. METHODOLOGY

3.a. Theoretical Framework

The role of women un improving the human security of a household is multifaceted. Women who participate in the labor force supplement household income, gain enhanced skills, and exercise greater control of economic allocations improving overall welfare by enabling consumption of a diverse and nutritious diets, facilitating access to healthcare, sanitation, health insurance, and reducing risks associated with single source earnings etc. Further, women's labor force participation may increase their bargaining power, resulting in prioritization of spending on nutrition, education, and health.

Climate change risk, characterized by extreme weather events and environmental degradation, presents significant challenges to household's human security. Female labor force participation (FLFP) can act as a moderating factor in this relationship by changing how households respond to climate-related shocks. Climate risks disrupt agricultural productivity and access to nutritious food. Additionally, climate-related extreme weather events and environmental changes exacerbate health risks through malnutrition, diseases, and reduced access to healthcare. Livelihoods for many a households tend to be climate-sensitive resulting in increased volatility in earnings.

Figure 1: Conceptual Framework



Women's participation in the labor force introduces additional income sources, reducing dependency on climate-sensitive earnings and enhancing financial capacity to invest in adaptive measures. Female labor force participation also results in greater resilience by enabling savings and insurance products that help households manage climate-induced shocks. Women's incomes are more likely to be allocated toward health, nutrition, and education, which improve long-term adaptive capacities.

3.b. Econometric Model

Based on our theoretical framework the following econometric model is constructed to assess the impact of climate change risk on human security:

$$HSI_i = \alpha_o + \alpha_1 CCRIndex_i + \alpha_2 FE_i + \alpha_3 (CCRIndex_i * FE_i) + \sum_{j=4}^{n} \alpha_j X_{ij} + \mu_i \qquad (1)$$

Where HSI_i stands for the value of Human Security Index for household *i*, $CCRIndex_i$ is the climate change risk faced by household *i*, FE_i is the dummy for whether there are female earners in the household and X_{ij} represents control variables related to household *i* which are gender of the head of household, region, secondary occupation of household head, family type and indebtedness.

Our dependent variable is human security of household. Household human security will be measured through an index that considers several aspects, including food security, health, and livelihood (Kumssa & Kiriti-Nganga, 2016). Our indicator of human security comprises three dimensions: food security, health security, and economic security. Food security is defined as access to safe, nutritious, and sufficient food. Health security refers to a household's overall health status and vulnerability to illnesses. Finally, economic security is defined as a means of earning a livelihood and their

reliability and sustainability. Together, these three elements combine to formulate a household's human security.

We hypothesize that female labor force participation and climate change risk are two key determinants of household human security. Female labor force participation is operationalized as the dummy for whether the household includes a female earner. The female earner in the household is likely to contribute to improved food security, health, and economic security (Pérez et al., 2015). Kiefer et al. (2005) find that women have more awareness about nutrition and hygiene as compared to men. Sangwan & Kumar (2021) elicit that female labor force participation is linked with dietary-diversity and household's production. According to Burke & Dundas (2015) female labor force participation is associated with positive health outcomes for the households.

Climate change risk faced by households has three essential components namely, sensitivity, exposure, and adaptation. Once we understand climate change risk and its constituents, we must recognize that the greatest threat climate change risk poses are to the human security of a household. Climate change risk can affect the human security of the household through any of its components as climate change can adversely affect access to food, deteriorate health and devastate livelihood. Hence, we can assert that the climate change risk faced by a household will lead to the deterioration of its human security. Climate change places a heavy toll on the quality of life and general wellbeing (Chaudhry, 2017). It adversely affects production and availability of food, creates physical and psychological health hazards, devastates livelihood, destroys assets and reduces the ability to work.

The role of female labor force participation in moderating the effect of climate change risk on human security of households is explored through the interaction between climate change risk and female labor force participation dummy. Female earners also play a key role in managing household resources to build resilience to climate change (Pérez et al., 2015). Mavisakalyan and Tarvedi (2019) hold the view that women whenever, given the opportunity demonstrate more environmentally conscious preferences. This view was reinforced by Kim (2022). That translates into reduction in emissions due to female labor force participation (Wang and Zhang, 2020). Dey et al. (2018) are of the view that women play a notable role in nutrition and resource management of households which contribute to household resilience to climate change risk. Achuo et al. (2023) link female labor force participation to environmental sustainability, neutralizing of the impact of climate change. Md, et al. (2022) establish that female labor force

participation enables higher levels of adaptation as well as partially insulates the household from exposure to economic shocks, reducing the risk posed by climate change to household's human security.

The gender of the head of the household has been taken as a control variable. Households headed by men are expected to have a higher level of human security as compared to female-headed households (Amaza, 2006) and in case of a country like Pakistan women generally become heads of their households as outcomes of serious shocks like loss of male earner due to death, disability, or abandonment. Indebtedness is also taken as a dummy variable taking a value 1 if the household is currently indebted. We expect that indebted households have a low level of human security as compared to non-indebted households. This is so because indebted households have economic liabilities that add to the economic stress and lower household's ability to withstand any economic or health related shock resulting in lower human security outcomes.[6] Further, the dummy for household head having a secondary occupation is also incorporated to assess whether more than one sources of income improves human security of households. It is expected to have a positive sign as it not only supplements the primary source of income improving the economic situation of the household but also insulates the household from unforeseen shocks caused by climate change. We have also added the dummy for nuclear families with the expectation that a joint family system provides the necessary family support for withstanding uncertain situations.

3.b. Sample and Data Collection

The data was collected from four Districts of Punjab namely Rawalpindi, Sialkot, Lahore, and Bahawalpur. In order to ensure uniform representation from North and South Punjab, we have opted for an equal sample size from each district and within districts from each tehsil.[7] A total of 1000 households were selected for data collection through a questionnaire, filled through interviews with the household heads using a nonprobability purposive sampling technique. The questionnaire comprises three sections: demographic profile, human security of the household, and climate change risk faced by the

[6] The table of Summary Statistics is provided in Appendix A1.

[7] From Bahawalpur all five tehsils namely, Hasilpur, Khairpur Tamewali, Ahmadpur East, Yazman and Bahawalpur were selected. We also accessed data from all four tehsils of Sialkot district namely, Daska, Pasrur, Samrial and Sialkot. In Rawalpindi district data was collected from tehsils, Gujar Khan, Kahuta, Kallar Syedan, Murree, Taxila, Kotli Sattian and Rawalpindi City. Lastly, all four tehsils of Lahore district namely, Model Town, Raiwind, Shalimar and Lahore were also accessed for data collection.

household.[8]

3.c. Construction of Indices

Our analysis involves construction of two household level indices for human security and climate change risk. The responses collected through questionnaire were used to construct both the indices. Detailed descriptions of the process of index development are discussed in the subsequent two sub-sections.

3.c.i. Climate Change Risk (CCR) Index

The sensitivity of a household to climate change refers to the extent to which it is impacted by climate change effects. The household's exposure to climate change risk encompasses the experiential dimension of climate change, namely the degree to which the household has encountered climate change risks irrespective of the actual impact on the household. Both sensitivity and exposure combine to reflect the overall level of climate change risk. However, the role of adaptation in mitigating the climate change risks experienced by households cannot be overlooked. Adaptation is the ability of the household to respond and adjust to climate change using various strategies, which would reduce climate change risk. Thus, the net climate change risk faced by a household is the aggregate of its sensitivity and exposure, discounted by the household's level of adaptation. The study uses the Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability for Climate Change Risk (CCR) as given below:[9]

$$CCR = Exposure + Sensitivity - Adaptability \quad (2)$$

The climate change risk is the degree to which a system is vulnerable to the adverse effects of climate change, including variability and extreme climate conditions. The risk in itself is the function of the character, magnitude, and rate of climate variations to which the system is exposed, sensitive and reflects adaptive capacity. Four major climatic events, namely temperature, rainfall, floods and windstorms, are considered. The calculated values of the Climate Change Risk Index (CCRIndex) lie between 0 and 1. Here 0 means no risk while 1 means highest risk.

3.c.ii. Human Security Index

To construct the human security index, we have taken three core dimensions of human security: food, health and economic security. For each of these dimensions we have calculated individual indices and then we have constructed an overall human security index based on the three-dimensional indices.

[8] Questionnaire can be provided on demand.

[9] c.f. Arif et al. (2017).

For food security index, we have adapted Food and Agriculture Organization's (FAO) Food Insecurity Experience Scale (FIES) developed in 2014. This scale, consisting of 8 questions, has been widely used to measure food security at the household or individual level based on experience in terms of food security. After obtaining yes/no responses on all eight questions, the total score has been obtained. The obtained score is then divided by 8 (maximum score). This way the range of index of food security becomes 0-1, with 1 means complete secure and 0 means completely insecure.

$$Food\ Security\ (FS) = \frac{Total\ obtained\ score}{maximum\ possible\ score} \quad (3)$$

Similarly, for health security there are fourteen items and for economic security there are eleven items. The indices for both health security and economic security are constructed by the authors based on extensive literature review. The items comprise of yes/no questions. For both these indices as well first the total score has been obtained and then that obtained score is divided by the maximum possible score similar to equation 4, again 1 meaning completely secure and 0 meaning completely insecure.

After obtaining the indices on each of the dimensions of human security separately a composite index of human security has been constructed by using the weighted average of these indices as follows

$$HSI_i = 1/3(FS_i + HS_i + ES_i) \quad (4)$$

The value of Human Security Index also ranges between 0 and 1 meaning completely insecure and completely secure, respectively.

3.d. Estimation Techniques

The econometric model is estimated using simple Ordinary Least Squares (OLS). Since we are using cross sectional data for the analysis the most likely problem that can occur is Heteroscedasticity. Heteroscedasticity tend to increase the variance of the coefficients resulting in lower p-values. The issue can be detected using Breusch-Pagan (BP) and White tests of heteroscedasticity. The null hypotheses for both the tests imply homoscedasticity. We have used both the tests for confirmation and since the tests indicate existence of heteroscedasticity, we have employed robust estimate of variance developed by Hubert (1967) and White (1980, 1982) independently.

4. RESULTS AND DISCUSSION

This section presents and discusses empirical findings. The first section deals with descriptive analysis while the second section reports and discusses regression results.

4.a. Descriptive Analysis

Data presented in Table 1 shows that most of the households (73%) have moderate human security, while only 8.2% of households are highly secure in the selected sample. In terms of food security, about 73.3% of the households are highly secure, of the remaining households about 20.1% are highly insecure. The average value of food security index is quite high (0.79). Similarly, about 11.5% of the households have high health insecurity, while 13% are highly secure. The average value of health security index is 0.76. In terms of economic security, about 61% of households are moderately secure, while about 20% of the households are experiencing high economic insecurity. The overall human security index has an average value of 0.723, with only about 8% of the households in the sample being highly secure, compared to 19% coping with high human insecurity.

Table 1 Frequency Distribution of Human Security and its Dimensions

Frequency Distribution of Human Security and its Dimensions				
	Human Security	Food Security	Health Security	Economic Security
Highly Insecure	190 (18.9)	202 (20.1)	116 (11.5)	200 (19.9)
Moderately secure	734 (72.9)	67 (6.7)	761 (75.6)	617 (61.3)
Highly Secure	83 (8.2)	738 (73.3)	130 (12.9)	190 (18.9)
Total	1007 (100)	1007 (100)	1007 (100)	1007 (100)

Looking at the climate change risk and its dimensions, about 89% of the households in our sample are facing moderate to high level of climate change risk. The average value of climate change risk index is 0.56. We have also studied the constituents of climate change risk i.e., exposure, sensitivity and adaptation. On the extremes of the spectrum, about 15% of the households experience high exposure to climate change risk while 12.3% of households

experience low exposure. Somewhat different trends can be seen for sensitivity. About 18% of the households experience low sensitivity to climate change risk compared to 12% experiencing high sensitivity. About 70.5% of households have moderate sensitivity to climate change risk. Most households are in our sample (75.4%) have moderate levels of adaptation. Of the remaining 24.5% most have low adaptation (13%). The average adaptation scores are also low at about 0.521.

Cross-tabulation (Table 3- Appendix) between female labor force participation and human security index shows that about 20% of highly insecure households have no female earners compared to 7.36% of highly secure households without female earners. In contrast about 10% of households with female earners are highly secure and 17% are highly insecure. Cross-tabulation between climate change risk and human security index shows that about 22% of highly insecure households are also experiencing high climate change risk, while only 3.6% of the highly secure households must cope with high climate change risk.

4.b. Regression Results and Interpretation

The regression results of human security, female labor force participation and climate change risk are presented in Table 2. The impact of climate change on human security is consistently significant and negative. This depicts that climate change risk reduces human security. This effect is consistent with our expectation and its implications tend to be dire. Climate change risk may expose the household to severe uncertainties by reducing production of food, loss of employment opportunities, and increase in morbidity and health-related expenses. This renders household vulnerable to all sorts of insecurities including food, health and economic insecurities. Ajaz & Majeed (2018) and Babar *et al.* (2021) established the impact of climate change risk on human security and wellbeing through the health channel. The economic uncertainty created by climate change risk was explored by Das *et al.* (2020). Further, Ahmad *et al.*, (2016), Ali *et al*., (2017) and Ullah *et al.*, (2018) also establish the negative relationship between climate change risk and human security. Our results, however, do indicate that climate change risk is statistically insignificant for food security.

Table 2-Regression Estimates for Human Security & Its Constituents

Variables	(1)	(2)	(3)	(4)
	Human Security Index	Economic Security	Food Security	Health Security
Climate Change Risk	-0.1031***	-0.1063***	-0.0811	-0.1132***
	(0.0363)	(0.0422)	(0.0719)	(0.0212)
Female Earners (if household has female earners=1)	0.0782***	0.1372***	0.1165**	0.0086
	(0.0311)	(0.0372)	(0.0587)	(0.0283)
Female Earners * Climate Change Risk	-0.0900*	-0.1304**	-0.1513	-0.0101
	(0.0551)	(0.0640)	(0.1077)	(0.0132)
Gender of Household Head (if female=1)	0.0622***	0.0761***	0.1035***	0.0071
	(0.0197)	(0.0221)	(0.0563)	(0.0151)
Indebtedness (if indebted=1)	-0.1563***	-0.1681***	-0.2562***	-0.0440***
	(0.0167)	(0.0163)	(0.0351)	(0.0112)
Secondary Occupation of Household Head	0.0642***	0.0805***	0.1000***	0.0119
	(0.0138)	(0.0164)	(0.0269)	(0.0108)
Family Type (if Nuclear= 1)	-0.0042	-0.0137	-0.0123	0.0133
	(0.0119)	(0.0134)	(0.0240)	(0.0086)
Intercept	0.1695*	0.6211***	0.7704***	0.8202***
	(0.1392)	(0.0345)	(0.0563)	(0.0202)
R^2	0.1531	0.1645	0.0985	0.0567
BP Test χ^2	26.51***	0.63	54.79***	7.05***
(p-value)	(0.0000)	(0.4283)	(0.0000)	(0.0079)
F-Statistic	25.91***	34.85***	13.82***	8.75***
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)
N	1005	1005	1005	1005

Note: * Shows significant at 1% while ** shows significant at 5% and *** shows significant at 10%. Standard Errors are reported in parentheses.

Female labor for participation is found to have positive effect on human security as its constituents. The coefficient is also statistically significant for human security, food security and economic security. Women's participation in the labor force boosts household income, improving consumption capability, and reinforcing economic stability. This added financial resource supports essential needs like food, shelter, healthcare, and children's education, thereby diminishing vulnerability to shocks. Moreover, by diversifying the sources of income within the household, women's employment reduces its vulnerability to economic shocks such as job loss or

fluctuations in the economy. This, in turn, contributes to greater resilience against poverty and strengthens the overall stability of the household's financial well-being. When women participate in the labor force, they contribute to the household income, which often results in greater purchasing power for food. This enables families to afford a wider variety of nutritious food items, essential for a balanced diet. This is evident from the positive and significant coefficient of female labor force participation for food security.

The role of female labor force participation in the relationship between household human security and climate change risk is examined by including the interaction between climate change risk and female labor force participation in the model. Women who contribute to household income not only manage resources effectively but also exhibit environmentally conscious behaviour (Pérez et al., 2015; Mavisakalyan & Tarvedi, 2019; Kim, 2022). This contributes to reduced emissions (Wang & Zhang, 2020) and enhances household resilience to climate change through resource management (Dey et al., 2018). Research also indicates that female labor force participation encourages environmental sustainability and mitigates the impact of climate change by fostering adaptation and shielding households from economic shocks (Achuo et al., 2023; Md et al., 2022).

Our results depict that female headed households tend to have higher human security as compared to male headed households. Women develop strong coping strategies and are very resourceful when managing household resources. This adaptability is vital in traversing environmental shocks, which allows female headed households to sustain themselves more effectively (Fuller & Lain, 2020). Ardi, et al. (2022) establish that female headed households may engage in diverse livelihood strategies, which can hedge them against risk and reduce vulnerability. The diversification of livelihood act as the buffer against climate change risk leading to improvement in human security.

Indebtedness is also taken as a dummy variable taking a value 1 if the household is currently indebted. The results depict that indebted households generally experience lower levels of human security compared to those without debt. This is primarily due to economic liabilities that increase stress and reduce the household's resilience against economic or health-related shocks, thereby leading to worsening of human security outcomes. Further, the dummy for household head having a secondary occupation is also incorporated to assess whether more than one sources of income improves human security of households. The coefficient of secondary occupation dummy has a positive sign as having a secondary occupation not only

supplements the primary source of income improving the economic situation of the household but also insulates the household from unforeseen shocks. Family type is found to statistically insignificant.

Our results are more or less according to the expectations. The impact of climate change on human security consistently shows significant and negative effects. This vulnerability encompasses insecurities related to food, health, and economic stability. Studies by Ajaz & Majeed (2018), Babar et al. (2021), Das et al. (2020), Ahmad et al. (2016), Ali et al. (2017), and Ullah et al. (2018) underscore the detrimental impact of climate change on human security through various channels. Female labor force participation on the other hand exerts positive influence on human security. Women's engagement in the workforce significantly boosts household income, enhancing consumption capabilities and economic stability. Additionally, the interaction between climate change risk and female labor force participation highlights that women not only manage resources effectively but also demonstrate environmentally conscious behavior, leading to reduced emissions and enhanced household resilience to climate change impacts (Pérez et al., 2015; Mavisakalyan & Tarvedi, 2019; Kim, 2022; Wang & Zhang, 2020; Dey et al., 2018; Achuo et al., 2023; Md et al., 2022). This underscores the role of female labor force participation in promoting environmental sustainability and mitigating climate-related vulnerabilities for households.

5. CONCLUSION

Our study aims to evaluate the impact of climate change risk on household human security in selected districts of Punjab, Pakistan—namely, Rawalpindi, Lahore, Bahawalpur, and Sialkot—and to investigate whether female labor force participation enhances households' resilience against climate change risks. The regression analysis reveals that climate change poses a significant security risk, consistently lowering human security of households in our sample, whereas female labor force participation demonstrates a positive impact on human security. Women's participation in the workforce plays a crucial role in raising household income, which in turn enhances consumption capabilities and fosters economic stability. This improved financial standing not only supports better living conditions and access to healthcare and nutrition.

Furthermore, the economic empowerment of women has been linked to more resilient and adaptable households, as it diversifies income sources and reduces the vulnerability to shocks. Women who contribute to household

income manage resources effectively and exhibit environmentally conscious behaviour, reducing emissions and enhancing household resilience to climate change (Pérez et al., 2015; Mavisakalyan & Tarvedi, 2019; Kim, 2022; Wang & Zhang, 2020; Dey et al., 2018). Overall, women's workforce engagement is a critical factor in achieving sustainable economic progress and societal well-being.

In conclusion, our study underscores the impact of climate change and female labor force participation on household human security in selected districts of Punjab, Pakistan. The findings highlight that climate change significantly threatens household security, necessitating effective mitigation strategies. Conversely, female labor force participation emerges as a potent factor in bolstering household resilience, improving financial stability, and fostering environmentally conscious practices. These insights emphasize the importance of integrating gender-focused economic policies to enhance household adaptability and resilience against climate change risks. Promoting female labor force participation not only advances gender equality but also contributes to broader sustainable development goals, ensuring a more secure and prosperous future.

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Table 3. Cross tabulation of Female Labor Force Participation & Human Security

Role of Female Labor Force Participation

Human Security	Female Labor Force Participation		Total
	No	Yes	
Highly Insecure	133	57	190
	(13.21%)	(5.66%)	(18.87%)
Moderately Secure	496	238	734
	(49.26%)	(23.63%)	(72.89%)
Highly Secure	50	33	83
	(4.97%)	(3.28%)	(8.24%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.0428**		
	Economic Security		
Highly Insecure	146	54	200
	(14.5%)	(5.36%)	(19.86%)
Moderately Secure	418	199	617
	(41.51%)	(19.76%)	(61.27%)
Highly Secure	115	75	190
	(11.42%)	(7.45%)	(18.87%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.079**		
	Food Security		
Highly Insecure	146	56	202
	(14.5%)	(5.56%)	(20.06)
Moderately Secure	38	29	67
	(3.77%)	(2.88%)	(6.65%)
Highly Secure	495	243	738
	(49.16%)	(24.13%)	(73.29%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	0.0218		
	Health Security Risk		
Highly Insecure	77	39	116
	(7.65%)	(3.87%)	(11.52%)
Moderately Secure	507	254	761
	(50.35%)	(25.22%)	(75.57%)
Highly Secure	95	35	130
	(9.43%)	(3.48%)	(12.91%)
Total	679	328	1007
	(67.43%)	(32.57%)	(100%)
Kendall's Tau-b	-0.0359		

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Knowledge, Attitude and Practice based Study on Extreme Weather Events in Pakistan

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Abstract

Climate change is the global threat, and Pakistan is the eighth most affected country from the climate change. The study analyzes the status of knowledge, attitude and practice about extreme weather events among general population in Pakistan. The data is collected using cross sectional design from participants (n=266), including female (n=142) and male (n=124). Descriptive statistics are presented, and the findings reveal that 88% of participants had good knowledge about extreme weather events, its threats and potential impacts. More than 50% of participants depicted good attitude to learn about extreme weather events and 93% participants engaged in good practices to mitigate the threats of extreme weather events. The Chi-Square test shows that gender and area are significantly associated with extreme weather events on the basis of knowledge, attitude and practice. The study suggests that state agencies and other non-governmental bodies should introduce environmental interventions and pragmatic measures to raise awareness among participants to cope with extreme weather events.

Key words: Attitude, extreme weather, environmental interventions, Climate change, Pakistan

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INTODUCTION

Research on climate change has progressed from evaluations of its impacts to the formulation of measures for adaptation (Ali et al., 2017; Ali & Erenstein, 2017; Gorst et al., 2018; Fahad & Wang, 2018; Ullah et al., 2018; Abid et al., 2019). The frequency and predictability of extreme weather events are increasing due to the combined effects of human activity and global warming on the hydrological cycle (Evans & Boyer-Souchet, 2012; Ummenhofer & Meehl, 2017; Best & Darby, 2020). Devastating floods, the opposite extreme of hydrological occurrences, have emerged more frequently and have had a lasting impact in the world's largest rivers (e.g. Arnell & Hirabayashi et al., 2013; Espinoza et al., 2022).

Pakistan faces heightened vulnerability due to the increasing variability induced by climate change. Unusually high temperatures during spring and throughout the summer season intensified a powerful depression originating from the Arabian Sea, resulting in substantial rainfall in the south regions. With a predominantly arid desert climate, Pakistan frequently contends with severe heat waves, including a notable event in early summer 2022, amplified by anthropogenic climate change (WWA, 2022). The country faces periodic catastrophic rainfall-induced floods, exemplified by the 2010 event. While there is compelling evidence pointing to heavy rainfall across South Asia (Seneviratne et al., 2021) and a strengthening and monsoon movements from the west over Pakistan (Hanif et al., 2013), there is low confidence regarding whether human influence on the climate is the primary driver of the extreme rainfall (Seneviratne et al., 2021).

1. LITERATURE REVIEW

Climate change has been labeled as “the most significant global health risk of the 21st century” (Borg et al., 2021; Clayton, 2021)). Health risks associated with climate change encompass the worldwide temperature increase, alterations in precipitation trends, and heightened occurrence of extreme weather phenomena (Massaza et al., 2022; Martin, 2021). Heatwaves, hurricanes, tropical storms, floods and drought are wide spreading worldwide, and these disasters caused by environmental changes are considered as extreme weather events (Elsner, 2020). Extreme weather events, primarily those related to climate and hydrology, have the potential to impact biodiversity and

river ecosystems' ecological processes. The effects of extreme events on biodiversity and ecological processes vary (Bowler et al., 2020). Unknown repercussions for the linkages between biodiversity and ecosystem function may arise from changes in community structure brought about by trend and event effects on ecosystem functions (Biggs et al., 2020).

Human health used to be impacted by extreme weather events in two primary ways. Firstly, they can result in injuries or fatalities directly. Secondly, they indirectly contribute to mental health disorders, physical illness, water contamination, resurgence and redistribution of infectious diseases and property and infrastructure damage (Forzieri et al., 2017; Füssel et al., 2017). The intersection of extreme weather events and water quality also holds significant importance in the realm of climate change economics theory and related literature. The significant impact on water quality is evident in non-high-income countries and in nations with low technological innovation, particularly in areas unrelated to water resources (Zou at al., 2023). Extreme weather events, including extreme drought, heavy rainfall, and extreme heat, were observed to result in a reduction of plant biomass and C flux (Qu et al., 2023).

The impact of extreme weather events on wheat yields was observed to be time-specific, with the week of occurrence playing a crucial role in determining its effect on yields (Powell & Reinhard, 2016). Extreme weather events promoted urbanization (Yiadom et al., 2023; Qian et al., 2022; Yiadom & Abdul-Mumuni, 2022; Wu et al., 2020; Luong et al., 2020). Additionally, extreme weather events have very weak negative correlation (Yiadom et al., 2023; Yiadom et al., 2023; Tui & Fakhruddin, 2022; Ngcamuv & Chari, 2020). Extreme weather events reinforced urbanization which resulted in high temperature rise, drought, floods and rise in sea level (Chen et al., 2021). The application of imagery methods and remote sensing for monitoring and identifying the impacts of extreme weather events is an area that still requires further development (Cogato et al., 2021).

Extreme weather events were found to be common causes of seascape and landscape changes. Those changes led to transformation and feelings of psychological desolation (Beggs et al., 2022). Extreme

weather events have irreversible impacts on biophysical systems of earth causing mental and physical health risks (Whitemee et al., 2015).

Experiencing direct contact with severe weather phenomena like floods and hurricanes not only poses an immediate threat to life but also leaves lasting effects on individuals' mental well-being. These effects encompass conditions such as mood disorders, depression, sleep disturbances, anxiety and post-traumatic stress (Palkinas & Wong, 2020).

The recent studies indicate that the repercussions of climate change reach beyond physical well-being, significantly impacting mental health (Cianconi et al., 2020; Stone et al., 2022). Intersectional analysis revealed that females in both younger and older age groups perceived higher risks of extreme weather events as compared to their male counterparts of the same age. Females exhibited significantly higher risk perception for all hazards compared to males with similar education levels (Cuesta et al., 2022).

A KAP study found that workers have improved their knowledge on heatstroke treatment and daily life habits as well as interventions played a positive role in prevention of heat waves for migrant workers (Peng, 2019). Another study found that 79% participants recognized climate as a major threat while exposing to extreme weather events (Peria et al., 2016).

Another KAP study found high scores on knowledge and practice as compared to attitude in preventing sunstroke to avoid heat exposure and played significant role in minimizing heat-related diseases (Li et al., 2016). The research revealed that visitors at Al-Mashar Park exhibit insufficient readiness to address the challenges posed by climate change, despite the evident climate variability in Hail (Said, 2022). An intervention-based study conducted to improve knowledge and attitude to cope with heat waves. The study found interventions were significant in enhancing level of knowledge and attitude towards heat waves in participants (Xu et al., 2018).

76% of respondents in the Dengue Fever (DF) expressed the belief that climate change could impact the transmission of DF and demonstrated commendable levels of understanding (76.7%), positive attitudes (87.9%), and practical application (39.1%) toward climate

change. The analysis revealed statistically significant associations between robust knowledge and positive attitudes with effective climate change adaptation or mitigation practices (Rahman et al., 2021). Another study found participants were interested to seek more about climate change and association between climate change and infectious disease outbreaks (Sambath et al., 2022).

The medical students had very poor knowledge about climate action and the Sustainable Developmental Goal. Most of the students (97.4%) agreed that global warming was the major consequence of human actions. Those students have greater knowledge were involved in environment-friendly practices and other (72%) were gaining information about climate change through internet sources (Reddy et al., 2022).

Climate change is believed to be bad among participants (83%) but, some participants considered climate change as controllable (67%). Most participants viewed extreme weather events cause illness due to heat stress and poor air quality. Participants had very poor knowledge regarding the causes of climate change (Yang et al., 2018). Another study was conducted on the knowledge, attitude and practice of climate change. The participants had a higher level of awareness but had little knowledge about occurrences and repercussions of climate change (Gadzekpo et al., 2018).

The knowledge of climate change among participants was associated with their socioeconomic status and level of education and the participants' attitude regarding climate change was significantly associated with internet usage and their residential status and their practices towards climate change were connected to socioeconomic status and their level of education (Rahman et al., 2021). Gender influences the adoption of climate change adaptation strategies. The socioeconomic and institutional factors played a significant role in determining adaptation strategies, with discernible variations between male and female farmers (Acheampong et al., 2023). Gender roles, educational background, age, knowledge level, marital status, dynamics of intra-household power, religious beliefs, social standing, and ethnic identity all intersected with gender in shaping perceptions and adaptation strategies regarding extreme weather events (Haque et al.,

2023).

Female participants had more knowledge about climate change than male participants and they predisposed good attitude more than males. Females (57.8%) were found involved in good practices about climate change education than males (42.2%) (Chaudhry et al., 2024). Teachers had moderate knowledge about climate change education. Their attitude towards gaining climate change education was moderate but their practice level was not satisfactory. Female teachers were involved in high level of practice while, male had high level of knowledge and attitude about climate change education (Karami et al., 2017).

The literature showed that many a study conducted on the climate change in different regions of the world. But it is evident from a vast literature review, not a single study was conducted on the Knowledge, Attitude and Practice-based on extreme weather events among general population of Layyah. The aim of a Knowledge, Attitude, and Practice-based study on extreme weather events among population of district Layyah, Punjab in Pakistan was to comprehensively examine the level of awareness regarding extreme weather events in participants, their disposition and practice towards coping extreme weather events threats. The objective was to provide interventions, educational initiatives, and policy measures aimed at enhancing public preparedness, fostering adaptive behaviors, and ultimately reducing the vulnerability of communities to the adverse effects of extreme weather events in Pakistan.

3. THEORETICAL FRAMEWORK

The study is grounded in Climate Change Adaptation Theory and enriched by a Gendered Vulnerability Perspective, creating a comprehensive lens to examine individuals' knowledge, attitudes, and practices (KAP) regarding extreme weather events (EWEs). Climate Change Adaptation Theory highlights how individuals, communities, and systems adjust to actual or anticipated climatic changes through three essential processes: acquiring knowledge about the risks, impacts, and mitigation strategies for EWEs; experiencing shifts in attitudes,

including perceptions of risk, self-efficacy, and willingness to adapt; and

adopting behaviors that enhance resilience and mitigate vulnerabilities. Integrating the Gendered Vulnerability Perspective provides a deeper understanding of how adaptive capacities are shaped by gendered roles and experiences, ensuring a more inclusive exploration of the subject (IPCC, 2022; O'Brien et al., 2007).

3.1 Method: Participants

The participants were the population of district Layyah living in rural and urban areas. A sample of participants (n=266), male (n=124) and female (n=142) participated in the study**.** Convenient sampling was used to collect data from participants.

3.2 Study Design

A cross sectional design was used to examine Knowledge, Attitude, and Practices (KAP) regarding extreme weather events of the District Layyah population in Pakistan. Data were collected from 25th November to 20th December 2023. Data were collected through web-based survey from the participants of six cities (Layyah, Chowkazam, Choubara, Kot Sultan, Fatehpur, and Kror Lal-esan) form rural and urban areas of district Layyah.

3.3 Instruments

A structured self-devised questionnaire of 15 items was administered to collect information on knowledge (awareness of the term extreme weather events and their causes and potential impacts), attitude (interest level to know more about extreme weather events and their threats) and practice (proactive steps taken against mitigating threats of extreme weather events) from the participants. The reliability of the items is checked through Cronbach Apha value such that a higher value (greater than 0.7) indicate reliability. We checked reliability of Knowledge variable comprising 5 items (α=0.85), five questions of Attitude (α=0.81), and five questions of Practice (α=0.72) and the Cronbach Apha is in the acceptable range.

3.4 Ethical Considerations

Informed consent was sought from each participant before data

collection, ensuring confidentiality and voluntary participation. The study participants were approached through physical meetings and telephone calls. The participants were briefed about the purpose of study and its implications.

3.5 Results

SPSS 27 was used to perform the statistical analysis from the collected data. Descriptive statistics were used to calculate the frequencies and percentages of demographic variables. Chi-Square was used to analyze the association between extreme weather events and gender and area of participants. Table 3 showed responses to the knowledge questions. 100% of participants knew about extreme weather events as well as 88.3% knew types of extreme weather events. 85.7% participants have recognized the warning signs of extreme weather events of their region and knew the potential impact of extreme weather events in Pakistan. 89.1% participants were familiar with safety precautions and measures used during extreme weather events.

Table 4 showed that 61.3% participants (n=163) stated showing good attitude in the case of extreme weather events.

Table 1: Demographic characteristics of participants *(n=266)*

Variables Characteristics		Frequency	Percentage
Gender	Female	142	53.4
	Male	124	46.6
Age	18-25	13	4.9
	26-35	96	36.1
	36-45	102	38.3
	above 45	55	20.7
Education	Bachelor	17	6.4
	Master	36	13.5
	MPhil	141	53.0
	Ph.D.	72	27.1
Area	Urban	167	62.8
	Rural	99	37.2
Residency	near road	74	27.8
	near river	63	23.7
	near factory	101	38.0

	near market	28	10.5
Career	Student	19	7.1
	domestic worker	90	33.8
	govt. employee	121	45.5
	private employee	36	13.5
Years of living in area	less than1 year	33	12.4
	2-10 year	169	63.5
	11-20 years	64	24.1
City	Layyah	66	24.8
	Chowkazam	54	20.3
	Choubara	49	18.4
	Kot Sultan	52	19.5
	Kror Lal esan	19	7.1
	Fatehpur	26	9.8
Home ownership	Own	188	70.7
	Rented	78	29.3
	Alone	90	33.8
	<5	123	46.2
Household size	members	53	19.9
	>5 members	266	100
	Total		

Table 2: Knowledge Variable (n=266)

Knowledge status	Frequency	percentage
Good	235	88.3%
Bad	31	11.7%
Total	266	100%

Note: 88% of participants have a good knowledge of extreme weather events *n=235(88.3%).*

Table 3: Items on knowledge of extreme weather events *(n=266)*

Knowledge statements	Yes (%)	No (%)

I know about extreme weather events.	100%	0.0%
I know the types of extreme weather events.	88.3%	10.5%
I know how to recognize early warning signs of extreme weather events in my region.	92.9%	7.1%
I understand the potential impact of climate change on the frequency and severity of extreme weather events in Pakistan.	85.7%	14.7%
I am familiar with the safety precautions and measures recommended during extreme weather events.	89.1%	10.9%

Table 4: Attitude status among participants *(n=266)*

Attitude status	Frequency	Percentage
Good	163	61.3.%
Bad	103	38.7%
Total	266	100%

Table 5: Attitude towards extreme weather events threat prevention *(n=266)*

Attitude statements	Agree n (%)	Disagree n (%)
I am concerned about the impact of extreme weather events on vulnerable populations in Pakistan	74.4%	25.4
I believe that community preparedness and resilience are essential in mitigating the effects of extreme weather events	88.3%	11.7%
I feel a sense of personal responsibility to stay informed about extreme weather events and take necessary precautions	81.2%	18.2%
I support government initiatives aimed at addressing the challenges posed by extreme weather events.	86.8%	13.2%
I am ready to do whatever I can help preserve the environment.	76.3%	23.3%

Table 5 showed 74.4% participants were concerned about the impact of

extreme weather events in Pakistan as well as 88.3% believed community preparedness and resilience are essential in mitigating the effects of extreme weather events. Moreover, 81.2% participants felt responsibility to stay informed and 86.8% supported government initiatives aimed at addressing the challenges posed by extreme weather events. And 76.3% of participants were ready to help in preserving the environment. Table 6 showed 93.6% participants were engaged in good practices to cope with extreme weather events' threats in Pakistan.

Table 6: Practice status among participants (n=266)

Practice status	Frequency	Percentage
Good	249	93.6.%
Bad	17	6.4%
Total	266	100%

Table 7: Practice to cope with extreme weather events threats *(n=266)*

Practice statements	Yes *n* (%)	No *n* (%)
I actively participate in community efforts to raise awareness about extreme weather preparedness.	91.7%	8.3%
I regularly monitor weather forecasts and warnings issued by relevant authorities.	86.8%	13.2%
I actively engage with local and national initiatives that promote climate adaptation and disaster risk reduction	92.5%	7.5%
I engage in practices that reduce my environmental impact and contribute to climate resilience.	97.7%	2.3%
I educate my family members and friends about the importance of preparedness for extreme weather events.	98(98.0%)	2(2.0)

Table 7 showed 91.7% participants actively participated in community efforts to raise awareness about extreme weather preparedness. 86.8% participants were agreed they regularly monitored weather forecasts and warnings issued by relevant authorities. And 92.5% participants were actively engaged with

local and national initiatives that promote climate adaptation and disaster risk reduction. 97.7% participants were engaged in practices to reduce environmental impact and contribute to climate resilience. 98.0% educated their family members and friends about the importance of preparedness for extreme weather events.

Table 07 showed 91.7% participants actively participated in community efforts to raise awareness about extreme weather preparedness. 86.8% participants were agreed they regularly monitored weather forecasts and warnings issued by relevant authorities. And 92.5% participants were actively engaged with local and national initiatives that promote climate adaptation and disaster risk reduction. 97.7% participants were engaged in practices to reduce environmental impact and contribute to climate resilience. 98.0% educated their family members and friends about the importance of preparedness for extreme weather events.

Table 8 showed the association between gender and perception of extreme weather events. So, cross-tabulation of Chi-Square proved that gender is significantly associated with extreme weather events variable $\chi 2$ (1) = 6.970a, P<0.05*. Moreover, area has also positive significant association with extreme weather events' perception, attitude and practices ($\chi 2$ (1) = 6.366a, P<0.05*).

Table 8: Cross-tabulation of gender, area and extreme weather events *(n=266)*

1. Gender	Good	Bad	Total	Pearson Chi-Square	Sig.
Female	76	66	142	χ^2=6.970[a]	0.006*
Male	86	38	124		
Total	162	104	266		
2. Area					
Urban	92	75	167	χ^2=6.366[a]	0.008*
Rural	70	29	99		
Total	162	104	266		

P<0.05*

5. DISCUSSION

Climate change is posing serious threats in form of extreme weather events in Pakistan. Earthquakes, heat waves, floods, cyclones, thunderstorms and hailstorms are deteriorating the natural environment in Pakistan. Extreme weather events are instilling fear and anxiety among participants. The study

was aimed at analyzing the knowledge, attitude and practice towards extreme weather events among participants of district Layyah in Pakistan. KAP scores were high at knowledge about extreme weather events among participants. 88% participants (n=266) had high level of education about extreme weather events. The findings were found similar to previous KAP study that high scores on knowledge and practice in preventing sunstroke to avoid heat exposure and played significant role in minimizing heat-related diseases (Li et al., 2016).

85.7% participants recognized the warning signs of extreme weather events of their region and knew the potential impact of extreme weather events in Pakistan. Another study supported the findings that 79% participants recognized climate as a major threat while exposing to extreme weather events (Peria et al., 2016). 89.1% participants were familiar with safety precautions and measures used during extreme weather events. Workers have good knowledge on heatstroke treatment and daily life habits, whereas intervention has enhanced knowledge to prevent from heat waves (Peng, 2019).

KAP scores were low at attitude (61%) towards extreme weather events among participants as compared to scores at knowledge and practice as the previous study found attitude score were low on KAP among participants (Li et al., 2016). Participants exhibited insufficient readiness to address the challenges posed by climate change, despite the evident climate variability in Hail (Said, 2022). Another study found participants were interested to seek more about climate change and about linkages between infectious disease outbreaks and climate change (Sambath et al., 2022).

The findings showed 93.6% participants were involved in proactive practices to cope with extreme weather events' threats in Pakistan. Robust knowledge and positive attitudes with effective climate change adaptation or mitigation practices were effective to cope with the threats of extreme weather events (Rahman et al., 2021). The study found interventions were significant in enhancing coping practices towards preventing heat waves (Xu et al., 2018).

Chi-Square was used to analyze the association between gender and extreme weather events. The findings affirmed that gender is strongly associated with knowledge, attitude and practices of extreme weather events among participants. The results were congruent with previous research as gender is associated with risk perception, attitude towards preparedness of disasters (Cuesta et al., 2022). Female participants had more knowledge about climate change than male participants and they predisposed good attitude

more than males as previous studies also showed females (57.8%) were found involved in good practices about climate change education than males (Chaudhry et al., 2024). Female teachers were involved in high level of practice while, male had high level of knowledge and attitude about climate change education (Karami et al., 2017).

The findings also showed area was positively associated with extreme weather events' knowledge, attitude and practice among participants. The findings were in line with the past studies that the knowledge of climate change among participants was associated with their socioeconomic status and the participants' attitude regarding climate change was significantly associated with their residential status and their practices towards climate change were connected to socioeconomic status and their level of education (Rahman et al., 2021). Gender roles, education, age, knowledge, religious affiliation, marital status, intra-household power dynamics, ethnicity, and social status were identified as intersecting factors shaping perceptions and adaptation strategies related to climate change (Acheampong et al., 2023; Haque et al., 2023).

6. **CONCLUSION**

The study reported high scores on Knowledge and Practice regarding extreme weather events in Layyah. While KAP scores on Attitude was quite low as compared to Practice. Overall, the proportions of participants regarding awareness, their predisposition to learn and in engaging practices in eliminating the threats of extreme weather events were high. The study emphasized upon the awareness of physical, social, psychological consequences of extreme weather events among participants which could involve policy makers to play role in engaging in the primary and secondary prevention against extreme weather events' threats. Furthermore, social media campaigns should be launched to promote attitude-based awareness among people towards learning and practicing against extreme weather events.

The study was conducted only in district Layyah. Close ended questions were asked from the participants, their answers may result in higher proportions. All potential participants were encouraged to participate in the study which may lead to response bias. Higher estimates of practice related questions may be the outcomes of social desirability effect due to close ended responses. The future studies can be conducted from different divisions and districts of country to generalize the better results. Open ended questions and interview survey should be adopted besides close ended question to get broader information regarding knowledge, attitude, and practice about

extreme weather events to avoid social desirability effect. Future studies should examine the association among extreme weather events and education, age, knowledge, religious affiliation, marital status, intra-household power dynamics, ethnicity, and social status.

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Exploring the Gendered Dimensions of Health and Well-being in Climate Change Adaptation

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Abstract

Climate change is a formidable challenge affecting global health outcomes and productivity. This paper examines the extent to which climate change adaptation factors combined with gender and maternal health intersect and their impacts on pregnant women. It explores the perception of young pregnant women about their health by aligning gender, climate change vulnerability, and experiences. The literature review has been expanded to examine theoretical framework and empirical findings regarding climate change and gender. The study uses qualitative data obtained through face-to-face interviews with ten pregnant ladies of different socioeconomic statuses residing in environmentally vulnerable areas. This selection remains consistent with qualitative research guidelines where participants are chosen to provide depth rather than breadth of information. Considering climate change as an aggravating factor in gender disparities, the study identifies additional physical, emotional, and psychological loads placed on pregnant women. Some themes are derived include differences in climate change consciousness, physical health consequences, healthcare accessibility issues, emotional strain, and sociocultural dynamics. This research highlights the importance of gender inclusion in climate adaptation measures and addressing maternal health in development policies. The findings indicate how collaborative and just adaptation can be achieved for both the present population and future generations. The small study area is a limitation that indicates the importance of future research on integrating quantitative data and extending the research area to investigate this crucial issue further.

Keywords: Vulnerability, adaptation, Intersectionality, well-being, maternal health,sustainability

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1. INTODUCTION

Climate change is one of the most significant contemporary issues and is closely connected with numerous natural disasters that directly impact human health. The effects of climate change are unequal on different segments of populations depending on regional location, class, and gender. Out of all thesefactors, gender has emerged as vital in differentiating climate change's effects, especially on health outcomes.One of the many aspects of women's health affected by natural disasters is maternal health since pregnant women being highly vulnerable, suffer from the consequences of disasters more severely. There is still a shortage of literature linking women, climate change adaptation, and maternal health as key factors determining the population's level of flexibility. This study best articulates the analytical variables and proactively demonstrates theoretical foundations and where the study fills the existing gaps.

The knowledge of climate change implications has become quite popular, shifting focus to examining how the changes affect different populations. Pregnant women are especially vulnerable because of physiological changes that make them more sensitive to environmental stressors such as heat, pollution, and contaminated water (Bekkar et al., 2020). Nevertheless, the gender-sensitive aspects of climate adaptation policies and the gendered impacts of climate policies on maternal health have not been adequately explored in the body of literature and public policies. Such a gap indicates the importance of further analysis of how climate change deepens existing health inequalities and how adaptation measures can be adjusted to reflect the situation of pregnant women.

This paper further notes that the integration of a gendered lens into the study of climate change impacts is paramount since gender affects vulnerability as well as adaptive capacities (Beck, 1996). Women, especially pregnant women in many societies, are more affected by the health effects of climate change because of gender disparities, such as poor access to healthcare services, low economic status, and decision-making power (MacGregor, 2010). These inequalities are usually enhanced during times of environmental stress, leaving mothers' health more compromised. Therefore, the sociocultural context greatly influences how pregnant women comprehend and deal with these risks. For example, religious and traditional practices influencing pregnancy and maternal health care seeking, status, and opportunities of women are either protective or risk factors in climate change-caused maternal mortality.

Therefore, this research addresses this gap by examining young pregnant women's attitudes to climate change's effects on their health and their unborn babies' health, with particular emphasis on sociocultural factors. Therefore, using both quantitative and qualitative data, the study seeks to assess the extent to which climate change, a global issue, impacts maternal health in specific sociocultural contexts. Therefore, this exploration is critical to guide policy and interventions that will fit pregnant women's needs considering compounded climate challenges. Therefore, this study examines young pregnant women's perceptions of climate change impacts on their health and unborn children, with emphasis on sociocultural influences.

The significance of this study lies in its potential to shed light on the overlooked gendered dimensions of climate change adaptation, particularly concerning maternal health. As climate change increasingly impacts global health, the specific vulnerabilities faced by pregnant women remain underexplored in both academic circles and policymaking arenas. By comprehending the intersection of gender dynamics and climate adaptation initiatives, this research contributes to a deeper understanding of how environmental alterations singularly impact the health of mothers; furthermore, the study highlights how expectant mothers encounter health hazards disproportionately due to entrenched social influences. Spanning local, regional, and international scales, it seeks to focus more on culturally specific risks vulnerable groups face.

2. LITERATURE REVIEW

In recent years, climate change and health have become increasingly important areas of study, mainly since the impacts of global warming disproportionately affect vulnerable populations. There are significant implications for maternal health from climate change adaptation, which is not only a global health issue but also a gendered issue. As extreme weather events and rising temperatures increase, pregnant women face increasingly severe health risks. Several studies examined how climate change exacerbates health disparities, restricts access to essential healthcare services, and poses new health risks for mothers and children. This review highlights the intersection between gender, health, and climate change, emphasizing the importance of including gender-sensitive approaches in climate adaptation strategies to protect and improve maternal health outcomes.

Ahmed and Fajardo (2022) focused on the Philippines, which experiences

severe climatic conditions such as typhoons and floods. It shows how such climate-related disasters hinder access to health care, which is vital for pregnant women. This caused the exposed healthcare facilities to become inaccessible and delayed the attendance of mothers and newborn babies during and after such events due to infrastructural damage. This puts the lives of the women and their babies at a higher risk of maternal and neonatal mortality. Similarly, Ahmed and Fajardo have contended that climate change mitigation policies for these regions require the development of adaptation measures for these worsening vulnerabilities. For example, they suggest the development of mobile healthcare units and training community health workers to provide emergency maternal care.

Lopez and Martinez (2021) explored how the issues of gender, health, and climate change impact the rural people of Latin America. According to their findings, women and pregnant women, in particular, are the subject of the disproportionate adverse effects of Climate Change. The authors highlighted several factors contributing to this vulnerability: poor health literacy, inferior standard of living, and gender roles that can confine women and hinder their authority to choose. These factors work against pregnant mothers and make it difficult for them to receive the necessary attention, especially during disaster risks such as drought or floods. In the flux of outlining proposed strategies for climate adaptation, the authors underscore that such strategies have to factor in the gender dimensions of these vulnerabilities. Women are urged to be involved in the decision-making processes to be catered for in climate change adaptation.

Chandra et al. (2020) confined their study to South Asia, which is characterized by high temperatures and, more often, heat waves. In their study, they examined how climate changes affect pregnancy, and the authors concluded that higher temperature, especially from heat, is linked with the increased incidence of preterm birth and low birth weight, among other pregnancy complications. This study considers how maternal health objectives ought to be incorporated into the adaptation and mitigation of climate change. For example, early warning systems for heat waves, excellent places for AWASH women, and periodic health activities during heat waves areavailable.

Garcia and Brown (2019) used survey questionnaires to investigate how community-based adaptation interventions enhance maternal health in East Africa. The studies they did indicate that there are health benefits to mothers and their children when women are brought on board to design and implement climate change adaptation projects. Several examples of effective

community mobilization included lobbying for forming women's health

committees, addressing climate resilience in agriculture, and ensuring food availability during pregnancy. These interventions also enhance maternal health while promoting women's autonomy and capacity to prevent and manage climate-sensitive ailments. The authors recommend using similar grassroots approaches as part of broader climate change adaptation policies.

In his study of maternal health in India, Singh and Sharma (2018) also focused on the impacts of climate policy being sensitive to gender. These authors' analyses corroborate that states with policies on climate change that integrate gender and health have decreased MMRR during disasters compared to those with no climate change policies. The authors explained the impact of gender- integrated strategies, such as unique health care for pregnant women during monsoon and drought periods and providing transport to access maternal care. Their main suggestion is that future climate policies at the national and local levels should focus on maternal health, especially in areas most affected by climate change.

Chen et al. (2017) also synthesized broad qualitative evidence on climate change, gender, and maternal health in LMICs. Then again, they discovered in other similar research reviews that it is sporadic direct negative maternal health impacts of climate change, such as maternal mortality, pregnancy complications, and facility-based antenatal and post-natal care, are studied. The authors also pointed out that more research needs to be done on the complex relationship between gender, climate change and health. Alternatively, they suggest that more such studies are required to meet policy demands of climate change adaptations because adaptations do not consider these categories of pregnant women.

The findings were observed from the study of Rao and Fisher (2016) examining the socioeconomic determinants of maternal health in the climatically transformed Sub-Saharan Region. During the study, it was ascertained that women, particularly pregnant women, Suffer most from economic losses due to climate factors such as low agricultural production and food scarcity. Women suffering from these stressors are more likely to suffer from malnutrition, anemia, and other health complications, which can have severe consequences for both mothers and their unborn children. Climate adaptation plans must include measures to enhance economic resilience, such as supporting climate-resilient agriculture and social safety nets. As a result of climate change, the socioeconomic dimensions of

maternal health in this region must be addressed.

Despite the available literature on climate change, gender, and maternal health, some research gapsremain. Prior research focuses on zones, such as the Philippines, Latin America, and South Asia, and does not consider other high-risk areas in Low Middle-Income Countries.However, there are no studies that connect climate change with maternal mortality, compromised pregnancy, and the availability of proper antenatal and postnatal care. The various social, economic, and cultural factors that shape how pregnant women understand and engage withclimate change have not been adequately explored. These gaps can only be addressed by using research based on various regions, employing both quantitative and qualitative methods, and exploring the category of pregnant women regarding climate change.

3. METHODOLOGY

This study used a qualitative research approach to understand the effects of climate change on pregnancy regarding maternal health. Semi-structured interviews served as the primary approach for data collection because it was essential to explore participants' impressions, firsthand experiences, and ways of managing climate-leading environmental changes. This approach was taken because individuals' situations and circumstances are often multifaceted and complicated to measure. Based on the purposive sampling method, ten pregnant women were interviewed and selected based on different socioeconomic statuses, ages, and regions from the areas affected most by climate change. The participants were women who received medical care at community health facilities, maternity clinics, or organizations involved in maternal health and environmental change, pregnant, and living in environment-shifted areas. Respondents covered the age group of 20-35 years, had different levels of education, including primary, secondary, university; and they were rural and urban dwellers.

The data was collected through one-on-one interviews conducted face-to-face or over the Internet regarding the availability and convenience of participants involved. The interview guide was structured around several key themes: Knowledge about climate change, physical health, health care, psychological and social effects, management strategies, influence on the environment, food security, social networks, attitudes towards policies, cultural and religious practices, and possible future impact on children. Every interview ranged from 45 to 60 minutes, was recorded verbally with participants' permission, and then transcribed and analyzed. The primary method used in the study was thematic analysis, which allows for analysis

of patterns, similarities, and differences in thoughts and ideas regarding the experiences of the participants.

4. FINDINGS AND DISCUSSIONS

The findings indicate that climate change influences maternal health in various ways and to different extents, depending on the participants' knowledge and attitudes to climate change. All ten participants described similar experiences, and no further themes emerged during the data analysis process; therefore, thematic saturation was reached after the ten interviews. Accordingly, the thematic analysis revealed a wide range of concerns, from increased concern about severe weather events to difficulties in health care due to environmental changes. Each theme mirrors the complex interplay between climate change and physical health, mental health, and socioeconomic determinants of pregnancy in impacted areas.

Theme 1: Awareness of Climate Change and Its Effects

Concerning climate change, we observed that the participants had low to moderate awareness and accepted the reality of climate change and the prospect of its effects. But the extent of this knowledge was much higher. Few participants were sensitive about how climate change, especially heat waves, affected their pregnancies and health.

For instance, one participant stated, "Heat makes me feel so tired, and I had to sit inside for most of the heat wave period; I wonder how this affects the baby." This implies that environmental stressors can potentiate pregnancy's physical and emotional burdens. On the other hand, other participants had rather apparent and routine acutely modified views and knowledge from the media exposure. They were not as certain about the immediate effect of climate change on one's health.

It points to a knowledge deficit and also clarifies the need to implement appropriate educational interventions aimed at increasing pregnant women's awareness of how climate-related factors can impact them and their unborn babies. Education is also found to be highly influential, and the respondents with higher levels of education are perceived to be more informed in their attitudes towards climate change.

Theme 2: Physical Health Impact

All the participants described the physical impact of changes in their environment during pregnancy as unfavorable. Prolonged exposure to heat

and polluted air were two more common explanations for symptoms that interfered with activities and health.

For example, one participant said, "Sometimes I could not stand the heat, and I would always feel so exhausted that I felt like fainting when walking to the store." Another participant said, "I have breathing issues, and when the air is growing polluted, I have constant concern about the healthof my child." These cases confirm the cross-sectional nature of environmental pollution with physical health, especially in marginalized groups, including pregnant women.

The study also underscores the need for additional studies to identify the specific health effects attributed to environmental factors and implement effective measures to reduce their impact, particularly in urban settings where pollution levels are comparatively higher.

Theme 3: Access to Healthcare

This study showed that pregnant women face various challenges in the use of health services, especially those of low-income status. The participants noted that climate change would worsen these difficulties, mainly during floods.

One participant said, "I am so scared that again, once the flood comes, I will not be able to arrive at the clinic anyway…what if something goes wrong?" Besides, one participant said, "Most of thetime, I move in this hot weather to the hospital because this is the only source of prenatal care." These are problematic barriers because prenatal care is so crucial.

The study indicates that while socioeconomic status and environmental conditions are critical in producing a vulnerable situation in terms of health care, they are also essential in providing an opportunity or enabling environment for health access. Developing responsive solutions to make healthcare services available in geographical and climatic constraints affecting vulnerable population groups due to climate change will be crucial.

Theme 4: Emotional and Psychological Impact

Respondents stated they often experience emotional and psychological strain associated with climate change, especially mentioning pregnancy and the future of their offspring as areas of concern. Some reported increased levels of stress and anxiety primarily because of the trends in global warming.

As for the questioning, one of the participants said, "I always get anxious thinking of the kind of world I will be raising my child in; I get

terrified when I think about the future." Another exampleis, "I feel stressed

knowing that weather conditions could be unfavorable to my child." Such responses point to the psychological toll that climate change has on individuals, especially pregnant women. The implications stress the need for more mental health services and programs that may cover the psychological aspects of climate change and how people can manage it.

Theme 5: Coping Mechanisms

Participants named the various coping strategies they used to deal with the effects of climate change during pregnancy. One of the social methods pursued was to avoid heat and concentrationsof heat by avoiding the outdoors during the hottest part of the day. They also pointed out the significance of family help to cope with physical discomforts and having a cooler climate in the dwelling space.

One of the participants stated that her family assists her a lot, especially when the weather is hot; they ensure that the house is well-air-conditioned and that she is not uncomfortable. The last strategy involves changing diet; for instance, taking a lot of water and light foods. Such behaviors are characteristic of actively promoting health protection in response to unfavorable environmental conditions. The study implies that coping strategies and support systems are particularly useful in managing physical and psychological changes to the climate during pregnancy.

Theme 6: Environmental Concerns and Food Security

Specific risks identified by participants concerning climate change were related to the availabilityand quality of food because of climate change impacts, especially on locally produced foods. Volatile weather conditions have hindered farming activities, causing concern about food availability during pregnancy. For instance, one participant said, "There are no fresh crops here, and vegetables are scarce; I'm concerned about feeding my baby the right nutrients." Another said, "Food prices have inflated a lot; it's challenging to sustain a healthy diet." These are especially important for pregnant women who need a regular and healthy diet for their benefit and that of their unborn child. Consequently, the appropriate authorities must adopt strategies that enhance food stability and focus on preserving the environment, especially in areas affected by climate change.

Theme 7: Social Support Networks

The study showed that social support is a crucial factor that can help pregnant women deal with the effects of climate change. We found a significant correlation between stress due to environmental changes and the participants' resilience: participants with strong family and community support provided greater resilience and dealt better with stress.

Specifically, one of the participants stated, 'My family and neighbors are always there for me. They make everything easier to handle.' On the other hand, those who reported low social support facedhigher levels of stress and struggled to cope with climate shocks. These results underscore the significance of developing and preserving social support, which is crucial to help and comfort in terms of environmental pressure.

Theme 8: Perception of Climate-Related Policies

The participants also showed hesitance and a lack of confidence in the existing policies on weatherchange to their satisfaction so far as the pregnant moms are concerned. Some considered governmental measures poorly applicable or too general and did not address their needs and circumstances.

A participant said, "I have not consumed any policy that addresses such climate problems to pregnant women." Another participant commented, "It seems like we are not valued as far as climate change is concerned." Such feelings show a policy-performance gap for the climate changeproblem in the study area. These realities point to the urgent need to develop better policies that encompass pregnant women in the context of climate change.

Theme 9: Cultural and Religious Beliefs

Customs and religions played a significant role in how participants perceived and managed climatechange's effects. Some could interpret these changes within the spiritual or cultural perception of reality that can provide solace and purpose.

One participant supported this finding, "I do think this is all done for a purpose; maybe it is writtenin heaven for me to take care of the environment, and this gives me hope." Other participants alsonoted the impact of cultural practices in supporting environmental conservation and people's sustainable behaviors in their day-to-day lives. Hence, it is appropriate to integrate culture and spirituality into climate change discussion and practice to strengthen adaptation practices that arecompatible with the views of affected populations.

Theme 10: Future Outlook and Concerns for Children

One common thread of discussion throughout the study was the session participants' worry aboutwhat kind of world their children will grow up in with the already noticeable adverse effects of climate change on the environment. Some voiced profound concern over the prospects of environmental futurizing and said they did not want their children to grow up in a damaged environment. One participant said, "I only wish for my child to be happy, healthy, and safe in the future, but I am so afraid of the future." Another said, "It is painful not to feel guilty thinking and imagining the world we are leaving for our kids."

These concerns raise the psychological effects climate change has had on parents and underpin the importance of welfare-based policies and interventions for future generations. For this reason, the findings stress the need for companies to consider environmental management activity in strivingto create an environmentally sustainable future for the next generation.

4.1 Discussions

This research addresses important research questions regarding climate change effects on pregnant women, and direct and indirect consequences. There were differences in the level of concern where women with higher education reported having a better understanding in relation to climate risks. Maternal physical health issues like heat stress, effects of air pollution and poor nutrition became notable sources of stress during pregnancy. Additional challenges consisted of emotional stress such as; the anxiety resulting from the uncertainty of the future and psychological stress, which point to the deep and severe mental impacts of climate change. Furthermore, cultural practices and more importantly, support from people of faith and family helped a lot in as far as coping mechanisms were concerned. It enhances the understanding of the complex nature of how climate change impacts maternal health in different dimensions to support development of effective intervention measures.

5. CONCLUSION

Overall, the findings of this research show the disturbing effects of climate change on young pregnant women, especially in the selected sociocultural cultures. The study also shows how climate change makes existing gender disparities worse, as these women experience more physicaland emotional stress. Educational background plays a significant role in climate change, but they are aware of its impacts on human health, such as heat stress. It also shows that there are vast challenges to reaching medical facilities

during disruptive weather, which poses a considerable risk to the lives of expecting mothers. Mental and emotional strainis quite common and includes sadness and deep concerns about future generations and unborn children. Even though such enduring factors as seeking familial support are involved in coping, these are ordinarily inadequate.

It has been found that the social and cultural support system plays a vital role, indicating that if the adaptation strategies must be effective, they have to be sensitive to the cultural contexts of the individuals. Furthermore, the study notes a disconnection between climate policies and the experiences of vulnerable women to underscore the importance of policy sensitivity. This research is crucial as it focuses on addressing the gender lens in implementing climate adaptation measures to preserve the well-being of mothers to do and enhance gender equity.

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Climate Change adaptation and maternal health through legal frameworks and policy

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Abstract

Climate change debate generally ignores intersectionality despite its intense challenges to the wellbeing and maternal health of women in Pakistan where socio-economic inequalities intersect with climatic vulnerabilities. This study examines Pakistan's legal framework concerning the protection of wellbeing and maternal health of women in the context of climate change adaptation with the help of a qualitative approach. The paper emphasizes the intersectionality of environmental and gender-related issues through a comprehensive review of Climate Change Policies of Pakistan, amplified by analytical, empirical and reform-oriented research. It also identifies challenges to effective implementation, including gender-based inequalities, inadequate healthcare infrastructure, limited access to healthcare resources and less involvement of women in decision-making. To sum up, this research highlights the necessity of incorporating gender-sensitive perspectives into climate change mitigation and adaptation efforts. Consequently, this will not only safeguard the well-being of women but also contribute to sustainable development in the country. Policymakers can help protect maternal health by advocating gender-responsive approaches, improved healthcare access, and community-based adaptation strategies, Moreover, this paper suggests policy recommendations to address these challenges and strengthen women's resilience to climate change impacts.

Key Words: maternal health, climate change, women rights, environment, gender inequality, sustainable development, Pakistan, policy implementation

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1. INTODUCTION

Climate change represents one of the most critical challenges of our era, with profound and far-reaching impacts on communities worldwide.

However, its effects are not uniformly distributed, disproportionately burdening vulnerable populations, particularly women (Women, 2022). In Pakistan, a country characterized by significant socio-economic inequalities and environmental vulnerabilities, women face amplified threats to their well-being and maternal health due to the intersection of gender inequality and climate-related stresses (Okesanya, 2024).

Women constitute nearly half of Pakistan's population, yet they bear a greater brunt of climate change impacts. Approximately 70% of those living in poverty in Pakistan are women, a group already more susceptible and vulnerable to environmental damage (Khaliq, 2009). The combination of inadequate healthcare infrastructure, limited access to resources, and minimal involvement in decision-making processes exacerbate their vulnerability. This issue is further compounded by traditional gender roles and socio-cultural norms, which restrict women's ability to adapt and respond to climate-related challenges effectively.

The urgency of this research is highlighted by the increasing frequency and severity of climate-related events in Pakistan, such as floods, heatwaves, and droughts. These events disproportionately affect women, compromising their health, safety, and livelihoods. For instance, the devastating floods of 2022 left nearly 650,000 pregnant women without access to healthcare, forcing many to give birth under precarious conditions. Additionally, the lack of basic menstrual hygiene products and sanitation facilities during such crises underscores the dire need for gender-sensitive climate adaptation strategies.

This research paper aims to examine Pakistan's legal framework concerning the protection of women's well-being and maternal health in the context of climate change adaptation. By employing a qualitative approach that includes legal analysis and policy assessment, this study provides a comprehensive analysis of existing laws and policies, evaluate their implementation, and identify the challenges hindering their effectiveness. The research addresses critical questions, such as how current laws and policies in Pakistan address the impacts of climate change on women's well-being and maternal health, the barriers to effective implementation, and the formulation of policy recommendations to enhance resilience and adaptive capacity among women.

By illuminating the intersectionality of environmental and gender-related issues, this study aims to inform policymakers, stakeholders, and the international community about the critical need for targeted interventions and

reforms. Ultimately, this research strives to contribute to a more inclusive and resilient approach to climate change adaptation, ensuring that the unique needs and challenges faced by women in Pakistan are addressed and mitigated.

2. LITERATURE REVIEW

Climate change is increasingly recognized as a significant threat to global health, with implications for vulnerable populations such as women in developing countries like Pakistan. This literature review aims to provide a comprehensive overview of existing research on the intersection of climate change, gender inequality, and maternal health in Pakistan.

Ebrahim (2023) highlighted that women's voices in Pakistan are often ignored in climate change discussions. Sonia Arif, a 40-year-old beautician and mother of four, is facing financial hardships after her husband Arif had to close his tailoring shop due to their inability to pay the monthly rent of 40,000 Pakistani rupees (USD 139). “I am sick of the yelling that has become a norm in my house for the past two years. The unbearable heat has added to my plight. In my next life, I want to be born as a man,” she says. The restricted role and freedom of women in Pakistan has added to their challenges in coping with climate-related extreme events. The limited roles and freedoms of women in Pakistan exacerbate their difficulties in dealing with climate-related extreme events. Climate change affects every aspect of women's lives: their economic stability, marital relationships, and physical health" (Ebrahim, 2023). The author has not shed any light upon any legal means through which this issue can be cured.

Ihsan Ullah (2023) in his research paper noted that Pakistan is among the countries most vulnerable to climate change impacts. The northern regions of the country have faced numerous extreme cold weather events, such as floods, heavy snowfall, and torrential rains, which have significantly affected maternal and infant health. Pregnant women or those trying to conceive are particularly susceptible to the negative effects of extremely cold weather on their reproductive health, including decreased fertility, menstrual cycle irregularities, and even miscarriages. The Paris Agreement on Climate Change, the United Nations Framework Convention on Climate Change, and the Sustainable Development Goals (SDGs) have all recognized the connection between climate change and women's health and emphasized the crucial role women play in combating climate change. Additionally, the World Health

Organization (WHO) has highlighted the link between gender, health, and climate change and proposed measures to mitigate its impact on women's health (Ullah, 2023). The author has cited the legal framework and international treaties concerning women's health and climate change, but he did not mention the reason for failure of implementation of these laws in Pakistan. This aspect is catered by the research in question.

In the book "Climate Change and Women: A Study in Selected Sites in Rural Sindh, Pakistan-2011" by Shirkat Gah (2012), it is highlighted that recent studies indicate an increase in women's vulnerability to the effects of climate change due to shifts in weather patterns. Although climate change is expected to impact all sectors of society, women are likely to be more severely affected due to their dual roles in both reproductive and productive capacities (gah, 2011). While the book thoroughly details the impacts of climate change on women, it falls short of providing strategies to address these challenges. The current research focuses on addressing this gap by proposing solutions.

Chauhan (2014) analyzed the deeply patriarchal nature of Pakistani society, highlighting significant gender disparities in health, education, income opportunities, employment, personal security, asset control, and political participation between women and men. The study mentioned that it is due to the lack of a comprehensive government policy and program on the equitable representation of women in public sector organizations. Like many other developing nations, Pakistan's affirmative action programs focus on ethnic and income inequalities rather than addressing gender inequalities. While his paper provides comprehensive insights into the various aspects of the current research, it does not address the reasons behind the ineffective implementation of laws designed to protect women in Pakistan.

3. METHODOLOGY

A research paradigm is a guiding philosophy that directs a researcher in exploring, assessing, and comprehending a situation, especially in the context of social sciences research (Creswell, 2012) (Krauss, 2005). Research paradigms consist of three main components: ontology, epistemology, and methodology. Ontology is the study of the nature of reality, questioning whether there is a single reality, multiple realities, or no reality at all (Blaikie, 2009). For instance, does climate change in fact effect women differently? Is there any law which provides protection of maternal health and wellbeing of

women? Epistemology is the study of knowledge and how we can understand reality. It encompasses the scope and methods of acquiring knowledge, as well as the processes for validating that knowledge (Saunders, Lewis, & Thornhill, 2009). For example, whether there is an effective implementation of such laws in Pakistan? Methodology is the study of the approaches and techniques used to investigate the environment and validate the knowledge obtained (Gelo, Braakmann, & Benetka, 2008). For example, how to know that such reality exists? The present study adopts the constructivism paradigm, as it is believed that reality is multifaceted, with various interrelations and interdependencies. These can be understood by exploring different ideas and perspectives (Dnezin & Lincoln, 2005). This approach encourages the full involvement of the researcher in social inquiry to generate a deep and comprehensive understanding of reality (Gelo, Braakmann, & Benetka, 2008). This school of thought considers the qualitative research method appropriate for gaining insight into research problems. The major strength of this approach is that it leads to a profound understanding of a research problem within a specific setting, due to the close interaction of the researcher with the phenomenon (Baxter & Jack, 2008).

The study focuses on rural areas in Pakistan, recognizing their unique socio-economic and environmental challenges. Targeting diverse regions in Punjab, Sindh, Khyber Pakhtunkhwa, and Balochistan, the research aims to capture a broad spectrum of conditions and vulnerabilities. These areas experience significant climate-related challenges like water scarcity and extreme weather, which exacerbate socio-economic inequalities and impact maternal health. Rural women in Pakistan experience significant disparities in healthcare access, economic opportunities, and environmental conditions, leading to compounded maternal health challenges. The findings of this study aim to provide actionable insights for enhancing policy implementation and protecting the maternal health and wellbeing of women in Pakistan's rural areas amidst the challenges posed by climate change.

This study is undertaken to cater the problem of implementation of laws on climate change regarding the maternal health and wellbeing of women in the rural region of Pakistan. The methodology used to conduct research is analytical research, empirical legal research and reform-oriented research. The technique for analyzing data is qualitative. A comprehensive review of existing literature on climate change, maternal health, and socio-economic inequalities in Pakistan is conducted. This includes academic articles, government reports, policy documents, and NGO publications as well

as examination of legal documents, policies, and international agreements related to climate change, public health, and women's rights in Pakistan. These methods are best to analyze the existing legal framework and practical challenges of policy implementation concerning women's wellbeing and maternal health in the context of climate change. Through this methodology it is easy to evaluate the effectiveness of current policies and legal frameworks in addressing the intersection of climate change, socio-economic inequalities, and maternal health.

4. RESULT

4.1. Overview of the Data

The data is collected through a qualitative method using analytical research, empirical legal research and reform-oriented research. According to data from the United Nations, 80% of individuals displaced by climate change are women. The catastrophic floods of 2022 left nearly 650,000 pregnant Pakistani women without access to healthcare, compelling many to give birth in the open. Additionally, the persistent floods deprived eight million girls and women of basic menstrual hygiene products and toilets needed for managing their periods (Waheed, 2023). The data included socio-economic status, environmental conditions, health records, and case studies.

4.2. Key Findings

4.2.1. Impact of Climate Change on the wellbeing and Maternal Health

Due to geographical location and socio-economic conditions, Pakistan is extremely susceptible to the effects of climate change. Women in Pakistan encounter numerous overlapping challenges, such as restricted access to healthcare, socio-economic disparities, and traditional gender roles. These factors increase the impact of environmental damage and climate variability on their wellbeing and maternal health (Habib SS, 2021). After disasters, women are disproportionately affected by limited access to clean water and sanitation facilities. The impact of climate change on women's health can vary significantly, even within Pakistan. There is a strong call to integrate women's reproductive health into national climate strategies and disaster relief efforts (Berninger, 2024).

The rise in both average and extreme temperatures is expected to increase heat-related illnesses and fatalities among vulnerable populations, including pregnant women (Asokan & Dutta, 2008). Pregnant women are particularly vulnerable to rising temperatures and heat waves due to their

reduced ability to regulate body temperature. As a result, they experience heightened susceptibility to the impacts of climate change (Wells, 2002). According to the World Health Organization (WHO), 99% of all maternal deaths related to childbirth occur in developing countries (Costello, Abbas, Allen, Bell , & Bellamy, 2009). Ensuring good maternal health is vital for achieving healthy birth outcomes and maintaining a healthy pregnancy (Organisation). In a recent review (Bhutta, Lassi, Blanc, & Donnay, 2010), a clear link was established among reproductive health, maternal health, and perinatal birth outcome. Nearly 3 million neonatal deaths and stillbirths each year are linked to maternal health issues, including inadequate nutrition, poor living conditions, and infectious diseases (Friedman, Mital, & Kanzaria, 2007). The heavy floods of 2022 in Pakistan are just one of many examples where women were hit the hardest by the crisis through malnutrition and dehydration; at the same time, female genital mutilation, child marriage and gender-based violence rose (Berninger, 2024). Exposure to heat can lead to health harms for pregnant women, including hypertensive disorders of pregnancy and its complications (CDC, 2024). According to United States Environmental Protection Agency (Agency, 2016) , climate change can worsen environmental hazards that threaten the health of pregnant women and increase health risks for the baby. Maryum Shabbir Abbasi, Khansa Naeem, Danish Hasan Ansari conducted a study in the areas of Muzaffargarh and Tharparkar districts of Pakistan which highlight the profound impact of environmental and socio-economic factors on maternal health and wellbeing of women from these areas.

Rajju,34, Sanghar, Tharparkar, Sindh, Pakistan

"I was seven months pregnant when we migrated due to drought in our village (Sanghar). We migrated on camel and worked as labor to lift weights and as a result lost my infant. My family took a loan of 10,000 Rs (95.2 USD) from the landowner for meeting my health expenses. I went into depression after losing my baby (Abbasi, Naeem, & Ansari, 2021)*."*

Maya, 40, Islam Kot, Tharparkar, Sindh Pakistan

"I was pregnant at the time of migration. Owing to lack of health and nutritional facilities, my situation got worse. In such a bad condition, I went to Islamkot where I delivered a baby girl, who died three days after her birth due to malnutrition. My aged mother-in-law was also with us. During migration, she fell ill and died of prolonged illness for four years. Meanwhile, we did not receive any relief package from the government. We finally took a Rs 30,000 (285.7 USD) loan from a microfinance bank to make our both ends

meet. However, few women received some amount through Benazir Income Support Program (Abbasi, Naeem, & Ansari, 2021)*."*

Kausar,23, Mohalla Bukhari Wala, Muzaffargarh

"During floods, I was 4-month pregnant. I got sick due to malnutrition and was referred to a city hospital for treatment. I also had other kids at that time and would give them muddy water by mixing sugar into it to feed them as a replacement of milk. I used to eat leftover food from the temporary place we were staying at (Abbasi, Naeem, & Ansari, 2021)*."*

4.2.2. Environmental Vulnerabilities

Women's vulnerability to climate change arises from a combination of social, economic, and cultural factors (Osman-Elasha, 2009). Women have restricted access to and control over environmental resources and services, minimal involvement in decision-making (Raza & Murad, 2010), and are excluded from the distribution of environmental management benefits. As a result, they are less equipped to address climate change (Osman-Elasha, 2009). During extreme weather events like droughts and floods, women often work harder to sustain their households, limiting their time for education, skill development, or income generation. Despite comprising 70% of those living in poverty and heading 40% of the poorest urban households, women, who produce 50-80% of the world's food, own less than 10% of the land (Osman-Elasha, 2009).

Women make up a large portion of impoverished communities that heavily rely on local natural resources for their livelihoods, especially in rural areas. They bear the primary responsibility for household water supply, energy for cooking and heating, and ensuring food security (Osman-Elasha, 2009). In Pakistan, socio-cultural norms and childcare duties often prevent women from migrating, seeking refuge, or working when disasters occur. This situation places additional burdens on women, such as traveling farther for drinking water and firewood. Women already encounter gender inequalities in areas such as human rights, political and economic status, land ownership, housing, exposure to violence, education, and health (Osman-Elasha, 2009). Climate change will further exacerbate these vulnerabilities. Additionally, it is well-known that during conflicts, women face increased risks of domestic violence, sexual intimidation, human trafficking, and rape (Davis, 2005).

Rural women have no say in decision-making, whether it is about household or the migration because she is not considered the family head. Owing to patriarchy, it is men who decide everything, and women had to

follow (Abbasi, Naeem, & Ansari, 2021). In the Focus Group Discussion (FGD) and in depth interviews conducted for the study by Maryum Shabbir Abbasi, Khansa Naeem, Danish Hasan Ansari in the areas of Muzaffargarh and Tharparkar districts of Pakistan, it was revealed that 100% women have no say in decision-making (Abbasi, Naeem, & Ansari, 2021). This study also involved cases in which women were left behind and other family members, mainly men, were migrated internally or internationally for a job. Even in such cases, women can't decide where to migrate, if there is flood or drought. It is out of the question for a single woman to move without any of her family members. The reason for not having power to decide is that women in rural and even in urban migrants are not literate. There were very few respondents who went to school (Abbasi, Naeem, & Ansari, 2021). One of the respondents during the study's (Abbasi, Naeem, & Ansari, 2021) interview said that the decision to sell seeds during drought was of her husband. She said:

"We had to sell the seeds, which we had during drought, at a very low rate of Rs 1000 due to illness and shortage of money. Later we bought the seed at Rs 4000 (Abbasi, Naeem, & Ansari, 2021)*."*

4.2.3. Socio Economic Inequalities

In Pakistan, women face additional disadvantages: 9.1 million (Zaidi, 2022) women work in agriculture, contributing significantly to food production and security. However, they are mostly unpaid, experience higher time poverty, and are more susceptible to exploitation compared to men. Women's ownership of land, and control over physical assets is minimal: only 2 percentage of women report owning a house or agricultural land as compared to 72 percentage men. Only 55% of women have access to adequate healthcare, and 48.1% of women and girls aged 15 to 49 in Pakistan, particularly in rural areas, have no say in decisions regarding their own health care (Ilyas, 2018). Only 28 percentage women aged 15 to 49 have reported intimate partner violence in their lifetimes (ICF, 2019). and roughly 1,000 women are killed for honor every year (Watch, 2021).

In a study (Abbasi, Naeem, & Ansari, 2021) of Muzaffargarh, a woman participating in a study said:

''After the 2010 floods, we moved to city (Mohalla Bukhari Wala) with the help of our relatives. Everything, including result cards of kids, got lost during floods. The school is away from here. Girls stay at home because we can't bear the expenses of school van. However, boys go to school on bicycle."

In a largely patriarchal society, gender relationships face multiple challenges. Women's access to health and education is mostly limited compared to men, which is evident from a large gap in boys' and girls' literacy rate or schooling years (Shah, 2010).

4.2.4. Failure of Policy Implementation

Mitigating the negative impacts of human-induced climate change demands more effective policy decisions and superior governance practices (Biermann, 2014). Effective climate change adaptation policies offer a path to establish mechanisms that enhance resilience in various communities (Dupuis & Knoepfel, 2013). While substantial efforts are being made to develop a framework for climate change adaptation, the effectiveness of these efforts has so far failed to materialize. Since the climate change policy was developed in 2012, there has been little evidence of effective implementation on the ground (Masud & Khan, 2023). Given Pakistan's strategic location in South Asia and the severe impacts of climate change, it is crucial to closely examine the barriers to adaptation (Spires, Shackleton, & Cundill, 2014).

Coordination barriers

Currently, there is no provincial Climate Change Council to coordinate with the Federal Climate Change Council, leading to a lack of clear authority for implementing climate change policies at the provincial level. Establishing a federal climate change authority would be ineffective, as it would merely duplicate the efforts of existing disaster risk management agencies (Masud & Khan, 2023).

Lack of common understanding on how to govern climate change related actions

Creating provincial-level climate change policies results in a waste of time and resources due to duplication. There is also a lack of alignment between the national disaster protection plan and the flood risk management plans of disaster management authorities, which weakens sectoral cohesion (Masud & Khan, 2023).

Issues of differing federal and local priorities and knowledge gaps

The lack of alignment between federal and provincial priorities is causing coordination problems. Weak technical capacity at

> the provincial level has led to challenges in prioritizing climate change issues. As climate change is a relatively new field, advancing this agenda at local levels, particularly when driven federally, is difficult. Climate change is often viewed as an extension of broader environmental issues (Masud & Khan, 2023).

Although, the National Climate Change Policy (NCCP) document addresses essential public sector areas and includes both adaptation and mitigation measures, which are crucial for a strong policy however, it lacks other key elements necessary for a fully comprehensive climate change policy (Masud & Khan, 2023). The policy has been criticized for being vague and generic, with unclear prioritization of actions and identification of responsible authorities or organizations. It also lacks a mechanism for coordinating with other sectors. Additionally, the policy faces challenges in implementation due to insufficient information on the financial resources needed and the sources of funding (Masud & Khan, 2023). The drawbacks (Masud & Khan, 2023) of policy documents are as follows:

- The policy does not prioritize vulnerable sectors;
- With 24 objectives and 215 actions, the policy is overly ambitious and impractical;
- There are no target-oriented programs to specifically address climate change issues;
- There is a lack of accountability for shared responsibilities among different sectors and governing bodies;
- The policy is based more on political decisions than on real and thorough assessments;
- It lacks connections with the Sustainable Development Goals (SDGs) and other regulatory frameworks;
- It fails to identify complementary actions within existing sectoral policies, such as those related to national forests, agriculture, and water.

A key flaw in the policy document was its failure to clearly define target-oriented projects that separate climate change interventions from general development efforts. It has been noted that this ambiguity allows existing projects to be rebranded without yielding substantial climate change outcomes. Without clear targets, it will be challenging to measure the policy's effectiveness in driving adaptation actions, particularly at lower governance levels (Masud & Khan, 2023).

5. DISCUSSION & POLICY IMPLICATIONS

Pakistan's vulnerability to climate change, due to its geography and socio-economic conditions, significantly impacts its population, particularly women. Limited healthcare access, socio-economic disparities, and traditional gender roles worsen the effects of environmental degradation and climate variability on women's health and maternal well-being. Pregnant women are particularly at risk from rising temperatures and heatwaves, which affect their ability to regulate body heat. This vulnerability is concerning given that nearly all maternal deaths related to childbearing occur in Pakistan, as reported by the World Health Organization (WHO). Pakistan's diverse geography, including arid zones, river basins, and mountainous regions, exposes it to frequent floods, droughts, and extreme temperatures, significantly impacting communities, especially women. Socio-economic inequalities further exacerbate these impacts, as women from lower socio-economic backgrounds face greater challenges in accessing resources, healthcare, and education, making them more vulnerable to climate change. Extreme weather events can worsen these issues, leaving poor women with fewer resources to adapt. The impact of climate change varies between urban and rural areas. Urban women may face heat-related issues, while rural women deal with agricultural losses and water scarcity, requiring localized strategies to address their specific needs. Rising temperatures can lead to heat-related illnesses and complications for pregnant women, such as dehydration and preterm birth, necessitating targeted health strategies. Beyond immediate crises, climate change affects women's health in various ways, including worsening menopausal symptoms, prenatal stress, and exposure to harmful pollutants, which have long-term health implications.

Women's vulnerability to climate change in Pakistan is deeply rooted in social, economic, and cultural factors. These vulnerabilities are manifested in various ways, significantly affecting their ability to cope with and adapt to the impacts of climate change. Socio-economic inequalities significantly compound the challenges faced by women in Pakistan, particularly in the context of climate change. Women in Pakistan face significant environmental and socio-economic challenges exacerbated by climate change. Limited access to and control over resources such as land, water, and forests hinders their ability to manage these assets effectively. Despite their crucial role in food production, women own less than 10% of land globally, including in

Pakistan, restricting their decision-making power and benefits from resource management. Their minimal participation in environmental decision-making processes further marginalizes women, leaving their specific needs and perspectives often overlooked. This exclusion perpetuates policies that fail to address their unique vulnerabilities, reinforcing their marginalization.

Women in rural areas, who heavily depend on natural resources, face heightened vulnerability due to climate-induced resource scarcity. Their socio-cultural norms restrict mobility and limit their ability to escape or adapt during climate disasters, increasing their exposure to risks and reducing adaptability. Gender inequalities, including limited land ownership, unpaid labor, and restricted access to healthcare, compound the effects of climate change. Women's minimal land ownership and control over assets, combined with inadequate healthcare access and high rates of gender-based violence, further undermine their resilience and well-being. Addressing these challenges requires comprehensive, gender-sensitive policies that enhance women's access to resources, decision-making, and economic opportunities. Prioritizing women's empowerment can improve resilience to climate change and contribute to a more equitable and sustainable future.

Combating the negative impacts induced by anthropogenic climate change requires robust policy decisions and effective governance practices. While climate change policies designed for adaptation provide a potential pathway to build resilience in various communities, the effectiveness of these policies in Pakistan has yet to materialize. Despite substantial efforts to develop a framework for climate change adaptation since the introduction of the National Climate Change Policy (NCCP) in 2012, there is little evidence of effective implementation on the ground. The severity of climate change impacts in Pakistan, coupled with its strategic location in South Asia, necessitates a closer examination of the barriers to adaptation.

Effective climate change policy implementation in Pakistan faces several challenges. Coordination barriers arise from the absence of a provincial-level climate change council to connect with the Federal Climate Change Council, leading to inefficiencies and overlapping responsibilities. The lack of a unified understanding and governance structure further complicates efforts, with provincial and national plans often misaligned. Differing priorities and knowledge gaps between federal and local governments exacerbate these issues, as climate change is frequently treated as an extension of environmental issues rather than a critical standalone concern.

Criticisms of the National Climate Change Policy (NCCP) highlight its vague nature and lack of clarity on action prioritization and authority designation. The policy lacks a detailed financial plan, accountability mechanisms, and integration with Sustainable Development Goals (SDGs) and other regulatory frameworks, reducing its effectiveness. Its generic nature and absence of target-oriented projects further hinder progress, making it difficult to quantify and measure outcomes. To address these challenges, Pakistan needs to improve coordination, develop clear governance structures, prioritize vulnerable sectors, and establish specific, targeted projects. Enhancing these aspects is crucial for building resilience and achieving sustainable development in the face of climate change.

The United Nations' Adaptation Gap Report 2022 emphasizes the urgent need to scale up climate adaptation efforts. Given the evidence presented, it is crucial to integrate maternal health care into these adaptation processes (Change, 2021). Addressing the impact of climate change on maternal health requires comprehensive strategies that prioritize women's health and well-being. This includes improving healthcare infrastructure, enhancing access to clean water and sanitation, and promoting education and awareness about climate-related health risks. Policies should also support women's empowerment and resilience by providing economic opportunities and addressing socio-economic inequalities. Integrating reproductive health services into climate plans and disaster relief efforts is essential to ensure that pregnant women and their families receive the care they need during climate emergencies. Based on the challenges identified in the research paper and the need to address the unequal impact of climate change on women's maternal health in Pakistan, the following policy recommendations are proposed:

1. Gender Responsive Legal Framework;
2. Multifaceted Approach to Legal Implementation of Environmental laws;
3. Recommendations for Policy Makers;
4. Women’s Leadership, and Climate Resilience;
5. Supporting Human Rights.

6.1. Gender Responsive Legal Framework

Gender equality is a core principle in building a just and equitable society, universally acknowledged as a fundamental human right crucial for sustainable development. Legal frameworks are essential in defining gender relations, offering tools to remove systemic barriers and create an

environment where all individuals, regardless of gender, can access equal rights and opportunities.

In Pakistan, gender equality is a multifaceted issue shaped by cultural traditions, legal advancements, and social norms. The Constitution provides a foundation for gender equality by guaranteeing non-discrimination and equal protection for all. This is further supported by specific laws aimed at combating discrimination and safeguarding women's rights (Usman, Muhammad & Kanwel, Sidra & Khan, Muhammad Imran & Khan, & Asif, 2021). To effectively address the impact of climate change on maternal health, it is essential to enhance and enforce existing laws such as the Pakistan Environmental Protection Act and the Reproductive and Healthcare Rights Act with gender-sensitive provisions. Additionally, national climate policies should include gender-focused language to prioritize women's health. Key principles for development policies include:

Climate change impacts and responses are not gender-neutral; integrating gender considerations is crucial for achieving equality, reducing poverty, and ensuring effective climate action;

Addressing gender inequality requires confronting power imbalances and involving both men and women in the process;

Effective solutions must account for diverse gender experiences and contexts, avoiding one-size-fits-all approaches.

When designing climate change policies, it is important to consider how gender roles influence the issues and how the policy will address these dynamics. Evaluate the risks and benefits for different genders, strategize to close gaps, and maximize opportunities. Ensure that resources, needs, and success metrics are gender-inclusive, and clearly define accountability for gender-related impacts (Berger, 2011).

Given the significant impact of climate change on women's well-being, it is essential to incorporate women's reproductive health into national climate plans and disaster relief efforts. Ensuring access to reproductive health services during climate emergencies can mitigate adverse outcomes for women and children. This integration also supports gender-sensitive approaches in climate adaptation and mitigation strategies.

6.2. Multifaceted Approach to Legal Implementation of Environmental laws

Pakistan faces major environmental challenges that require updates to its legislative, institutional, and judicial frameworks. Although laws like the Constitution, the Pakistan Environmental Protection Act (1997), the Reproductive and Healthcare Rights Act (2010), and the Maternity Benefits Ordinance (1958), along with international agreements such as CEDAW, have been enacted, there is a significant gap between their introduction and effective implementation. This gap is due to factors like limited resources and capacity within enforcement agencies, insufficient stakeholder awareness and training, poor coordination among government bodies, and cultural norms that may obstruct gender-sensitive measures. Political and bureaucratic delays also add to the problem. Addressing these issues requires a multifaceted and comprehensive approach that includes strengthening enforcement, improving coordination between agencies, raising public awareness, and incorporating gender perspectives into policy execution to effectively address both environmental and social challenges.

6.3. Women's Leadership, and Climate Resilience

Resilience, a concept from ecology and sustainable livelihoods, describes a system's ability to recover and adapt after a disturbance. It hinges on the system's capacity to respond to and adjust to changes (Langston, 2017). Women's agency outside the household is a vital aspect of resilience with transformative potential, as it can lead to significant changes in food systems, promoting greater sustainability and equity (Bryan, 2023). Women's leadership in climate governance can empower other women and influence how governments and communities address climate change. Increased representation of women in policymaking often results in more effective and inclusive climate policies that better address women's needs and preferences.

Women's empowerment can boost resilience by allowing women to access resources and respond more effectively to climate change. This, in turn, enhances welfare outcomes for themselves and others during recurring and intensifying climate shocks and stressors (akeshima, 2022). Enhancing women's leadership in climate governance is a crucial aspect of well-being. Sustainable Development Goal 5.5 seeks to ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making across political, economic, and public spheres.

6.4. Increasing women's representation in policy processes

Quotas are used in many countries to increase women's participation in policy and decision-making roles. Higher female representation in climate-related decision-making bodies boosts their influence and makes governance seem more inclusive. Quotas also offer female role models, which can inspire more women to participate in public life (Elizabeth Bryan, 2023). In addition to mandates and quotas, private sector incentives are employed to enhance gender equality and representation. These incentives include equity certificates for local governments or certifications for private entities to encourage women's involvement in climate-smart agri-food supply chains. For example, Uganda's Climate Smart Agriculture Program used equity certificates to motivate local governments to incorporate gender considerations into local development plans and boost women's participation and representation (Mohammed, 2023). In key ministries and organizations handling climate change responses, strategies to recruit, hire, and retain female staff are crucial. These strategies ensure that women are not only present in policy-making bodies but also actively involved in implementing climate solutions (Ragasa, 2013).

6.5. Enabling policies, commitments, and processes

Countries are increasingly incorporating gender equality into climate policy documents such as National Adaptation Plans (NAPs), Nationally Determined Contributions (NDCs), and national development plans. Although these policies often recognize women's vulnerability to climate change, few treat women as key agents of change or include mechanisms to monitor progress in this regard (Mohammed K. &., 2022). Women can impact climate solutions by advocating for policies through civil society organizations, leading initiatives within ministries, and participating in policy consultations. Additionally, national policies should include gender targets, and ministries must fund, monitor, and track these targets using sex-disaggregated data (Ragasa K. a., 2023). Engaging women's grassroots organizations and including gender experts in policy design and implementation are essential for effective climate solutions. Policies should address legal barriers, such as limited land rights, by expanding women's land rights and supporting these efforts with awareness campaigns and enforcement to enhance access and ownership (Mohammed, 2023).

6.6. Population Perspective: Supporting Human Rights

In the 1994 International Conference on Population and Development (ICPD) Program of Action, advancing gender equality, eliminating violence against women, and ensuring women's control over their fertility were identified as key elements of effective population and development policies. These principles are still highly relevant for climate change policies today. Therefore, both mitigation and adaptation strategies should adhere to ICPD principles, which emphasize a human rights-based approach to reproductive health and rights. This approach is preferred over focusing solely on demographic targets and should be central to shaping climate change and population policies.

In simple terms, the ICPD's focus on gender equality and reproductive rights should guide how we address climate change, ensuring that policies not only consider population numbers but also uphold individual rights and gender equity.

6. CONCLUSION

The intersection of climate change, socio-economic inequalities, and maternal health in Pakistan presents a critical challenge demanding urgent attention. This research highlights the disproportionate impact of climate change on women, especially in rural areas, where limited access to healthcare, traditional gender roles, and environmental stressors compound their vulnerabilities. Rising temperatures, extreme weather, and shifting precipitation patterns directly and indirectly affect women's health, posing significant risks to pregnant women, developing fetuses, and young children. Socio-economic factors further exacerbate these challenges, as women often lack control over resources, decision-making power, and access to healthcare. Despite policy frameworks like the Pakistan Environmental Protection Act, National Climate Change Policy and Reproductive Healthcare Rights Act, implementation remains inadequate due to coordination, capacity, and prioritization issues. Effective climate adaptation strategies must incorporate gender-sensitive approaches, ensuring women's participation in decision-making, improving healthcare access, and providing education and resources to build resilience. Addressing socio-economic inequalities through policies empowering women economically, providing education, and ensuring equal rights can mitigate climate change's adverse effects on maternal health. International collaboration and support are crucial for enhancing Pakistan's

capacity to implement effective strategies. Future research should focus on conducting longitudinal and cohort studies to monitor the long-term health impacts of climate change on maternal and neonatal health in Pakistan, particularly in rural areas. Research should also explore the development and implementation of climate-resilient healthcare infrastructure, the role of education and awareness programs in empowering women to adapt to climate change, and the integration of traditional knowledge with modern healthcare practices. Additionally, examining barriers to the effective implementation of gender-sensitive climate policies and proposing actionable solutions can ensure these policies are effectively executed at the grassroots level. By addressing these research areas, future studies can contribute to developing targeted interventions and policies to enhance resilience and protect maternal health in Pakistan. By prioritizing women's health in climate policies, Pakistan can build resilience against climate change, safeguarding maternal health and contributing to sustainable development and gender equality, creating a more equitable and resilient future.

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Gender-Inclusive Climate Change Adaptation Policies: An Empirical Analysis of Climate Swap Funding Impact Using Two-Step GMM Technique

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ABSTRACT

Climate change poses significant impact on human wellbeing, weakens economic stability and exacerbates social inequalities. Climate change adaptation policies mitigate this impact by considering the diverse gender-inclusive socio-demographic characteristics of the population. These policies ensure equitable and resilient outcomes to enhance the integration of gender-inclusive socio-demographic and climate change adaptation mechanisms. The objective of this research is to develop the dynamic nexus among climate change adaptation policies, gender-inclusive socio-demographic characteristics and climate swap funding. This study will be based on Ramsey-Cass-Koopmans macro-economic model incorporating gender inclusive socio-demographic characteristics of household. Considering the women empowerment a gender-inclusive socio demographic characteristic in climate change adaptation policies in the model. The panel dataset will be used to analyze the theoretical nexus in 46 developing economies for the period of 20 years from 2003-2022. Meanwhile, the study will also be empirically validated through innovative econometric approach Two Step System GMM. This technique is suitable as it investigates endogeneity factors besides gender inclusive socio-demographics that affect climate change adaptation policies. The expected outcomes resonate with the theory that gender-inclusive socio-demographic characteristic of household especially empowered women are crucial in climate change adaptation policies.

Keywords*:* Climate change adaptation policies, Women empowerment, Climate swap funding, Ramsey-Cass-Koopmans model, Two Step System GMM, Developing economies

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1. INTRODUCTION

Climate change is a contemporary issue posing significant impacts on human well-being, weakens economic stability, and worsens social inequalities. All

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such issues can be addressed by focusing on effect climate change adaptation policies(El Bilali et al., 2020; Estok, 2023; Lewis et al., 2023). These polices compatible with socio-demographic characteristics ensure equitable and resilient outcomes.

According to the World Meteorological Organization (WMO), the last decade recorded as the warmest on earth. More frequent and severe extreme weather events, including droughts, floods, and heatwaves, have been noticed during this decade. These events have devastated communities globally. For instance, in 2022, Pakistan experienced record-breaking rainfall leading to extensive flooding. This affected 33 million people, caused over 1,700 deaths, and resulted in massive economic losses estimated at $30 billion. Similarly, the drought in East Africa brought food insecurity for 20 million people. It exacerbates the existing vulnerabilities and social inequalities(United Nations, 2023).

Moreover, on a planetary scale unprecedented changes have occurred due to the rising levels of greenhouse gases, including carbon dioxide, methane, and nitrous oxide. The level of sea and ocean warming reached new highs. Becoming more threatening to coastal communities and ecosystems. A global mean sea level recorded high in Antarctic as sea ice extent fall to its lowest level in 2023 (Hu and Ahmad, 2024). These environmental changes have directly and indirectly impacted badly on human livelihoods and health. Therefore, driving the population to massive migration and displacement leads to economic instability. The study's backdrop stems from the growing realization that, as a result of inadequate infrastructure and resources, vulnerable groups—such as women and marginalized communities—are disproportionately impacted by climate change. These gender-specific needs are frequently not considered by current climate change adaptation policies, which results in unfair and inefficient solutions (Jin et al., 2024). The gaps addressed for environment based on gender orientation and importance of gender inclusive climate change adaptation policies are addressed in Appendix (Table: A, B).

The study's importance rests in its ability to close this gap by creating a thorough framework that integrates gender-inclusive socio-demographic traits into plans for climate change adaptation. Through an emphasis on women's empowerment and other pertinent socio-demographic characteristics, this study seeks to improve the efficacy of adaption tactics, thus advancing social justice and sustainable development(Anser et al., 2020). The goals of the research are to examine the dynamic relationship that exists

between funding for climate swaps, gender-inclusive socio-demographics, and policies for adapting to climate change. The study will also use novel econometric techniques, like the Two-Step Generalized Method of Moments (GMM) technique, to empirically validate these relationships.

This study offers a novel contribution: it applies the gender-inclusive socio-demographic characteristics of the Ramsey-Cass-Koopmans macro-economic model to the examination of policies for climate change adaptation(Dombi & Dedák, 2019; Hosoya, 2014; Nævdal, 2021). In addition to offering a theoretical framework for comprehending long-term inter-temporal decisions about capital accumulation, investing, and savings, this method highlights the significance of gender inclusion in these choices. The empirical validation of the study, which was conducted over a 20-year period (2003–2022) using panel data from 46 developing economies, provides strong evidence of the effect of gender-inclusive policies on climate change adaptation. The research helps create more egalitarian, sustainable, and successful climate change adaptation policies by incorporating these ideas.

2. LITERATURE REVIEW

The relationship between gender, strategies for adapting to climate change, and financial tools like climate swap money has drawn more attention in recent research(Ahmad et al., 2024). Research indicates that in order to address the disproportionate effects of climate change on women and gender-diverse societies, gender-inclusive climate adaptation policies are essential. Because of pre-existing socioeconomic disparities, restricted access to resources, and lesser participation in decision-making processes, these groups frequently confront greater vulnerabilities(Ahmad et al., 2023).

Climate swap money has demonstrated potential in strengthening resilience in vulnerable areas. It is a financial instrument where debt is exchanged for promises to invest in climate adaptation projects. Research like that conducted by the OECD (2019) and the World

Bank (2018) shows that when these monies are allocated to gender-inclusive projects, they not only increase community resilience and environmental results, but also empower women. It has also been demonstrated that incorporating gender perspectives into policies related to climate adaptation increases the efficacy of these interventions. Projects that involve women in the design and implementation stages, for example, are more likely to harness local expertise and address specific risks, resulting in more sustainable outcomes(Ahmad et al., 2022; Suwandi, 2022).

The two-step Generalized Method of Moments (GMM) technique is used in empirical investigations to give reliable approaches for evaluating various financial mechanisms and policies' efficacy. Unobserved heterogeneity and possible endogeneity are two major problems in policy effect evaluations that are addressed by this method(Nosheen et al., 2021a). Notwithstanding these advantages, there are still gaps in the empirical data about the precise effects of gender-inclusive climate policies that are financed by climate swaps. This gap has begun to close with recent empirical studies that employ the two-step GMM strategy, showing that these policies, when properly funded and executed, can greatly improve adaptation outcomes(Nosheen et al., 2021b).

2.1 Research Gaps

There are still a lot of research gaps in spite of the growing awareness of the significance of gender-inclusive climate change adaptation plans. The empirical assessment of the effects of gender-inclusive adaptation activities funded by climate swap arrangements is one crucial area that lacks thorough investigation. Although previous research has highlighted the potential advantages of these strategies (UN Women, 2020; World Bank, 2018), there is little empirical data regarding their efficacy, especially in a range of socioeconomic and environmental circumstances. Furthermore, there is a lack of application of sophisticated econometric methods such as the two-step GMM in this field, raising concerns regarding the validity of the results that have already been discovered (Brown et al., 2020; Smith et al., 2021). Moreover, most of the research concentrates on case studies or qualitative evaluations, but large-scale quantitative analyses that can yield generalizable insights are desperately needed. Closing these inequalities can help to accomplish the goals of climate resilience and gender equality by maximizing the allocation of funding for climate adaptation.

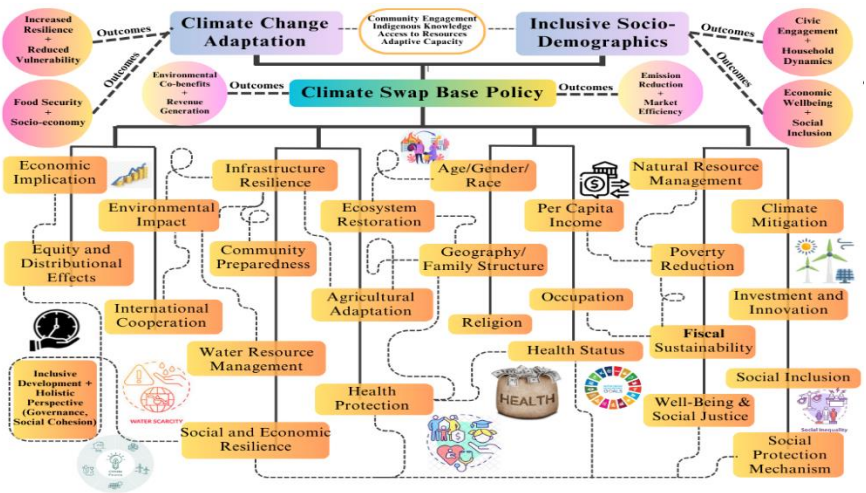
The body of research demonstrates the importance of maintaining funding for gender-inclusive adaptation programs as well as the necessity of thorough empirical evaluations to inform funding and policy choices. In addition to addressing gender disparities, this strategy increases communities' general resistance to the effects of climate change.

3. THEORETICAL MODEL

Climate change adaptation and socio demographics are studied with Ramsey-Cass-Koopmans macro-economic model. The basis of Ramsey-Cass-

Koopmans model (RCK) stands distinguished in context of climate change adaptation and socio demographics as it focuses on long-term intertemporal decision with respect to saving, investment and capital accumulation. Considering investment in adaptation activities related to climate change enhances productivity through climate resilient infrastructure and improves societies' ability to adapt to climate change impacts. Another feature of RCK is overlapping generations of individuals as climate change impact is borne by current and future generations. Ensuring sustainable policies considering the needs and interests of the future generation. Socio-demographic factors are the key player that influence individual savings and investment behavior in the RCK model. As for example, marginalized communities are most vulnerable to climate changes due to insufficient funds to financial resources and infrastructure. So, adapting climate change strategies needs to specify community with their specific socio demographic characteristics are studies in RCK model (figure 1).

Figure 1: Comprehensive overview of gender inclusive climate change adaptation and climate finance



Maximizing the utility of identical consumer in the context of intertemporal optimization[13] problem:

[13] $u(c,T)$: Utility function where c shows the consumption of the identical consumer (per capita consumption) and T shows the time.
$e^{(n-\rho)^t}$: Exponential discount factor, n shows the population growth rate and ρ shows discount rate.
$\int_0^{\infty}$; Shows integrating over time from $t=0$ to $t=\infty$
$u(c,T)e^{(n-\rho)^t}$; The objective is to maximize the integral utility of identical consumer with respect to the

$max \int_0^{\infty} u(c,T)e^{(n-\rho)^t} dt$ (1)

Subject to:

$\dot{K} = F(K,L,T) - cL - \delta(T)K$ (2)

$\dot{L} = n(T)L, \qquad L_0 = 1$ (3)

Assuming that climate change is time independent and exogenous indicator T . the greater the value of T indicates larger the impact of climate changes. Four level meet the criteria where climate changes affects the optimization conditions, (i) health impact (ii) longevity of capital impact (iii) market impact and (iv) non-market impact

$\dot{c} = -\frac{u_c}{u_{cc}}(fk - \delta - \rho)$

The steady state condition $\dot{k} = \dot{c} = 0$ implies $fk = \delta + \rho$ and $c = f - \delta k - nk$.

Dealing with the Dynamics of Capital Accumulation

Taking into account the impact of climate changes on the physical stock of capital. Keeping saving rate exogenous in order to isolate the capital accumulation effect. Assuming that economic agents will not change their saving behavior in response to the climate change. Thus saving rate will be constant function of output.

$\bar{s} = 1 - {}^{c}/_{f}$ Multiplying f both sides we get $\bar{s}f = 1 - c$

$\bar{s}f = (\delta + n)k$

$\frac{\partial k}{\partial T} = \frac{k(\delta_T + n_T) - \bar{s}f_T}{\bar{s}f_k - \delta - n}$

Dealing with the Dynamics of Savings

Taking s^G gross savings per capita equals deduction of consumption from the savings.

$s^G = f - c = (\delta + n)k$

Differentiating the gross savings s^G with respect to climate change *T*

The individual (saver) is not willing to set a aside extra money to compensate the unwanted and negative effects of climate change.

Magnitude of Dynamic Effect

Few required changes have been made that suits our objective. However, the basic model we have followed is DICE (Dynamic Integrated Climate Economy) model. To distinguish between saving and capital effect, the model we have followed is applicable in two different modes. These models are associated with growth models.

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time. As it conveys the meaning of finding the consumption path over time that maximizes the discounted utility. The discount factor indicates the individual consumer's time preferences for future consumption.

3.1 Empirical Methodology

The empirical methodology of gender inclusive climate change adaptation policies are based on on the proportion of female-headed households. As we know that Female-headed households might have different savings behavior due to various socio-economic factors. The formula for women adjusted saving behavior as recommended by RCK model in section 3.

$$Adjusted\ Gross\ Savings\ (Women) = Gross\ Savings * \left(\frac{Female\ Headed\ Household}{100}\right)$$

Such formula helps us to find the gender based decision in household consumption and savings pattern. Therefore such proxy is suitable to determine the RCK parameter leading toward the gender inclusive climate change adaptation policies. Table 1 gives an overview of RCK model comparison with other macro-economic and development economic models.

Table 1: Similarities and Differences to Incorporate Climate Change polices among various Economic Models

	Solow Swan Growth Concepts	**Ramsey Cass Koopmans Growth Concepts**	**Mankiw-Romer-Weil Growth Concepts**	**DICE Model**
Similarities	Long term growth	Long term growth	Long term growth	Long term growth with specific emphasis on the interaction between economic growth and climate change
	Capital accumulation, labor and	Intertemporal utility maximization	Capital accumulation, labor and	Economic growth theory along with

	technological progress basic determinant of growth	by households	technological progress basic determinant of growth	environmental considerations
Differences	Constant returns to scale in production	Incorporates intertemporal optimization and consumption smoothing	idea of endogenous technological progress	Explicitly models the effects of greenhouse gas emissions, climate policies, and climate damages on economic growth
	Does not include endogenous factors such as savings decisions or technological progress	representative agent making consumption and saving decisions	human capital accumulation as a key determinant of growth	Focuses on policy analysis related to climate change mitigation and adaptation strategies, which is not a primary focus of the other growth models

Variable	Definition	Proxy of the variables	Sources
Economic Growth	Economic growth is inclusive and equitable, ensuring mutual benefits of development shared by all segments of society. It includes vulnerable populations disproportionately affected by climate change.	1. GDP per capita 2. Sustainable economic	WDI
Climate Finance/Debt Swap Funding	Outstanding debt is restructured or cancelled in favor of domestic resources invested by the indebted country for environment-oriented purposes. (These resources are portrayed as climate change adaptation policies, however they complement the infrastructure as climate change adaptation policies).	1Debt for nature swaps (SDGs 13).	OECD
Physical Stock of Capital	The physical stock of capital represents critical infrastructure investments needed to enhance resilience and provide social protection against climate change impacts. Such investments are essential for promoting sustainable development and ensuring the well-being of populations in developing economies vulnerable to climate change.	Gross fixed capital formation (% GDP)	WDI
Human capital	Capacity-building investments needed to strengthen workforce skills, education, and healthcare systems to enhance resilience and social protection against climate change impacts. Such investments are essential for promoting inclusive growth, reducing vulnerability, and ensuring sustainable development in developing economies facing climate risks.	Human capital index based on years of schooling	Penn World Table
Climate Adaptation Policy	Climate adaptation policy entails implementing initiatives and investments to safeguard vulnerable communities, improve social protection mechanisms, and ensure access to essential services in the face of climate-related risks	Index of Health, education and environment using KMO methodology	WDI

Gender based RCK Savings Parameter	The concept of savings can be represented as Gross savings represented by the difference between disposable income and consumption. The decision is based on female headed household patterns.	Percentage of GDP	WDI
Endogenous Growth Parameter	It consists of growth rate of population and depreciation rate measured as depreciation parameter.	The value obtained by summing up (population growth rate and average depreciation of capital stock)	WDI, Penn World table
Trade Openness	The extent to which developing economies engage in global trade partnerships and integrate into the international market.	Trade percentage of GDP	WDI

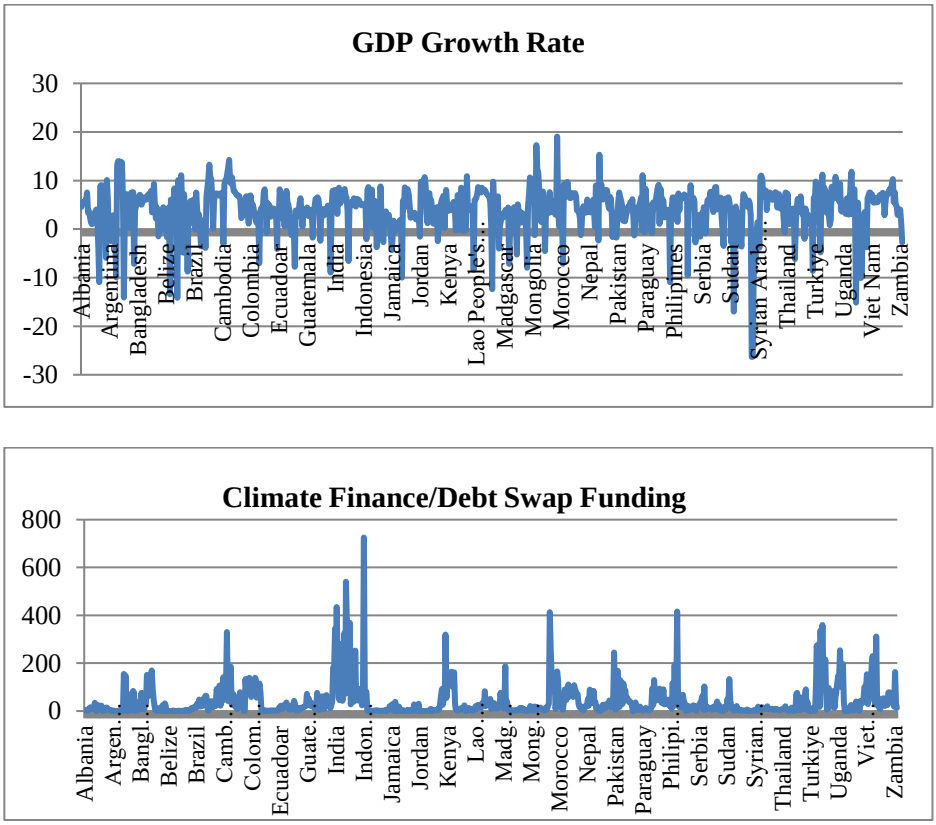
Table 2: An overview of the many terms, definitions, proxies, and sources used to evaluate the efficacy of policies for adapting to climate change and their influence on sustainable development is given in this table. GDP per capita and sustainable economic indicators are used to measure economic growth, with a focus on include disadvantaged groups (WDI). Investments geared toward the environment are financed by climate financing, especially through debt-for-nature swaps (OECD). The Human Capital Index serves as a stand-in for human capital, which is concentrated on healthcare, workforce skills, and education (Penn World Table). An index of environmental, health, and education indicators is used to evaluate climate adaption policies (WDI). The savings habits of families headed by women are used to examine gender-based savings as a percentage of GDP (WDI). The gross fixed capital formation, which is a measure of the physical stock of capital, emphasizes the essential infrastructure investments required for resilience (WDI). The trade percentage of GDP (WDI) is used to measure trade openness, while the endogenous growth parameter (WDI, Penn World Table) incorporates population growth and depreciation rates. When taken as a whole, these factors provide a thorough framework for assessing the complex effects of climate change and the efficiency of adaptation measures in promoting equitable and sustainable growth.

4. RESULTS AND DISCUSSION

Table 3 offers descriptive statistics for important factors that are considered when evaluating how well policies for adapting to climate change affect sustainable development. For every variable, there are 920 observations in the data. GDP per capita indicates economic growth with a mean of 3.78 and high variability (standard deviation of 5.69), showing a range of growth experiences from -20.72 to 7.42 in the sample. The mean value for debt swap/climate financing funding is 3.18, indicating a moderate level of investment, with a range of 1.00 to 5.00. The physical capital stock, which is a necessary component of resilience, ranges from 4.62 to 59.41% of GDP on average. With a mean of 10.54, the growth parameter—population growth rate plus depreciation—highlights the dynamics of the economy and demographics. With a mean of 4.64 and values ranging from -15.23 to 18.42, trade openness—a measure of participation in international markets—indicates varying degrees of trade integration within the sample. The mean index score for human capital is 2.23, which represents differences in the education and skill levels of the workforce. A mean score of 8.75 for climate

adaptation strategies indicates that they are being implemented widely. In contrast, the gender-based RCK savings metric exhibits significant variability, from 0.32 to 39.32 for an average of 8.34. Figure 2 shows the trends of the various variables.

Figure 2: Trends of GDP, Climate Finance and Capital Stock



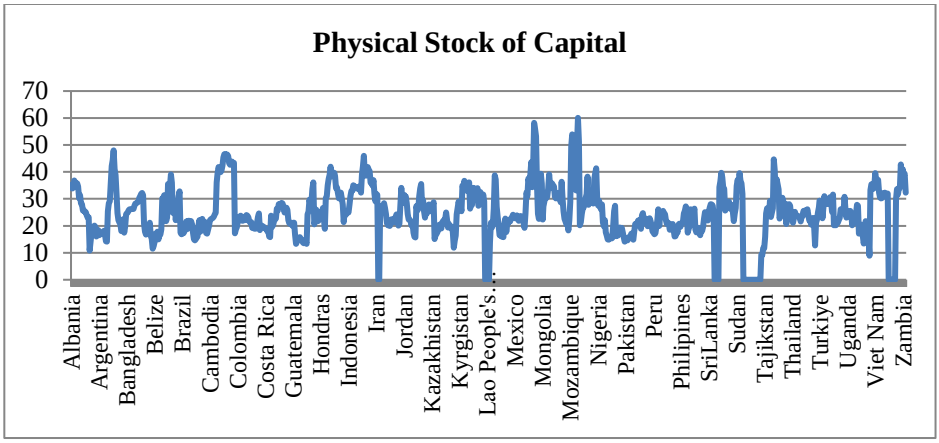


Table 3: Descriptive Statistics: RCK Savings rate and Climate Finance and Climate Adaptation Policies

Variable	Observations	Mean	Std. Dev.	Min.	Max.
		Full Sample			
Economic growth	920	3.78	5.69	-20.7	7.42
Debt Swap Funding	920	3.18	1.42	1.00	5.00
Physical Stock of capital	920	28.45	3.73	4.62	59.41
Human capital	920	2.23	1.99	2.54	3.83
Climate Adaptation Policies	920	8.75	0.59	7.17	10.38
Gender based RCK Saving	920	8.34	6.29	0.32	39.32
Growth Parameter$(n+g+\delta)$	920	10.54	2.58	4.84	16.77
Trade Openness	920	4.64	2.75	-15.2	18.42

Table 4: Correlation Matrix: RCK Savings rate and Climate Finance and Climate Adaptation Policies

Matrix	Economic growth	Climate Finance/Debt Swap Funding	Physical Stock of capital	Human capital	Climate Adaptation Policies	Gender based RCK Saving Parameter	Growth Parameter*(n+g+ʊ)*	Trade Openness
Full sample								
Economic growth	1							
Climate Finance/Debt Swap Funding	0.3262***	1						
Physical Stock of capital	0.2295*	0.1695**	1					
Human capital	0.4357***	0.6146***	0.0412	1				
Climate Adaptation Policies	0.2591**	0.2645***	0.0595	0.1667**	1			
Gender based RCK Saving Parameter	0.267***	0.1737*	0.2715***	0.0416	0.1508**	1		
Growth Parameter*(n+g+ʊ)*	0.1804*	0.53452***	0.1943***	0.009	0.7756***	0.1395**	1	
Trade Openness	0.3267***	0.0785	0.2280***	0.1288**	0.1789**	0.2559***	0.1303236	1

Table 4 depicts the links between important variables pertaining to policies for adapting to climate change and economic growth are displayed in the correlation matrix for the entire sample. All the variables show a positive association with economic growth, with trade openness (0.327***) and human capital (0.436***) having the strongest correlations. There are noteworthy positive relationships between debt swap funding and climate finance/growth (0.326***), human capital (0.615***), and the growth parameter (0.534***). The physical capital stock has a favorable correlation with both trade openness (0.228***) and economic growth (0.2295*). Economic growth (0.436***) and climate finance (0.615***) have a substantial correlation with human capital. Policies aimed at addressing climate change have moderately positive associations with several variables, most notably the growth parameter (0.776***). Climate funding (0.535***) and strategies for climate adaptation (0.776***) are highly correlated with the growth parameter. Trade openness has a positive correlation with both the physical stock of capital (0.228***) and economic growth (0.327***). The interdependence of different adaptation policies, human and physical capital, climate finance, and economic growth. A substantial positive association has been observed between the gender-based RCK savings parameter and the physical stock of capital (0.271***), economic growth (0.267***), and climate adaptation strategies (0.151**). Table 5 Economic growth has a moderately favorable impact on Model 1 (Fixed Effect), as indicated by its coefficient of 0.2316, which is significant at the 10% level. Physical capital and human capital both show considerable positive benefits with coefficients of 0.237 (1% level) and 0.296 (5% level), respectively. Climate finance/debt swap funding indicates a large positive influence (0.451, significant at the 5% level). While the growth parameter exhibits a modest positive effect (0.0346, 10% level), the gender-based RCK saving parameter also considerably positively effects growth (0.124, 1% level). In this paradigm, trade openness is not significant. The model explains 15% of the variability in economic growth, according to the R-squared value of 0.15. The coefficient of economic growth in Model 2 (Random Effect) is smaller (0.115, 5% threshold). Funding for debt swaps and climate change continues to be positively substantial (0.275, 1% level). While the gender-based RCK saving parameter (0.1527, 1% level) and human capital (0.1996, 10% level) demonstrate significant positive impacts, the physical stock of capital is not significant. Additionally, the growth parameter (0.0513, 10% level) is still significant. Trade openness is still not very important. At 0.14, the R-squared

value is marginally less. Endogeneity is indicated by the Durbin-Wu-Hausman test, indicating that the fixed effects model may be a better fit.

Table 5: RCK Savings rate and Climate Finance and Climate Adaptation Policies (Full Sample): Fixed Effects/Random Effects: Dependent Variable (Inclusive economic growth index)

Variables	**Model 1**	**Model 2**
	Fixed Effect	**Random Effect**
Economic growth	0.2316 (0.1158)*	0.1154 (0.0360)**
Climate Finance/Debt Swap Funding	0.4514 (0.2033)**	0.2747 (0.0798)***
Physical Stock of capital	0.2374 (0.0593)***	0.1199 0.0666
Human capital	0.2958 (0.0989)**	0.1996 (0.0753)*
Gender based RCK Saving Parameter	0.1237 (0.0318)***	0.1527 (0.0381)***
Growth Parameter$(n+g+\delta)$	0.0346 (0.0163)*	0.0513 (0.0212)*
Trade Openness	0.0042 (0.0028)	0.0041 (0.0040)
Constant	3.0084 (0.7539)***	2.9677 (0.7032)***
Observations	920	920
R-squared	0.15	0.14
Durbin Wu Hausman (DWH) Test	23.57	48.97
No of countries	42	42

Notes: Robust standard errors are in parentheses. *, ** and *** denote significance at the 10, 5 and 1% levels, respectively.

Table 6: RCK savings rate and Climate finance on Climate Adaptation Policies (Full Sample): Dependent Variable (Climate Adaptation Policies)

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Economic growth	-0.2374	-0.2279	-0.2121	-0.2619	-0.2254
	(0.1187)*	(0.0897)**	(0.0754)**	(0.1636)	(0.11270)*
Climate Finance/Debt Swap Funding	0.0043	0.0039	0.0041	0.0038	0.0037
	(0.00100)	(0.0015)**	(0.0014)*	(0.0019)*	(0.0009)***
Physical Stock of capital	0.11034	0.1073	0.1078	0.1029	0.1084
	(0.0735)	(0.0422)*	(0.0383)**	(0.0343)***	(0.0542)*
Human capital	1.027	1.2161	0.9382	1.0002	1.1052
	(0.5135)*	(0.7896)	(0.3338)**	(0.6251)	(0.3696)**
Gender based RCK Saving Parameter	0.0494	0.0158	0.0523	0.0854	0.0392
	(0.0123)***	(0.0044)***	(0.0090)***	(0.0185)***	(0.0122)***
Growth Parameter$(n+g+\delta)$	-0.0231	-0.0417	-0.0611	-0.0291	-0.0638
	(0.0235)	(0.0198)	(0.0160)***	(0.0182)	(0.0581)
Trade Openness	0.1264	0.1897	0.1934	0.1328	0.1554
	(0.0632)*	(0.0746)**	(0.0688)**	(0.0664)*	(0.0777)*
GDP growth(-1)	0.6663	0.62765	0.6832	0.6812	0.5978
	(0.3331)*	(0.2471)***	(0.2431)***	(0.3406)*	(0.2989)*
Constant	1.2482	1.3942	1.3734	1.7991	1.3211
	(0.4710)**	(0.5488)**	(0.4887)**	(0.6919)**	(0.5977)**
Observations	920	920	920	920	920
Number of Groups	42	42	42	42	42
F /Wald test	(5.76)	(7.16)	(3.76)	(4.34)	(2.52)

The study uses the two-step SYSGMM approach, which considers it appropriate to control endogeneity and is suitable for cross-country differences(Jiang & Khan, 2023; Sinha & Vodwal, 2022). The two-step SYS-GMM is more efficient than first-difference estimators. This study employs a two-step SYS-GMM to produce asymptotically efficient values when the problem of heteroscedasticity is heavily embedded. The pre-SYS-GMM test fixed effects and random effects are given in Table 6.

The table displays the findings from five econometric models, each of which used a different collection of variables to analyze key aspects impacting economic growth. Economic growth is significantly correlated at different levels (10% to 5%) and negatively correlated across all models, with coefficients ranging from -0.2374 to -0.2121. Economic growth is constantly positively and significantly impacted by debt swap funding and climate finance, with coefficients between 0.0037 and 0.0043 that are significant at the 1% to 5% levels.

In all models, the physical capital stock shows a positive correlation with economic growth, with coefficients ranging from 0.1029 to 0.11034, most of which are significant. In most models, human capital has a substantial positive influence (though not always a large one), with coefficients hovering around 1.0. All models show that the gender-based RCK saving parameter has a positive and significant effect on economic development; coefficients range from 0.0158 to 0.0854, all of which are significant at the 1% level. With the exception of Model 3, where it is significant at the 1% level, the growth parameter exhibits a negative but generally non-significant impact on economic growth. In the majority of models, trade openness has a large and positive impact, with coefficients ranging from 0.1264 to 0.1934. With coefficients averaging 0.66, the delayed GDP growth variable is positively significant in all models, suggesting persistence in economic growth tendencies.

5. CONCLUSION

The study concludes that several important discoveries are highlighted by the study's use of five econometric models to analyze the factors driving economic growth. Economic growth consistently exhibits a negative connection across all models, indicating the possibility of underlying structural or external variables negatively affecting growth. However, funding for debt swaps and climate change emerges as major, consistent positive drivers of economic growth across models(Benhamed et al., 2023; Petrović, 2023; Zhao & Liu, 2023). This suggests that certain financial tools designed

to combat climate change can significantly influence the promotion of economic expansion. Both the human and physical capital stocks show strong positive returns, highlighting the role that infrastructure and skill development play in promoting economic growth and resilience. favorable effect, highlighting the contribution of gender-inclusive finance policies to economic expansion.

Furthermore, although the impact of trade openness on economic growth differs among models, the analysis shows that it generally has a favorable effect. The significance of the delayed GDP growth variable emphasizes the tenacity of growth trends and suggests that past economic performance can impact future growth paths. The growth parameter's negative coefficients indicate possible limits associated with population growth and capital depreciation, notwithstanding the variables' typically favorable effects. These constraints may require additional research. All things considered, the results point to the necessity of a multimodal strategy that includes trade integration, gender-inclusive policies, climate finance, and the development of human and physical capital. Policymakers seeking to strike a compromise between aims for gender parity, climate adaption, and economic development may find great assistance in these observations.

5.1 Policy Implication

The results of the study highlight how crucial it is to incorporate gender-inclusive strategies into policies for adapting to climate change in order to promote sustainable economic growth. Financial mechanisms that expressly target gender-responsive initiatives, such as debt swap funding and climate finance, should be prioritized by policymakers as they have been found to considerably boost economic growth and resilience. These benefits can be further amplified by making investments in human capital and physical infrastructure, with a focus on empowering women via skill development and education. Policies that encourage gender-based savings and financial inclusion are particularly crucial because they guarantee that women and other marginalized groups are better prepared to handle the risks associated with climate change in addition to contributing to economic stability (Ahmad et al., 2024).

Further investigations exploring the precise processes via which policies promoting gender-inclusive climate adaptation spur economic growth are warranted. This involves investigating how women's empowerment and financial inclusion can promote more resilient and sustainable economies both directly and indirectly. Insights into the long-term effects of these policies and recommendations for best practices for incorporating gender issues into more

comprehensive economic and environmental initiatives may be obtained via longitudinal studies. It will also guarantee that policy recommendations are both locally and globally relevant if research is broadened to encompass a wider range of socioeconomic and geographic contexts. Designing more focused and efficient initiatives that not only reduce climate threats, but also advance gender equity and inclusive development would be made easier with the help of such thorough assessments.

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Appendix

Table A: Gender Data for Climate Action: COP28 and Beyond

Section	Key Points
Introduction	Gender equality is a priority in COP28 to ensure women's equal participation and promote gender-responsive climate action.
Definition of Gender Data	Gender data captures information on the different lived experiences of women, men, and gender-diverse people, including data disaggregated by sex or gender, and data reflecting gender issues.
Definition of Gender-Responsive Climate Action	Gender-responsive climate action actively promotes gender equality by recognizing gender differences, ensuring equitable participation in decision-making, and distributing benefits equitably.
Importance of Gender Data in Climate Action	Gender data helps highlight the unique impacts of climate change on women, girls, and gender-diverse people and informs the design and monitoring of gender-responsive climate policies.
Challenges in Gender Data Collection	Efforts to collect and use gender data have been slow, with a lack of high-quality, regularly collected, and internationally comparable gender data.
COP28 Gender Data Priorities	Enhanced collection and use of gender data is crucial for advancing gender-responsive climate action at global, regional, and national levels, especially in the context of the Paris Agreement.
First Global Stock take	The first Global Stock take highlights the need for stronger outcomes emphasizing gender equality and social inclusion, and encourages the use of gender data in national climate actions.
Global Goal on Adaptation	Negotiations for the Global Goal on Adaptation should include gender targets and indicators, supported by the collection and use of gender data.
Strengthening Gender Data Beyond COP28	Parties should invest in gender data systems, enhance gender data collection and use in UNFCCC processes, and track participation of women, girls, and gender-diverse people in climate decision-making.

Table B: Mapping Gender Data Gaps in the Environment and Climate Change

Category	Information	Detail in Hand	Facts and Figures
Introduction	Gender data is crucial for understanding the impacts of climate change on women, girls, and gender-diverse people.	Women, girls, and gender-diverse people often have less access to and control over environmental resources. For example, in many regions, women are more likely to face health risks and food insecurity due to climate change (World Economic Forum) (UN Women).	**Investment in Gender-Responsive Climate Action**: Only 3% of climate finance goes to gender-responsive projects (UN Women) (UN Women).
Gender Data Definition	Gender data includes information on the different lived experiences of women, men, and gender-diverse people.	This data is both quantitative and qualitative, with collection methods accounting for stereotypes and social norms. Recent reports highlight the need for improved data to understand the intersection of gender and climate change impacts. (UN Women).	**Proportion of Women in Climate Decision-Making**: Women make up 38% of the delegates at COP28 (World Economic Forum) (UN Women).
Gender Data in Environmental	International commitments recognize the link between environment, climate change, and gender equality but lack targeted measures for gender	Only 20 out of 114 SDG indicators with an environmental focus require gender-specific and/or sex-disaggregated reporting (UNFCCC) (UN Women).	**Access to Clean Energy**: Only 20% of women in low-income countries have access to clean cooking solutions (UN Women).

	data collection.		
Gender Data Gaps	Key findings include lack of individual-level data, absence of standardized data collection methods, and insufficient disaggregation by age, race, etc.	Most environmental data is collected at the household level, which does not allow for intra-household gender differences. Data on gender-based violence in environmental contexts is especially lacking (World Economic Forum) (UN Women).	**Disaster Mortality**: Women are 14 times more likely than men to die during a disaster (UN Women).
Land Ownership and	Limited data on women's land ownership and security, collected mainly through national agricultural surveys and international databases.	Definitions of 'ownership' and 'secure rights' are difficult to operationalize for data collection. Recent efforts are focusing on better data collection methods (UNFCCC) (UN Women).	**Climate Displacement**: 80% of people displaced by climate change are women and girls (UN Women).
Natural Resource	Data on women's roles in natural resource management is often collected through national censuses and agricultural surveys.	Data on women's employment in natural resource sectors varies widely between countries, limiting comparability (UN Women) (UN Women).	**Gender-Based Climate Funding**: Approximately 0.01% of global climate finance is explicitly targeted towards gender equality (UN Women) (UN Women).

Water, Sanitation, and Hygiene	Household-level data on WASH is commonly collected but lacks individual-level analysis.	59% of countries produce data on safe drinking water access; 60% on safe sanitation and hygiene services. Women often bear the burden of securing water in areas affected by climate change (UN Women) (UN Women).	**Proportion of Women in Agriculture**: Women represent 43% of the agricultural labor force in developing countries, yet they have less access to resources and services compared to men (UN Women).
Clean Energy	Data on women's access to clean energy and employment in the clean energy sector is scarce.	Sex-disaggregated data on clean energy employment is especially hard to find. Efforts are being made to include more gender-specific data in this sector (UNFCCC) (UN Women).	**Access to Safe Water**: 70% of women in rural areas of developing countries do not have access to safely managed drinking water (UN Women).
Environmental Decision-	Tracking women's participation in environmental decision-making processes is essential for promoting gender-responsive policies.	The UNFCCC regularly reports on the gender and age composition of COP delegations and constituted bodies (UNFCCC) (UN Women).	**Impact on Health**: 60% of preventable maternal deaths occur in humanitarian settings and fragile contexts exacerbated by climate change (World Economic Forum).
Disaster Risk Management	Gender data is lacking in disaster risk management, despite acknowledgment of gender aspects in international frameworks.	The Sendai Framework indicators recommend but do not require disaggregation by sex, age, and disability (World Economic Forum) (UN Women).	**Representation in Climate Negotiations**: Women constituted 33% of the heads of delegations at the latest UN climate conference (UN Women).

Disaster-Related	Near-total absence of sex-disaggregated data on disaster-related mortality and morbidity.	Only 11 out of 85 countries disaggregated disaster-related mortality data by sex (UN Women).	**Climate-Related School Dropout Rates**: In climate-affected areas, school dropout rates for girls increase by 12% compared to non-affected areas (UN Women).
Climate Migration	More data is needed on the gender dynamics of climate-induced migration and displacement.	UNHCR's 2022 Global Trends Report provides sex and age disaggregated data for 76% of refugees and displaced persons (UN Women).	**Employment in Clean Energy Sector**: Women hold 32% of jobs in the renewable energy sector globally (UN Women).
Sexual and Reproductive	Linkages between climate change and sexual and reproductive health are recognized but not well measured.	Studies link climate change impacts with disruptions in sexual and reproductive health services, increasing risks of maternal and child health issues (World Economic Forum) (UN Women).	**Women's Land Ownership**: Only 13% of agricultural landholders worldwide are women (UN Women).
Gender-Based Violence	Awareness of the link between climate change and gender-based violence is growing but data remains insufficient.	Gender-based violence in environmental contexts includes control over land access and participation in climate justice movements (UN Women) (UN Women).	**Climate-Induced Food Insecurity**: By 2050, climate change is projected to increase the number of food-insecure women and girls by 132 million globally (UN Women) (UN Women).
Unpaid Care Work	Climate change impacts unpaid care work, increasing the time required for resource collection and care activities.	Extreme weather events increase unpaid care work for women and girls, such as time spent on resource collection (World Economic Forum) (UN Women).	**Gender-Based Violence in Climate Contexts**: In areas affected by climate change, incidents of gender-based violence can increase by up to 30% during and after disasters (UN Women).

Efforts to Improve Gender Data	Key efforts include development of gender-environment indicators, national and international data collection initiatives, and partnerships for local data collection.	Gender and Environment Statistics by IUCN and UNEP propose 19 gender-environment indicators (UNFCCC) (UN Women).	**Women's Participation in Disaster Risk Reduction**: Only 15% of countries have policies in place to ensure women's participation in disaster risk reduction planning and decision-making (World Economic Forum) (UN Women).

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Women's Empowerment and Vulnerability to Climate Change: An Econometric Analysis of South Asian Countries

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Abstract

This research paper analyzes the impact of women's empowerment (WE) on vulnerability to climate change (VCC) in South Asian countries from 1995-2023. To the best of our knowledge, no study has empirically examined the importance of WE in resilience strategies following a climate shock. This article contributes to the literature by employing the second-generation econometric analysis of the gender-climate nexus and exploring the significance of gender in adaptive policy. We use a Cross-sectional Autoregressive Distributed Lag (CS-ARDL) model's co-integration technique which shows; (i) WE along with its components (women's civil empowerment, social empowerment, political empowerment, and economic empowerment) reduces VCC by the inclusion of women in climate leadership and decision-making processes. (ii) Gender intersectionality significantly impacts the relationship between WE and VCC in climate adaptation through the transmission channels of human resource development, governance, and social and economic resilience. The robustness of these findings has been tested through the Westerlund cointegration test, and the Dumitrescu Hurlin Granger causality test has been used to explore causality among the variables. The study highlights the significance of institutional resilience and Gender-responsive climate policies. Furthermore, the participation of women in civil, economic, political, and administrative decisions may improves adaptation to climate change.

Keywords: Women's empowerment; Vulnerability to Climate Change; Gender equality, Adaptive Policies, CS-ARDL

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1. INTRODUCTION

The conflict between economic development, environmental conservation, and resource utilization is becoming more pronounced as global warming and resource constraints worsen (Sarkodie & Strezov, 2019). As a response to climate change and environmental degradation, the concept of "green growth" has emerged. Green growth refers to promoting economic progress while preserving the environment. In 1985, the United Nations meeting in Nairobi

officially recognized women as significant players in environmental preservation. However, compared to scientific and technical solutions, women's participation in resolving climate change-related problems has received less scholarly attention(Gaard, 2015). This research aims to contribute to the literature on climate change by exploring the empowerment-climate nexus and integrating gender into adaptive policies. It explored how much women's empowerment (WE) affects Vulnerability to Climate Change (VCC) in South Asian countries. No prior study in the literature has empirically examined the role of WE in resilience strategies in the wake of climate change in the South Asian region.

Our hypothesis postulates that WE reduces VCC in South Asian countries. It is assumed that women's participation in civil, economic, political, and administrative decisions can improve climate change adaptation in these countries. WE can improve policies to reduce VCC by following ways. Firstly, women's participation in the decision-making process helps to formulate conducive climate policies(Alber & Roehr, 2007). Secondly, women, who have higher levels of education than men in terms of VCC, view climate shocks more critically (Ergas & York, 2012; McCright, 2010). Thirdly, increasing the participation rate of women in industrial enterprises promotes non-resource taxes(Asongu, Nnanna, & Acha-Anyi, 2020). Women with a strong voice, access to quality information, and innovative ideas can help decision-makers in addressing environmental issues(Emeordi, Igwe, & Madichie, 2023). WE can have positive impacts on social, economic, and political adaptation, ultimately leading to a decrease in VCC.

Economic development can be transformed into sustainable development by including women in parliament, administration, policy-making, and the economy as a significant factor of economic growth and as a vulnerable stakeholder in climate change(Achuo, Asongu, & S Tchamyou, 2022; Yadav & Lal, 2018). Heyland et al. (2010) report states that almost two-thirds of women worldwide are vulnerable to climatic shocks. Data on fatalities from climatic disasters indicates that women are more vulnerable than males. For example, the cyclones and floods that struck Bangladesh in 1991 revealed that 90% of the casualties were female. Women made up 75% of the Aceh tsunami victims in 2004. This outcome is directly linked to the under-representation of women within the civil, economic, and political decision-making bodies. Gender disparities make women and children 14 times more vulnerable to climate change than men (Asongu, Messono, & Guttemberg, 2022a; Miller et al., 2010). In Asia's dry zones, for example, women are often more affected by negative climate shocks than men due to

their lower educational and economic status, as well as limited access to knowledge, institutions, and decision-making bodies(Goh, 2012). Therefore, reducing gender inequality through social reforms is crucial in lessening the impact of climate change on communities(Cannon, 2002).

This paper makes unique contributions and presents distinct differences. First, no study has been conducted to examine the impact of WE on VCC in South Asian countries. The empirical literature on "feminist political ecology" encourages gender integration by emphasizing WE in adaptive policies(Alexander, Bolzendahl, & Jalalzai, 2016; Ergas & York, 2012; Israel & Sachs, 2013). Furthermore, the existing literature emphasizes the economic empowerment of women in developing countries (Asongu et al., 2022a), but the externalities of this empowerment on climate change remain underexplored. Second, this study contributes to the literature by exploring the significance of gender in the adaptation to climate change in South Asian countries. Third, the indicator of women's empowerment proposed by Sundström, Paxton, Wang, and Lindberg (2017) and Kabeer and Natali (2013) has been used. These methods are recognized for their completeness compared to the other indicators developed by Alkire et al. (2013) and Hanmer and Klugman (2016). Fourth, a comprehensive index of WE while considering all dimensions of WE; civil, social, economic, and political empowerment has been constructed. Fifth, the study has estimated the individual impact of four components of WE on VCC along with the channels through which the empowerment of women can promote VCC will also be examined.

This paper is constructed as; section 2 includes a literature review. Section 3 describes the theoretical framework of the model. Section 4 contains methodological details section 5 includes results discussions and section 6 concludes along with policy suggestions.

2. LITERATURE REVIEW

Development organizations and scholars are keenly interested in the concept of WE. The fifth of the seventeen Sustainable Development Goals was designated by the UN in 2015 as "achieving gender equality" and "empowering all women and girls"(United Nations General Assembly 2015). The impact of WE on VCC has been the subject of macroeconomic policies, theories, and green growth initiatives such as UN Women, UNIDO, and women's economic empowerment in green industry programs. Table 1 enlisted relevant economic theories that emphasize WE for adaptation and

resilience to climate change (CC). Research on the effects of women's political empowerment on economic development, growth, and VCC is documented in the literature(Asongu et al., 2020; Israel & Sachs, 2013; McCright, 2010).

Table 1: Economic theories relevant to WE

Theories	**Relevance**	**Reference**
Capability Approach (Amartya Sen)	Women's access to economic opportunities, health care, and education enhances resilience, and empowered women can better address climate-related issues.	(Assaduzzaman, 2023)
Sustainable Livelihoods Framework	By improving women's ability to adapt and diversify their sources of income, women's empowerment expands their access to these resources and lessens their susceptibility to climate change (CC).	(Natarajan, Newsham, Rigg, & Suhardiman, 2022)
Feminist Economics	Women's disproportionate VCC is lessened when empowered through fair resource distribution and decision-making representation.	(Agenjo-Calderón & Gálvez-Muñoz, 2019)
Household Bargaining Models	Decisions about climate adaptation, including investing in sustainable technologies or diversifying sources of income, are more likely to be influenced by women with more negotiating power.	(Eastin, 2018)
Human Capital Theory	Women are better equipped to respond to CC by	(Asongu, Messono, & Guttemberg, 2022b)

	embracing creative solutions and sustainable practices when they are empowered through education and capacity-building.	
Common Property Resource Management Theories	Women frequently possess unique expertise in natural resources, and their empowerment in resource management enhances community-level CC adaptation techniques.	(Khadka, 2022)
Neo-Classical Growth Theory	By encouraging creative ways for climate adaptation and advocating legislative changes, empowered women promote adaptive efficiency.	(Chitiga-Mabugu, Henseler, Maisonnave, & Mabugu, 2023)
Social Capital Theory	Empowering women increases their involvement in social networks, which are essential for CC solutions at the local level.	(Rice et al., 2023)
Environmental Kuznets Curve (EKC)	In economies, empowering women might hasten the shift to sustainable behaviors and lessen climate change susceptibility.	(Bilgili, Khan, & Awan, 2023)
Inclusive Growth Theory	Women's active participation in climate adaptation and mitigation plans is ensured by their empowerment, which promotes robust and inclusive economic systems.	(Nazir & Ali, 2020)

WE is a mechanism that improves women's capacity to make rational decisions in life and is a fundamental goal of human rights(Kabeer, 1999). Low levels of empowerment are linked to several detrimental economic and

health outcomes on the well-being of women (F. Haile, 2016; Yount, Dijkerman, Zureick-Brown, & VanderEnde, 2014) and their children(Thorpe, VanderEnde, Peters, Bardin, & Yount, 2016). The inclusion of women in societal mobilization affects political transformation, economic preparedness, and climate preservation by enhancing innovation and economic growth (Dahlum, Knutsen, & Mechkova, 2022). According to (DiRienzo & Das, 2019). Furthermore, women's representation supports productivity, good governance, the development of public goods, and environmental preservation. These in turn encourage social and economic resilience, which will ultimately reduce the effects of climate change.

Andrijevic, Crespo Cuaresma, Lissner, Thomas, and Schleussner (2020) conducted a study that showed promoting gender equality in institutions can reduce VCC. When women have legal protections and are constitutionally empowered, they are more likely to engage in entrepreneurship, which can lead to positive economic and financial outcomes (Rink & Barros, 2021). Women can also contribute to increasing production and social adaptability to climate change, while simultaneously reducing corruption(Samimi & Hosseinmardi, 2011).

Gaard (2015) argues that women are often excluded from decision-making processes and the understanding of risks during natural disasters. This exclusion contributes to higher mortality rates among women. Although these studies are primarily theoretical, they support the underlying theory, which states that WE lowers VCC globally. Furthermore, Yavinsky (2012) postulates that specific cultural bounds and societal odds exacerbate the vulnerability of women to climate shock. Women are also the most vulnerable to climate shocks due to their heavy familial duties, as natural catastrophes related to climatic change restrict women's ability to gather firewood and obtain drinking water in arid areas(Nwoke & Ibe, 2015). Van Aelst and Holvoet (2016) demonstrate that widows, single women, and entrepreneurial women are often more vulnerable to the effects of a climatic shock in Africa. WE is crucial for addressing their vulnerability to environmental degradation. An economically and politically autonomous woman positively impacts socio-economic conditions. Svaleryd (2002) explored that women’s active participation in public administration guarantees the adapted policies for public choices. Similarly, women’s social empowerment leads to a healthy labor force of women(Doepke & Tertilt, 2018).

3. THEORETICAL FRAMEWORK

We adopt the definitions and strategies of Kabeer (2012), and Sundström et al. (2017) to support the mechanisms by which WE affects VCC. We hypothesize that the complete relationship of WE towards VCC transmits from a combination of all four proposed aspects of WE. First, Increasing the number of women in politics enhances diversity, talent, knowledge, and experience (Sapiro, 1981). It led to the development of institutions that harmonize the interactions between citizens and the state (Swamy et., al. 2001). Dollar, Fisman, and Gatti (2001) found a negative correlation between corruption to the powerful representation of women in parliamentary and administrative organizations. Women's political participation in national parliaments leads to the formulation of strong policies regarding education and health (Brennan, Mavisakalyan, & Tarverdi, 2020). In most cases, women who hold prominent roles in politics and administration allocate their earnings from their positions towards supporting their families and educating young girls to make them climate resilient.

Second, the promotion of civil freedom of expression and movement encourages critical communication, which enhances idea exchange and enables better decision-making(Dahlum et al., 2022). Women's social empowerment is positively linked with a healthy female labor force (Doepke & Tertilt, 2018). Such civil liberties increase the female human capital endowment, which will raise the women's bargaining power in intra-household decisions and the market. Women get technical and skilled education that increases their opportunity cost to have more children in terms of their time allocation towards their jobs. Due to this substitution effect, women will give birth to fewer kids. This trade-off between WE and fertility rate led to effective human capital formation (a transition from the quantity to the quality of offspring). Ultimately, this phenomenon will trigger a demographic transition toward economic transition(Diebolt & Perrin, 2013). Empowered women create a virtuous cycle, starting with gender equality, low fertility rates, increased life expectancy, eradicated child stunting, and skilled human capital, leading to economic growth. Third, enabling women to voice their perspectives through civil society and media empowers policy-makers to choose more effective adaptation policies(Evans, 1995; Weldon, 2002). Women's active participation in public administration guarantees the adapted policies for public choices(Cabaleiro-Casal & Buch-Gómez, 2020). For instance, such countries tend to increase their public expenditures on education and health which leads to a healthy future workforce. Thus, women's representation promotes public goods along with productivity and good governance (DiRienzo & Das, 2019).

Fourth, the participation of women in economic activities will increase the labor force of the economy and hence economic growth (Folasade & Olarewaju, 2019). Transforming women into human capital enhances factor accumulation(Mulligan & Sala-i-Martin, 2002). Women's economic empowerment is a process that enhances women's ability to make strategic life choices(Kabeer & Natali, 2013) and is an essential objective of human rights. Low participation rate in the economic activities have significant negative impacts on well-being of women (S. Haile, Emmanuel, & Dzathor, 2016; Jones et al., 2019; Mabsout, 2011) and their children (Chakraborty & Anderson, 2011; Pratley, 2016; Thorpe et al., 2016) due to associated economic and health outcomes. The presented "business case" for WE has the potential to nudge hesitant leaders to empower women, even if for instrumental reasons. All of these factors suggest that the empowerment of women can enhance reduce VCC.

Details of all components of WE are described in Table A8 in the Appendix. WE can have a positive and significant impact on climate change and environmental preservation by altering society's choices and priorities in important ways(Duflo, 2012). Women have a very vulnerable social layer concerning climatic change, hence the inclusion of WE in the administration and execution of adaptive policies for environmental resilience is more justified. Expanding women's liberties, their involvement in civil society, and their participation in decision-making promotes climate shock adaptation (Sundström et al., 2017).

4. Model Specification and Methodology

4.1 Model Specification

We analyzed the relationship WE with VCC of South Asian countries, by using a variety of econometric techniques. We employ the CSARDL developed by (Pesaran, Shin, & Smith, 2001) to analyze the short- and long-term relationships. We have estimated the following two empirical models.

$$VCC_{it} = \beta_0 + \beta_1 WE_{it} + \beta_2 ECOR_{it} + \beta_3 GOVRit + \beta_4 SOCR_{it} + \beta_5 HDI_{it} + \rho_{it} \quad (1)$$

$$VCC_{it} = \beta_0 + \beta_1 ECOR_{it} + \beta_2 GOVRit + \beta_3 SOCR_{it} + \beta_4 WCE_{it} + \beta_5 WPE_{it} + \beta_6 WEEit + \beta_7 WSE_{it} + \beta_8 HDI_{it} + \rho_{it} \quad (2)$$

Where VCC is the vulnerability to climate change for country i over a period; it measures how vulnerable societies are to climate shocks. WE is the women's empowerment index. We developed the WE Index by combining V-

Dem's political representation, civil liberties, and involvement in civil society indices with a fourth indicator of women's economic empowerment. We use the PCA Method to develop a comprehensive WE index based on all four indicators of empowerment. A detail of all the indicators measured in each sub-index is given in Table A2 in Appendix. HDI is the human capital development index. SOCR, GOVR and ECOR variables indicate social, governmental and economic resilience of the society, simultaneously. We use these variables as the indicators to measure the adaptive capacity of a society as mentioned by Sarkodie and Strekov (2019) in the literature. WCE, WEE, WSE and WPE are women's civil empowerment, women's economic empowerment, women's social empowerment and women's political empowerment, respectively.

The detailed definition/description, data sources, descriptive statistics, and correlation analysis of the variables are provided in Table A1 (see appendix). We used balanced panel data from 1995 to 2023 for the South Asian countries, namely Pakistan, India, Bangladesh, Sri Lanka, Bhutan, and Nepal. Data on Afghanistan and Maldives was not available for many variables.

4.2 Preliminary tests

4.2.1 Cross-Sectional Dependence Tests

In order to decide the nature of the empirical relationship of the panel data, we first conducted cross-sectional dependence (CD) tests developed by Breusch-Pagan LM, Pesaran Scaled LM, and Pesaran (2015), to check CD in residuals and in variables. CD problem might arise due to cross-country similarity in the population, region, and political or socio-economic inducement. Therefore, we conduct CD dependence tests to test the cross-dependence among panel cross-sections. This test also helps to determine whether we should use first-generation estimation techniques or second-generation estimation techniques.

4.2.2 Slope Homogeneity Test

The methodology to determine if the slope coefficients of the cointegration equation are homogenous was established by Swamy (1970). Swamy's slope homogeneity test was enhanced by Pesaran and Yamagata (2008). This test checks the slope homogeneity/heterogeneity in the panel analysis. If the sample countries are heterogeneous; hence we should use heterogeneous panel methodologies.

4.2.3 Second Generation Unit Root Test

We employ Pesaran's second-generation unit root tests to check for stationarity in the presence of cross-sectional dependence. First-generation unit root tests (Levin, Lin, & Chu, 2002) do not take into account cross-sectional dependence. So, we employ second-generation unit root tests to check the stationarity level of variables. Thus, the cross-sectional augmented Dickey-Fuller (CADF) test by Im, Pesaran, and Shin (2003) and the cross-sectional augmented IPS (CIPS) test by Pesaran (2007) have been employed.

4.2.4 Westerlund Test for Panel Cointegration

To estimate the cointegration between dependent and independent variables over a range of cross-sections units and throughout time, we have applied Westerlund Test for Panel Cointegration (Westerlund, 2007). This test takes into account the special features of the panel data, such as CD and slope homogeneity issues.

4.2.5 Demitrus Hurlin Causality Test

To examine if there is any causal relationship between variables, we have used the Dumitrescu and Hurlin (2012) method. One of the primary challenges with panel data models is the specification of heterogeneity while conducting the causality test. To address this issue, Dumitrescu and Hurlin (2012) assumed that all coefficients could differ between cross-sections to account for the heterogeneity across cross-sections.

4.2.6 Cross-Sectional Autoregressive Distributed Lag (CSARDL)

The results of CS dependence and unit root tests proposed to apply the cross-sectional augmented-autoregressive distributed lags (CS-ARDL) approach for our model.

$$\Delta Y_{it} = \emptyset_i + \gamma_i (Y_{it-1} - \alpha_i X_{it-1} - \delta_{1i}\bar{Y}_{t-1} - \delta_{2i}\bar{X}_{t-1}) + \sum_{k=1}^{p-1} \partial_{ij}\Delta Y_{it-k} + \sum_{k=0}^{q-1} \tau_{ij}\Delta X_{it-k} + \vartheta_{1i}\Delta\bar{Y}_t + \vartheta_{2i}\Delta\bar{X}_t + \varepsilon_{it} \quad (5)$$

In the above equation, Y_{it} represents the dependent variable, while $\emptyset_i$ represents the intercept. α_i denotes the slope coefficients of independent variables as well as lagged dependent variables. X_{it} is a vector of independent variables. δ_i denotes the error correction term (ECM) indicating an adjustment of short-run disequilibrium towards long-run equilibrium after an economic shock. Y_{t-1} and X_{t-1} provide a proxy for the unobserved factor in the long run, while ΔYt and ΔXt provide a proxy for the unobserved factor in the short run in Equation (8).

5. EMPIRICAL RESULTS AND DISCUSSION

5.1 Result Discussion of Pre-Estimation Test

The findings of Cross-sectional dependency tests are statistically significant at 1%, which confirms the presence of the cross-dependence problem in all models. This implies that South Asian countries rely on one another. The estimates of the Slope homogeneity test of Pesaran and Yamagata (2008) reveal that the slope coefficients are heterogeneous at a 1% level of significance. Second-generation unit root tests of CIPS results show that all variables are integrated at the first difference, I(1). However, the results of CADF are quite different and indicate that only SOCR and GOVR are integrated at I(0) while all other variables are stationary at first difference. Results of the Westerlund test for panel cointegration confirm that all panel variables are co-integrated in the long run at a 1 percent level of significance. The results of the Durmitrescu- Hurlin test state bidirectional causality exists among WE and HDI; WE, ECOR, and GOVR cause VCC. WE also cause SOCR and SOCR cause ECOR and GOVR. (See details of all test statistics in Appendix A).

5.2 Result Discussion of CS-ARDL

Table 2: Long-Run Estimates of CS-ARDL

Models	**Model 1**	**Model 2**
Independent Variables	**VCC**	**VCC**
ECM	-0.943 (0.133)	
WE	-0.045*** (.008)	
WCE		-0.055** (.028)
WSE		0.036** (0.019)
WPE		-0.017** (.006)
WEE		-0.068** (0.039)

ECOR	-0.102** (0.042)	-0.027** (0.0128)
GOVR	0.017 (0.098)	0.334* (0.251)
SOCR	0.492*** (0.173)	0.0491** (0.023)
HDI	-0.488** (0.214)	

Where, *, **, *** indicates significance level of 1, 5 and 10%, correspondingly. Standard errors are in parenthesis.

The findings of the CS-ARDL estimation shows that all indicators are detrimental to VCC in South Asia in the long run as detailed in Table 2. Furthermore, empirical results shows that the WE index reduces VCC by 3% in South Asian countries. Individual impact of various components of WE on VCC shows that magnitude of the effect of women's economic empowerment is large. While magnitude of impact of women's political empowerment is only 1 percent. This low influence of women in the politics justified the VCC of South Asian countries. Overall negative effect of WE on VCC can be viewed by both direct and indirect dimensions of WE. On the direct front, women's sensitivity to natural crisis makes them more likely to participate in decision-making, which helps shape effective policies to control negative climate change(Alber & Roehr, 2007; Gaard, 2015). While, WE has an indirect impact in preparing the political, social, and economic spheres for climate change adaptation. Moreover, Swamy et al. 2001 examine that corruption is decreased when women participate in administrative and political decision-making processes. Consequently, this contributes to ensuring investments and profits that result in steady growth. As a result, the government's ability to withstand a climatic shock is considered as dependent on the stability of this steady growth (Sarkodie and Strekov 2019). The error correction term of all three models is negative and significant indicating the stability of the models in the long run. These results conclude socio-economic and governmental channels should be strengthened to empower women, which can ultimately help to reduce VCC and its negative economic impacts.

6. CONCLUSION AND POLICY RECOMMENDATION

This study examines how VCC can be reduced in South Asian economies. Six South Asian nations were selected as a sample size for the period of 1995 to

2023 for this purpose. The study controlled the problem of heterogeneity and cross-sectional dependency (CD) by using second-generation co-integration estimation techniques. Empirical findings of the CS-ARDL model confirm the negative association of WE VCC. Westerlund Cointegration test confirms the cointegration among the modeled variables. Furthermore, the Dumitrescu-Hurlin Granger causality test has been used to explore causality among modeled variables. The findings indicate that unidirectional causality exists from WE to VCC.

Four aspects of the WE have been considered, namely: women's civil liberty, women's civil society participation, economic participation of women, and women's involvement in political discourse. These four sub-components of WE act independently to introduce new ideas into society and select effective economic and environmental policies. The empirical literature has no study on how WE affects climate change in the South Asian region. The results demonstrate that the WE considerably lowers VCC. The results also show that HDI, and the resilience of government, society, and economy are the transmission channels by which WE affects VCC.

Based on the findings, the study proposes several policy suggestions elaborated in Table 3 along with the proposed interventions through which these suggestions can be implemented to achieve the specific objective. However, the effectiveness of the proposed policies may vary depending on the initial conditions specific to each country.

Table 3: Proposed Policy Recommendations and Implementation Steps

Policy Recommendations	Interventions/Implementation Steps
Comprehensive Mechanisms for Monitoring and Evaluation should be designed to track and assess the progress and effectiveness of educational policies on women's empowerment.	• Create a strong monitoring and evaluation mechanism that can track the enrollment, retention, and academic performance of girls, and to identify and address any barriers to their education. • Conduct periodic reviews of education policies to ensure that they are still relevant and effective, and to adjust based on changing needs and circumstances.
Women should have easy access to	• Provide women access to savings programs, microfinance, and credit to help them

Financial and Economic resources to get economic empowerment	pursue entrepreneurship in climate-resilient sectors. • Create legislation that supports women's involvement in sustainable and green companies, empowering them economically and lowering their susceptibility to the effects of climate change.
Women should have constitutionally Legal protections and Property Rights	• Legal administration of the laws protecting women's rights, particularly those related to land and property, so they can take part in natural resource management and sustainable agriculture. This guarantees that women have protected access to and control over the resources essential for resilience and climate adaptation. • Ensuring that women have equitable access to and control over land resources by addressing gender inequities in land ownership.
Women should have access to healthcare and reproductive rights.	• Ensure women's access to healthcare facilities, particularly in rural areas, to address health concerns including waterborne illnesses and difficulties with maternal health that are made worse by climate change. • Encourage family planning and reproductive rights while acknowledging the link between environmental sustainability and population dynamics.
Encourage the use of sustainable and climate-smart farming methods to increase the adaptability of female farmers to climate change.	• Launch women-led agricultural cooperatives to assist women in implementing climate-smart farming methods. These cooperatives should offer markets, financial assistance, training, and resource access. • Incorporate traditional knowledge and practices held by women into agricultural

	programs, to increase community resilience to climate change. • Provide women farmers with training in agroecology, sustainable farming, and climate-resilient crop management.
Develop a national climate action plan that recognizes the special vulnerabilities and strengths of women in the context of climate change.	• Conduct gender-specific climate vulnerability assessments to determine the particular difficulties experienced by women. • Establish gender-responsive goals and metrics for climate resilience and mitigation. • Budgetary resources should be equitably distributed for gender-inclusive projects.
Enable women to take an active part in the sustainable management of water resources, taking into account their important role in water-related activities.	• Promote women to participate in committees and decision-making bodies for water governance. • Provide training in sustainable water usage techniques, water conservation and rainwater harvesting. • Through the protection of land and property rights, ensure women's control over and access to water resources.
Every country should develop a Gender-Responsive Disaster Management system.	• Develop and implement gender-responsive disaster management plans, recognizing the distinct vulnerabilities and capacities of women in the face of climate-related disasters. • Ensure that evacuation and relief programs are designed to address the specific needs of women, including healthcare, sanitation, security, and protection from gender-based violence. • Establish women-led community response teams and provide training in disaster

	management.
Conduct awareness campaigns to endorse women's rights and gender equality about climate change.	• Integrate climate change education into school curricula, emphasizing its gender dimensions. • Women's leadership abilities can be strengthened via training and capacity-building initiatives. They will empower women to actively engage in decision-making at all levels.
International Collaboration should be encouraged globally due to increase environmental resilience.	• Collaborate with neighboring countries, and national and international organizations to share resources and best practices that promote women's empowerment and climate resilience. • Participate in regional initiatives that focus on the gender-climate nexus, promoting knowledge exchange and joint projects, accessing funding, technical expertise, and capacity-building support.
The Gender-Responsive Climate Action Plan should be launched for climate resilience.	• Establish a gender-disaggregated database to track the impacts of climate change on women and the effectiveness of gender-responsive policies. • Set gender-responsive targets and indicators for climate resilience and mitigation initiatives. • Promote partnerships between academic institutions, research organizations, and civil society to enhance knowledge-sharing and collaboration.
Address the intersection of climate change and women's health by ensuring access to climate-resilient healthcare services.	• Integrate climate-sensitive healthcare into national health policies, considering the impact of changing climate patterns on health. • Provide education and training for women on climate-resilient health practices and disease prevention.
Initiate education and	• Promote the understanding of climate

awareness campaigns to highlight the importance of women's roles in climate action.	change, its impacts, and the opportunities for women to contribute to solutions. • Support studies that highlight the contributions of women and the gendered impacts of climate-related initiatives.

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Appendix

Table A1: Description, Measurement of Variables and Data Sources

Variables (Symbol)	**Variable Description**	**Measurements**	**Source**
Human Development Index (HDI)	HDI encompasses a long, healthy life, education, and good living standards.	Index = 1 denotes maximum development, 0 denotes no development	Human Development Reports (2018)
Women's Empowerment Index (WE)	We is the process of increasing the abilities, agency, participation in social decision-making, and economic participation of	Index = 1 denotes fully empowered, 0 denotes no empowerment	PCA Method (Author's own calculation)

	women.		
Vulnerability to climate change (VCC)	It denoted varying levels of Human societies' vulnerability to negative impacts resulting from climate shocks, ranging from 0 to 100.	Index = 1 denotes fully empowered, 0 denotes no empowerment	Global Adaptation Index (2018)
Social Resilience	It is a question of social inequalities, in particular the quality of infrastructure, the educational framework and the ability to innovate	Index = 1 denotes fully empowered, 0 denotes no empowerment	Global Adaptation Index (2018)
Governmental Resilience	It combines the indicators of political stability. Control of corruption; the rule of law and the quality of regulation	Index = 1 denotes fully empowered, 0 denotes no empowerment	Global Adaptation Index (2018)
Economic Resilience	Measures the various economic operations favorable to the business climate necessary for the mobilization of capital in the private sector	Index = 1 denotes fully empowered, 0 denotes no empowerment	Global Adaptation Index (2018)

Table A2: Test of Homogeneity and Cross-Sectional Dependence		
Test For Slope Homogeneity		
Swamy test statistic	Model 1	Model 2
$\tilde{\Delta}$	6.230*** (0.000)	7.130*** (0.000)
$\tilde{\Delta}$adj	7.826*** (0.000)	8.586*** (0.000)
Cross-Sectional Dependence		
Tests	F. Statistics	F. Statistics
Breusch-Pagan LM	73.52708*** (0.000)	89.256*** (0.000)
Pesaran Scaled LM	9.590088*** (0.000)	62.5684 (0.000)
Pesaran CD	1.084818*** (0.000)	1.5689*** (0.000)

Where, *, **, *** indicate significance levels of 1, 5, and 10%, correspondingly. Standard errors are in parenthesis.

TableA3: Descriptive Statistics of Model 1

Models	Model 1	Model 2
Dependent Variables	VCC	VCC
WE	0-.032** (0.008)	
WCE		-0.056** (0.029)
WSE		0.026** (0.023)
WPE		-0.018** (0.006)
WEE		-0.058** (0.039)
ECOR	-0.072** (0.024)	-0.022** (0.014)
GOVR	-0.003 (0.081)	0.301* (0.265)
SOCR	-0.505** (0.221)	0.040** (0.0245)
HDI	-0.418*** (0.153)	

Table A4: Second Generation Unit Root Test

	LNVCC	WE	ECOR	GOVR	HDI2	SOCR
Mean	0.654585	0.013061	0.444079	0.402587	0.579540	0.242608
Median	0.643903	0.009446	0.412836	0.401746	0.581000	0.242093
Maximum	0.525484	2.064526	0.831469	0.657601	0.786000	0.324915
Minimum	0.786535	2.491113	0.170012	0.238487	0.417000	0.157198
Std. Dev.	0.061735	1.011885	0.149627	0.104883	0.092398	0.039274
Skewness	0.390297	0.478061	1.018611	0.651662	0.392714	0.162828
Kurtosis	2.504102	3.225809	3.956374	2.715540	2.448667	2.630128
Jarque-Bera	6.200510	6.997416	36.72069	12.90188	6.676267	1.760710
Probability	0.045038	0.030236	0.000000	0.001579	0.035503	0.414636
Variables	CORRELATION ANALYSIS					
LNVCC	1					
WE	-0.49	1				
ECOR	0.24	-0.14	1			
GOVR	-0.32	0.43	-0.14	1		
HDI	-0.65	0.68	-0.25	0.46	1	
SOCR	-0.36	0.19	-0.05	-0.15	0.46	1

Table A5: Short-Run Estimates of CS-ARDL

Variables	**CIPS**		**CADF**	
	Level	**1st Diff.**	**Level**	**1st Diff.**
HDI	-0.954	-3.414***	-1.113	2.610***
VCC	-1.803	-4.762***		
WE	-1.985	-4.732***	-2.044	-2.422**
ECOR	-2.053	-4.037***	-1.888	-3.004***
GOVR	-2.199	-4.295***	-2.429**	
SOCR	-2.051	-4.261***	-2.480**	
WCE	-2.549	-5.521***	-1.549	-4.521***
WSE	-1.984	-5.419***	-2.984**	
WPE	-2.356	-3.526***	-1.356	-2.526**
WEE	-1.343	-4.127***	-1.433	-3.127**

Where, *, **, *** indicate significance levels of 1, 5, and 10%, correspondingly. Standard errors are in parenthesi

Table A6: Pairwise Dumitrescu Hurlin Panel Causality Test

Pairwise Dumitrescu Hurlin Panel Causality Tests				
Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.	Direction of Causality
WE → VCC	3.887	1.699*	0.0893	Homogeneous Bi-directional
	3.101	0.908	0.3640	causality among WE and VCC
↛ ECOR	5.782	3.608***	0.0003	Homogeneous uni-directional
VCC	2.076	-0.125	0.9006	causality among ECOR and VCC
↛ GOVR	4.409	2.225**	0.0261	Homogeneous uni-directional
VCC	3.736	1.547	0.1217	causality among GOVR and VCC
HDI ↔ VCC	6.924	4.758***	0.0000	Homogeneous bi-directional
	6.744	4.576***	0.0000	causality among HDI and VCC
WE → SOCR	3.219	1.027	0.3045	Homogeneous uni-causality among
	6.203	4.031***	0.0000	WE and SOCR
↛ ECOR	1.988	-0.213	0.8311	Homogeneous uni-causality among
GOVR	3.895	1.707*	0.0879	ECOR and GOVR
↛ SOCR	3.902	1.714*	0.0866	Homogeneous uni-causality among
ECOR	0.895	-1.314	0.1887	SOCR and ECOR
↔ HDI	4.406	2.222**	0.0263	Homogeneous bi-causality among
GOVR	6.419	4.249***	0.0000	HDI and GOVR
↛ SOCR	4.466	2.282**	0.0225	Homogeneous uni-causality among
GOVR	2.091	-0.109	0.9128	SOCR and GOVR

Where, *, **, *** indicate a significance level of 1, 5, and 10%, correspondingly. Standard errors are in parenthesis.

Table A7: Westerlund Test for Panel Co-integration

Statistics	**Model 1**	**Model 2**	**Model 3**
Variance ratio	-2.3412***	-1.4322***	-1.8521***
	(-2.5482)	(-1.6722)	(-2.1542)

Where, *, **, *** indicate significance levels of 1, 5, and 10%, correspondingly. Standard errors are in parenthesis.

Table A8: Components and Indicators of Women Empowerment Index

Indicators	Definition	Data Source
Women's Social Empowerment Index	Women's access to justice, liberty from enforced labor, domestic mobility, and right to own property	Varieties of Democracy Database (2023)
Women's Civil Empowerment Index	Engagement in organizations of civil society, representation among journalists, and freedom of open discussion of political topics.	Varieties of Democracy Database (2023)
Women's Political Empowerment Index	women are equally represented in the legislative bodies and have a fair share of power allocation in all aspects.	Varieties of Democracy Database (2023)
Women's Economic Empowerment	Participate in the labor force by providing their skills and services for the production of goods and services within a specified period.	International Labor Organization (ILO)

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Leveraging Gender Inclusion and Partnerships in Reducing the Impacts of Climate Change in Northern Nigeria

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ABSTRACT

The climate change produces a food crisis, aggravating conflicts between herdsmen and farmers, violence against women and girls, and produce several other issues. This study examines leveraging gender inclusion and partnerships to reduce the impacts of climate change in Northern Nigeria. Literature and reports indicate that the Northern region of Nigeria has the most vulnerabilities to climate change as the region experiences high levels of desertification, heat waves, and poor and extreme rainfalls. Meanwhile, building a standard gender inclusion will accelerate the reduction of the impacts of climate change in the region. This study adopted qualitative research method whereby data are primarily sourced from the published articles, reports of government and international agencies. Findings from the study indicate that gender inclusion and partnership are essential for successfully implementing the national government policy. However, challenges have impeded the inclusion of women and localization in implementing climate change policy in Nigeria. The study concludes that national policy on adaptation programming must be targeted and gender-responsive, inclusive, and synchronized with other development agendas for reducing the impacts of climate change in Northern Nigeria.

Keywords: Climate, Gender inclusion, Partnership, qualitative, Northern Nigeria

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1. INTRODUCTION

There are connections between how many societal sectors are affected by climate change. Food production and human health can suffer during drought. Flooding has the potential to destroy infrastructure and cause diseases to spread. Problems with human health can reduce labor productivity, affect food supply, and raise mortality rates. The effects of climate change are

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evident in every facet of our global community. However, the impact of climate change is unique throughout the nation and the world; in fact, it might vary even amongst neighborhoods or people in the same town. Underserved communities, which frequently have the highest exposure to dangers and the fewest means to respond, might become increasingly vulnerable due to long-standing socioeconomic disparities.

Increases in temperature, erratic rainfall, rising sea levels and flooding, drought and desertification, land degradation, an increase in the frequency of extreme weather events, an impact on freshwater supplies, and a decline in biodiversity are all signs of Nigeria's changing climate (Haider, 2019). In many parts of Nigeria, especially in the northern region, the length and intensity of the rains have risen, resulting in significant runoff and flooding. The variation in rainfall is growing. Rising sea levels worsen flooding and the submersion of coastal lands and increase precipitation in southern regions (Tajudeen et al., 2022). Due to a decrease in rainfall and an increase in temperature, droughts have also become commonplace in Nigeria and are predicted to persist in the country's north. Many lakes nationwide, including Lake Chad, are drying up and may eventually vanish (Ross, 2018).

Since they make up most of the world's impoverished, these shifts primarily impact women (Toulmin, 2009; Women Watch, 2009). Women are more vulnerable to climate risk due to their increased reliance on natural resources and livelihoods that are typically more sensitive to changes in the climate, in addition to the fact that they make up the majority of the world's impoverished and lack the resources to deal with the adverse effects of climate change (Habtezion & Wanjiru, 2012). According to Durrani et al. (2024), Nigeria has extremely low levels of preparation and adaptation, making it not just one of the nation’s most susceptible to the effects of climate change. Local actors have emphasized that conflict and climate change significantly impact the nation's development. Lake Chad's retreat adversely affected fishing, agriculture, and herding, which resulted in the loss of 90% of the lake's surface area (Jedwab et al., 2023). Reduced agricultural land productivity has been a significant factor in Nigeria's shifting conflict dynamics since it has led to lower real incomes and more intense competition for resources, forcing households to relocate.

The impact of climate change on northern Nigeria must receive proper attention. The most vulnerable areas are the Northeast and the Northwest. The loss of wetlands and the rapid decline in surface water, plant, and animal resources on land have resulted from the combination of increasing temperatures and less precipitation (Abdulkadir et al., 2017;

Akande et al., 2017; Ebele & Emodi, 2016; Federal Ministry of Environment 2014).

The Nigerian federal government has reaffirmed its commitment to implementing policies that will address the effects of climate change (Egboboh, 2024)—in a report by Egboboh (2024), Abubakar Bagudu, the Minister of Budget and Economic Planning indicated that the Nigerian government has started carrying out several initiatives, such as establishing the National Council on Climate Change, passing the Climate Change Act 2021 into law, and budgeting N130 billion for the energy transition plan's implementation in 2024.

Meanwhile, gender inclusion and partnership remain focal in reducing the impacts of climate change in northern Nigeria. One requirement for achieving the UN's Sustainable Development Goals is gender inclusion and equality. Gender equality is an essential developmental approach to tackle the effects of climate change, eradicate poverty, raise living standards and health outcomes, and defend women's fundamental human rights. More efforts are made to reduce poverty, raise living standards, promote good governance, create wealth, and create jobs when women are empowered, given a voice in policymaking and execution, and ensured to participate in economic activity and income generating. According to Policy Vault (2021), following a protracted research and consultation process, including numerous government and public sector development stakeholders and partners, the Nigerian government unveiled the National Gender Policy in 2006. The leveraging opportunities will focus on addressing the climate change issue in northern Nigeria thanks to a long history of partnering with local and national NGOs, community-based organizations, international NGOs, government agencies, research institutions, private sector companies, and funding entities. There is a need to develop through many internal and external consultations utilizing various inclusive methodologies to ensure that the framework accurately reflects policy implementation needs.

Regrettably, Nigeria has seen a complicated web of hostilities that has left its people facing formidable obstacles. The internal disputes disrupted the nation's social fabric, resulting in extensive community displacement. These conflicts have been made worse by variables like climate change, economic inequities, ethnic differences, and religious tensions. A severe humanitarian crisis has resulted from the hostilities in the northeastern regions of Borno, Yobe, and Adamawa, forcing millions of people to flee their homes. People have suffered dramatically as a result of the disruption of livelihoods, uprooting of communities, and tearing apart of families. The fact that these

displaced communities frequently lack access to clean water, food, healthcare, and education highlights how urgent it is to confront this catastrophe on all fronts. Therefore, this study will examine leveraging gender inclusion and partnerships to reduce the impacts of climate change in northern Nigeria. The study examines the following research questions:

I. What are the nexus of standard gender inclusion and partnership for the reduction of the impacts of climate change in northern Nigeria?

II. What are the implications of gender inclusion and partnership on climate change reduction in northern Nigeria?

III. What challenges impede the inclusion of women and localization in implementing climate change policy and adaptation in northern Nigeria? and

IV. What are the best practices or suggestions in accelerating gender inclusion and partnership on climate change reduction in northern Nigeria?

All the above research questions will lay out the proper channel for understanding and bridging the empirical gaps in the study.

2. CONCEPTUAL CLARIFICATION

2.1 Gender Inclusion and Partnership:

Beyond diversity, gender inclusiveness is essential. Gender inclusion fosters an atmosphere where individuals of all genders are encouraged to share their unique abilities and viewpoints and feel appreciated, respected, and empowered (Naseer & Choden, 2023). Creating an atmosphere where individuals of all genders feel appreciated and respected is the goal of gender inclusion. It is about acknowledging and appreciating the variety of gender identities and manifestations beyond closing the gender pay gap and attaining gender equality. A nation that embraces gender inclusion gets access to many varied perspectives, ideas, and experiences that stimulate innovation, improve decision-making, and strengthen its competitive edge. Also, a society prioritizing gender inclusion and diversity must typically have higher levels of innovation, better decision-making, and longer-term profitability. Pytlik (2023) reported that gender inclusion is integral to human rights. It entails accepting and honoring each person's gender identification and ensuring they all have equal rights and protection from discrimination.

Gender inclusion goes beyond simple equality. It is the idea that gender stereotypes do not define society's responsibilities and expectations and that all opportunities, services, and businesses are accessible to all individuals. According to the World Economic Forum (2024), by enhancing gender parity and equipping women for upcoming economic and development obstacles, inclusion makes society flexible and competitive globally.

Partnership in promoting an inclusive society involves a collaboration effort. While establishing inclusive partnerships, an equity leader will always acknowledge and publicly recognize communities and cultures, and their ideas and solutions will be leveraged for shared benefit. Inclusive partnerships (IP) value and prioritize the diverse voices of women, men, boys, girls, and communities when making decisions that affect their lived experiences. This relationship requires the people and institutions with the power to account for past inequities and create conditions for developing and co-designing an equitable future. According to Women Deliver (2018), the key to advancing gender equality and addressing common difficulties is forming partnerships between individuals and organizations with varied resources, experiences, skills, and viewpoints. We must exchange best practices and lessons learned to advance gender equality. Exchanging experiences and showcasing the viewpoints of advocates at the international, regional, and local levels can lead to great success.

2.2. Climate Change

According to Turrentine, Jeff, and Denchak (2021), a substantial shift in average weather conditions over several decades or longer, such as a noticeable increase in temperature, precipitation, or dryness, is called climate change. What sets climate change apart from natural weather variability is the longer-term tendency. Since the Industrial Revolution, human consumption of fossil fuels has been the main factor contributing to the rise in the average world temperature (Lynas, Houlton, and Perry 2021). sing fossil fuels, deforestation, and certain industrial and agricultural processes increase greenhouse gas emissions (Ritchie, 2020). The lower atmosphere warms due to these gases absorbing part of the heat that the Earth emits after warming from sunlight. Carbon dioxide is the main greenhouse gas causing global warming, which has increased by almost 50% and is now at levels not seen in millions of years (Arias et al., 2021). In northern Nigeria, women are more likely to experience

heat waves and warm spells - because women are more prone to labor through the night and suffer from heat stress, especially during dry spells and heat waves (Foster et al., 2020). While males frequently slept in cool spots (such as under trees when the temperature increases) while waiting for their food to be prepared, most women reported experiencing abrupt dizziness after home duties in hot weather (Ayanlade et al., 2023). Although heat waves and dry spells impact the northern region's crops, research also revealed that animals, particularly birds, were disproportionately harmed by heat waves (Damma &

Alhassan, 2020).

In Nigeria and worldwide, people are at risk from climate change due to greater flooding, intense heat waves, shortages of food and water, increased disease, and financial losses. Conflict and human migration may also follow (Cattaneo et al., 2019). According to the World Health Organization (WHO), climate change poses the most significant risk to world health in the twenty-first century (Pachauri & Meyer, 2014; World Health Organisation, 2015). Inaction to slow global warming will expose societies and ecosystems to increasingly serious hazards (Pörtner et al., 2022, p. 9). There are certain limits to adaptation, but actions like flood control measures or drought-resistant crops can reduce the harm of climate change hazards (Pörtner et al., 2022; IPCC, 2023). Poorer populations are most vulnerable to climate change and have the least capacity for adaptation (Tietjen, 2022).

3. THEORETICAL FRAMEWORK

Climate Justice Theory

Climate Justice Theory (CJT), espoused by Mary Robinson and Naomi Klein, significantly influences environmental justice and is advocated by organizations, writers, researchers, and scholars on the impact of climate change distributive justice. This theoretical lens suggests that climate change should be viewed beyond environmental issues to encapsulate human rights and social justice. To this end, vulnerable and marginalized groups who contribute less but bear enormous pains of climate change should be incorporated into interventionists' policies and programs (Faustos & Tiziana, 2023).

The theory assumes that climate change has a discriminatory impact on vulnerable, poor population communities, low-income countries, women, Indigenous, and ethnic marginalized groups whose contribution to greenhouse emissions is minimal but suffers comparatively. Another tenet of CJT is that gagged, vulnerable, and special needs groups should be involved in decision-making processes that affect their predicament. In other words, input, demands, and efforts of most affected people in climate change areas and emergencies must be included in intervention efforts and policies.

CTJ also advocated for a global approach to the problem of climate change, arguing that Western countries should take responsibility for their historical atrocities of environmental abuse by providing adaptation and mitigation support systems to countries at the receiving ends through funds, knowledge, and technological transfer. The developed nations are placed in remedying efforts owing to their long history of transnational industrialization

and commercialization, which has depleted the environment. Theorists finally posited that climate change issue should not be treated in isolation from other pertinent societal challenges, including gender equity, minority rights, socio-political and economic justice, inequality as well as human rights (Fausto & Tiziana, 2023; Melanie & Hajo, 2016).

This perspective is relevant as it argues that addressing the impact of climate change in Nigeria requires paying rapt attention to gender specifics and other accompanying issues brought mainly by environmental-related crises like floods, droughts, desertification, deforestation, and famine. Climate Justice Theory advocates that all efforts to address climate's impact must focus on vulnerable groups (including women), not only Nigerians but elsewhere.

4. METHODOLOGY

The study adopted qualitative research method. Since this study aims to comprehend and analyze discourse, experiences, and social realities on gender inclusion and partnerships in reducing the impacts of climate change in northern Nigeria, qualitative research is a crucial methodology in this domain. This research uses various qualitative techniques to collect and analyze non-numerical data—words, images, and behaviors. The goal is to produce comprehensive and contextualized insights into the various research themes in the study.

The desk research technique is employed to derive data from secondary sources. The secondary sources include academic articles, papers, government reports, newspapers, and the Internet. All data are engaged in content analysis to provide better insights and harmonize the literature to provide a better opinion of the study. Qualitative content analysis is among the many qualitative techniques currently available for evaluating data and deciphering its significance (Schreier, 2012). It serves as a methodical, objective way to describe and measure events in research (Downe-Wamboldt, 1992; Schreier, 2012). Meanwhile, in this qualitative research, credibility, transferability, dependability, and confirmability are all vital to establishing trustworthiness from the various secondary sources (Hecker & Kalpokas, 2024). Furthermore, techniques, including peer debriefing, sentence checking, triangulation, and reflexivity, assist the researcher in the validity and reliability of all literature included in the study.

5. FINDINGS AND DISCUSSIONS

5.1 Gender inclusion and partnership for reducing Climate Change impacts

The effects of climate change are evident and pervasive throughout northern

Nigeria, as they are in many other parts of the world. The Intergovernmental Panel on Climate Change (IPCC) defines climate change as any change in climate over time, whether due to natural variability or as a result of human activity " (Parry et al., 2007). Climate change is acknowledged globally as a significant phenomenon that profoundly affects human development and socio-ecological, biophysical, and human systems.

The northern region of Nigeria is recognized for its agricultural production, which produces enough food to maintain the area and supply Lake Chad and other West African states (Sambo & Sule, 2023). Climate change was the primary cause of the drastic reversal of this productive trend, which involved numerous other aspects as well. For instance, farmers are moving southward due to the lack of rainfall in the north, where it is relatively higher. In the south, excessive rainfall causes floods that force residents of many settlements to relocate. Due to these conditions, farmers and herders struggle to find enough land, intensifying hostilities and the exodus of those who have lost their houses due to the unrest.

The number of people killed by farmer-herder conflict has surpassed even the casualties from the Boko Haram insurgency (Lorimer, 2021). Numerous thousands of individuals have either perished or had to escape from their homes. These conflicts have also led to an increase in ethnic, regional, and religious divisions in Nigeria. In addition to these problems, it is anticipated that the country's north will see increasingly regular droughts and desertification, and the rest will see an increase in flooding. These developments will significantly impact the agricultural output—which is currently insufficient to meet the nation's food demands (Durrani et al., 2024). This catastrophe has undermined national unity and stability.

Women must be stakeholders and planners in Nigeria's climate change efforts to ensure everyone has access to the necessary resources to adapt to and mitigate climate change. Women's contributions to enhancing catastrophe resilience and their pivotal role in promoting low-emission development are two instances of this kind of involvement.

In building gender inclusion and partnerships on curbing the impacts of climate change, these aims are included:

i. Develop climate change policy;

ii. Work with organizations to lower carbon emissions and

iii. To assist nature and people in adjusting to a changing climate.

Establishing early warning systems and improving readiness for extreme weather disasters are crucial for communities. Directly supporting disaster response (using localized methodologies) and improving system capacity

through grants for leadership development and training increased efficiency and ownership.

Progress has been uneven, and some of the gains are becoming more precarious as water stress intensifies due to climate change in the Lake Chad region in the northeast, unsustainable consumption, increased agricultural activity, and land degradation in the southeast, south-south, and south-west, and thousands of Nigerian women are gaining access to essential water and sanitation services nationwide.

In Nigeria, women handle most food preparation, which uses energy from the home. Women all around the nation use cook stoves that run primarily on coal and solid fuels like biomass, which includes wood, charcoal, leftover agricultural waste, and animal dung (Climate and Sustainable Development Network CSDevNet and Jeyiol 2024). Women are essential to the upkeep of their families and communities and implementing adaptation strategies to lessen the adverse effects of climate change. Moreover, in this sense, they need everyone's assistance and support. n building a common gender inclusion and partnership for the reduction of the impacts of climate change in northern Nigeria, the following are the avenues:

The gender strategy heavily relies on gender-responsive and transformative techniques, which can assist us in creating a more inclusive and long-lasting solution. According to Mohammed (2023), gender-responsive climate change and peacebuilding address the effects of inequality and conflict. Gender transformative approaches aim to identify and shift some of the underlying - and interconnected - causes driving inequality and conflict in the first place. Because gender inequality rarely exists in isolation, we also look to analyze how gender interacts with other forms of inequality related to age, sexual orientation, race, and other factors.

To build a better gender partnership, all Nigerian ministries, departments, Agencies, and commercial entities should adopt a purposeful climate change policy (Amobi & Onyishi, 2015). An integrated and coordinated policy would help mitigate climate change. A participatory research project oversees the Action Plan's execution involving the public and commercial sectors, development partners, academic and research institutions, CSOs (especially those that support women and youth), and government officials at all levels.

Women's distinct knowledge and abilities can augment the effectiveness and resilience of endeavors to address climate change. For instance, the government must implement policies considering variations in gender susceptibility and women's unique roles. In that case, advances in

gender equality and social inclusion can bolster efforts to combat climate change (Ergas et al., 2021). As the world moves toward a new climate regime, governments must acknowledge the connection between gender inclusion and partnership and climate change and involve women in policy formulation.

Gender mainstreaming could be crucial in ensuring that a gender equality perspective is used when developing climate change adaptation and mitigation policies. Gender mainstreaming should be considered a crucial component of adaptation to guarantee success and sustainability, in addition to being a factor that needs to be addressed in activities to reduce climate risks (Moungar, 2019). In addition to being differentially impacted by climate change compared to men, women contribute distinctively to the fight against it. Women are essential to the upkeep of their families and communities and implementing adaptation strategies to lessen the adverse effects of climate change. Therefore, women must be represented in decision-making at all levels so that they may put forward creative and long-lasting answers to the problems that occur with the environment.

Therefore, all groups' full and meaningful engagement becomes vital in decision-making and implementation towards developing resilient communities in the face of climate change. The National Action Plan on Gender and Climate Change focuses on practical methods for incorporating gender into the execution of national climate change initiatives, such as the Paris Agreement and the Nationally Determined Contributions (NDC), in keeping with Nigeria's goal to empower and address the needs of women in the context of climate change (Federal Ministry of Environment, Department of Climate 2020). The Action Plan outlines benchmarks for ensuring that the vital and significant roles played by women, young people, and other vulnerable groups in developing a climate-resilient Nigeria are considered when pertinent national policies and strategies are implemented.

5.2 Implications of gender inclusion and partnership on climate change reduction in northern Nigeria

The environment and economy of Nigeria are affected by climate change. Records of farmers and herders engaging in violent land battles and other events like flooding and extreme heat make this clear (Federal Ministry of Environment, Department of Climate Change 2020). These effects are consistent across the nation's many regions and fluctuate from year to year. Landslides, erosion, desertification, drought, and heat waves are just a few of Nigeria's severe environmental security issues due to climate change. These issues strain the country's infrastructure and natural resources (forests, water, and land). The communities that depend on natural resources for survival,

such as farmers and impoverished households and families, are impacted in turn. Different demographic groups in the nation are affected by climate change risk differently.

According to the Federal Ministry of Environment, Department of Climate Change (2021), Nigeria has enacted several policies, strategies, and action plans to tackle climate change and incorporate environmental and climate change management into the nation's socioeconomic development initiatives. Three primary development plans—the Economic Recovery and Growth Plan (ERGP) 2017–2020, The Transformation Agenda (2011–2020), and Vision 20:2020—set strategies and priorities for pursuing climate-resilient and climate-compatible activities. The National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) (2011), the National Renewable Energy and Energy Efficiency Policy (NREEEP) (2015), and the National Gas Policy (2017), National Policies on the Environment (2016), Nigeria Agricultural Policy 2001, Agricultural Promotion Policy (APP) 2016–2020, National Climate Change Policy and Respond Strategy (NCCPRS) 2012, National Biodiversity Strategy and Action Plan (NBSAP) 2016, National Forest Policy (NFP) 2010, National Forestry Action Plan (NFAP) 1996, viii. National Policy on Environmental (2016), Nigeria Industrial Revolution Plan (2014), National Gender Policy (2006), and REDD+ Strategy, 2019 are additional policies and strategies that have an impact on the climate change challenge both directly and indirectly.

Women on the Front Lines of Climate Change demonstrates that acknowledging the importance of women smallholder farmers is essential for effective climate change adaptation. It tells the stories of millions of women who, thanks to gender-sensitive adaptation, can now provide greater assistance for their families and communities worldwide.

According to the International Fund for Agricultural Development (2014), experience demonstrates that women are essential to enhancing the quality of life for their families and communities and are essential to efforts aimed at adaptation. The Climate Change Adaptation and Agribusiness Support Programme in Nigeria, for instance, has a strong emphasis on women and offers financing and seed money for ventures aimed at generating revenue. t also supports women in decision-making positions. The action outlines precise goals, a schedule for action, indicators, accountable institutions, and results about implementing the connection between gender inclusion and climate change in its priority sectors.

Technology has grown more important in coping with and reducing climate change since the United Nations Framework Convention on Climate

Change (UNFCCC) placed clean technologies at the center of international responses to climate change (Lorena, 2009). In parallel, various UN frameworks and processes have begun to address technology and climate change. Additionally, as an alternative to more costly emission reductions in their own countries, industrialized nations can invest in projects that lower emissions in developing nations thanks to the Clean Development Mechanism (CDM), created due to the Kyoto Protocol (UN Women Watch 2009). The issue is that, as of right now, gender equality receives very little attention, and the extent to which men and women are affected differently by climate change has gone unnoticed (Lorena, 2009). It is crucial to emphasize that equal participation by men and women in all facets of climate change initiatives, including technology, pays off. Technologies for adaptation and mitigation must reach the poor and vulnerable, who are most in need if they are to be effective in Northern Nigeria. Therefore, focused initiatives must acknowledge that women's situations may differ from men's, ensure that technology development and adoption suit their circumstances, and ensure that women have complete access to knowledge, information, and adaptation-related technologies.

According to a report from Deininger and Canagarajah (2023), it is common for women to be disproportionately responsible for obtaining fuel, water, and food—tasks that are made more difficult in environments where environmental deterioration occurs. Agriculture is the most significant industry for women workers in low- and lower-middle-income nations. During the dry season in the northern region, women put in even more effort to provide for their families. Girls feel more pressure, so they respond by quitting school to assist their mothers in carrying heavier loads. So, building a common gender inclusion and partnership will create opportunities for women and young girls to be relieved of the implications of climate change on their livelihood opportunities.

5.3 Challenges impeding the inclusion of women and localization in implementing climate change policy and adaptation in northern Nigeria

In order to address the gender aspects of climate change, Nigeria must overcome several obstacles (Satterthwaite et al., 2020), one of which is a deficiency of national expertise regarding gender inclusion and climate change and its consequences for national development (Rieckmann, 2018). According to recent research, the social ramifications of climate change vulnerabilities are gendered (Rao et al., 2019). Different climatic, political, and socioeconomic situations can be found in the northern region of Nigeria.

The effects of persistent exposure to extreme weather events are felt in social interactions, ecological services, and agricultural productivity because of the varied topography, biodiversity, and variations in precipitation and microclimate (Adeola et al., 2024).

Climate change impacts food security, water availability, land usage, assets, forestry resources, women's migration, policy, and climate awareness in northern Nigeria. Women bear a disproportionate share of the risks and expenses associated with climate change, making up a significant portion of the world's impoverished population (UNFCCC, 2018).

Due to a lack of financial support, food insecurity is more common in northern Nigerian states, households headed by women than by men. Climate change severely affects communities that rely on natural resources for their livelihoods, and women frequently have to gather firewood and water. Women must go great distances to get water in areas where drought results from climate change. Save the Children International states that gender inequality can perpetuate harmful practices like child marriage, limiting girls' opportunities for education, development, and empowerment (Azubuike, 2023). Girls and women are disproportionately affected by climate change impacts because they often shoulder the burden of caring for others and household duties in northern Nigeria. Girls are being violated across the nation because of rising rates of poverty and climate change, especially in the north, where child marriage is still a significant problem.

Scholars and decision-makers concur that there is now a gender disparity in climate change. In addition to discriminatory laws and regulations that limit women's rights and empowerment, social, economic, and environmental injustices cause disparities (Dawit et al., 2022; McOmber, 2020; Gonda, 2019). Customary family regulations on marriage, which allow girls to be married off as early as 15 (Goemans et al., 2022), prevent women from participating in policy and decision-making in northern Nigeria (Cattaneo et al., 2020). The employment, political engagement, and resource access policies do not adequately address the nexus between gender vulnerability, discrimination, and climate change (Bouchama et al., 2018).

According to a study by Pearson et al. (2017) study, gender stereotypes influence how people view and react to climate change. This study emphasizes the connection between gender and climate change. Abegunde (2014) noted that women are viewed as inferior to men in most parts of Nigeria, particularly in Northern Nigeria. This is also the case in other fields, such as politics, the music business, and education. Deeply rooted gender norms cast doubt on women's suitability for public leadership in the

North and the South. Based on religious and cultural standards, these prejudices cause women in Nigeria to doubt their place in public life.

Nigerian women make disproportionate contributions to society yet experience severe social injustices (Baskin, 2022). Women perform many "productive and reproductive" responsibilities by caring for the home, working in trade or commerce, and cultivating the land to support their families (Makama, 2013). The extent to which women participate in official and informal processes and institutions outside the home needs to be more significant, such as decisions at community government about resource use need to be made by both men and women. Despite a rise in women's involvement in Nigerian politics throughout time, women still have "a pronounced level of underrepresentation" in the country's political system when compared to men.

"Only 7 out of 109 senators and 22 of the 360 members of the House of Representatives are women at this time" (Agbalajobi, 2021). Regardless of educational attainment, all Nigerian women have obstacles to pursuing success and holding powerful positions. According to the study by dRPC (2023), it is a common misconception that women cannot hold leadership positions in government. However, there are systemic and cultural prejudices that affect women, such as discrimination by male supervisors, harassment, and uneven expectations in Nigeria. Despite their equal performance, these biases lead to harsher judgments of women and prevent them from obtaining leadership roles. Female appointees expressed irritation that they are held to greater standards by society due to their gender, which they feel keeps them from progressing in their positions.

In circumstances of poverty, vulnerable groups—women, children, farmers, people with disabilities, the elderly, and young people in particular—often suffer increased dangers and heavier loads because of the effects of climate change. Their restricted involvement in labor markets and decision-making procedures exacerbates inequality. t frequently keeps them from completely participating in planning, policymaking, implementation, monitoring, and assessment connected to climate change. The Intergovernmental Panel on Climate Change (IPCC) (2007) assessment report confirmed that the effects of climate change would differ based on gender, age, and class.

6. CONCLUSION

This study has examined leveraging gender inclusion and partnerships to reduce the impacts of climate change in northern Nigeria. The study pointed out that a "climate-neglect" approach to women, girls, boys, and men

programming, or a gender-blind approach to addressing climate-related implication risks, can worsen the vulnerabilities of the groups most affected by the effects of climate change, escalating already-existing inequalities and possibly escalating environmental and security threats. However, strengthening the inclusion of all genders and partnerships can reduce the impacts of climate change in northern Nigeria. This is essential for women's empowerment because it gives them the authority to make decisions, enabling them to fully engage in and build a better socioeconomic opportunity for all. Those who are most directly affected by climate change must contribute their expertise and experience to developing effective adaptation methods in communities in northern Nigeria. Women frequently live on the front lines of climate change as the primary sources of electricity, water, and food in rural regions. Because of this, they offer unique expertise and experience that can help develop effective adaptation measures. However, women continue to be disproportionately underrepresented in planning and decision-making processes, particularly at local levels, which can worsen already-existing patterns of marginalization. This is true despite growing awareness and recognition that women and local organizations are significant actors and influencers in climate change policy in Nigeria.

6.1 Recommendations

The following recommendations are made in tackling the various challenges facing leveraging gender inclusion and partnerships in reducing the impacts of climate change in northern Nigeria:

i. By promoting education and delaying marriage, investments in girls' rights enable them to realize their full potential and become significant leaders and members of their communities.

Women and girls who are empowered are essential in ending the poverty cycle and pushing for social change.

ii. The Nigerian government should prioritize implementing efficient mechanisms and initiatives to mitigate the effects of climate change, focusing on reducing its impact on women, girls, and children.

iii. To overcome these barriers, financial tools and opportunities for women to pursue leadership and education should be promoted.

iv. Implementing gender-sensitive legislative frameworks and climate information services is also necessary. Several variables, including age, gender, and information access, affect how widely adopted climate change adaptations and mitigations are.

v. Women ought to participate actively in the decision-making process and be afforded equal opportunity to create public policy, governance, and land use

across the 19 states in the northern region of Nigeria.
vi. Strong political will in engaging all genders and partners in implementing an action plan on vii. Education for women and girls is essential because it promotes leadership and participation in climate change, improves life skills, and increases a nation's ability to withstand climate-related disasters. Gender-responsive technologies like climate-smart agriculture should be encouraged.
viii. more just and equal society that recognizes the contributions of all of its members, regardless of gender, can be achieved by advocating for universal education among the northern states in Nigeria.
ix. Encourage strategies to increase the ability of local communities to effectively plan for and manage climate change, with a particular emphasis on women, youth, and vulnerable communities in northern Nigeria.

6.2. Policy implications

The study identified that policy in building a common approach needs to be adopted in leveraging gender inclusion and partnership in reducing the impacts of climate change in northern Nigeria, and these policy implications include the following:
1. The federal and state governments should give better attention to women, climate change, and security approaches because these gaps have negatively impacted women in northern Nigeria.
2. Strong economic and livelihood on smart agriculture should be implemented across the 19 northern states in Nigeria. Many farmers and women have experienced the negative impact of climate change on their farming programming.
3. A better community approach to relating with nongovernment should be used by all to create strong partnerships.
4. Gender openness in legislature and policy should be reviewed to allow more women to participate in climate change mitigation implementation in Nigeria. This indicates that women are needed to partner with minority groups across the country that are affected by climate change.

6.3. Future research prospects

The study looks forward to engaging in a more dynamic approach to the following future research prospects:
1. Climate finance and building a funding need in implementing policy to curb the impacts of the crisis.
2. Inter-government collaboration on gender inclusion to fill the gaps in climate change mitigation.
3. Attitudinal needs to champion the development of women in climate change policy for economic empowerment in the least developing countries in

the world.

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Characteristics of community change agents to promote equitable health services and combat harmful gender norms in climate-affected communities in Sindh province

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Abstract

The province of Sindh, Pakistan, faces heightened vulnerability to natural disasters due to its low-lying location in the flood-prone Indus floodplain. Pathfinder International implemented the Surmi project aimed at strengthening the resilience for climate shocks and emergencies by female volunteers called "Climate Champions" (CC) and trained them to support and provide women and girls the tools, knowledge, and resources they need to advocate for equitable health services and to combat harmful gender norms, including gender-based violence. A knowledge, attitude, and beliefs survey were conducted among 600 CCs aged 18-50 years residing in five intervention districts including, Thatta, Badin, Sanghar, Umer Kot, and Kamber Shahdad Kot. The results show that climate awareness is moderate among CC volunteers. Self-efficacy was strong within the group; 57% showed a fair or strong level of confidence in achieving life goals despite challenges. Unfortunately, strong gender norms remain prevalent among CCs; close to three-quarters (74%) had limited or no confidence in their ability to refuse a marriage that they did not desire. The qualitative data results show that CCs can be the change agents in climate-affected communities.

Keywords: Climate Champions, gender, innovations-based adaptation, quantitative survey, Gender-responsive infrastructure

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1. INTRODUCTION

Pakistan is in the top ten countries adversely affected by climate change as per the Global Climate Risk Index due to its geographical location around the equator – the region most affected by climate change (UNFAO, 2021).

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The current climatology and seasonal forecast suggest that the drought, torrential rain, and flood situation in Sindh will worsen in the future. This has already and will continue to negatively impact agriculture and livestock in Sindh's districts. The latest Integrated Phase

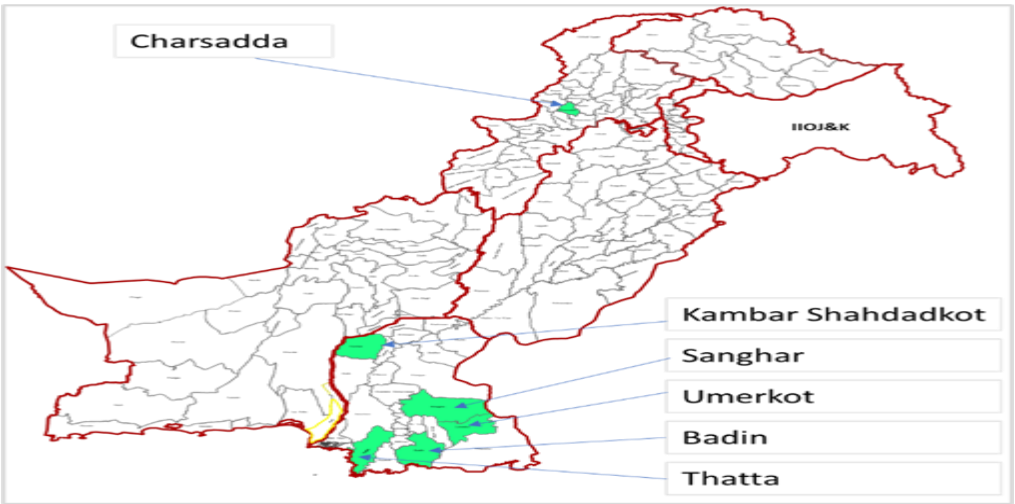
Classification acute food insecurity analysis by the Food and Agriculture Organization classified most of Sindh districts in either stressed or crisis phases at present and shortly. Food insecurity because of climate shifts would directly affect the overall well-being (health, livelihood, education) of the population at risk (Reliefweb, 2021a).

In addition to already existing challenges faced by Pakistan is the unavailability of clean drinking water and sanitation, where around 70% of the households still consume bacterially contaminated water while 25 million people still practice open defecation (UNICEF, 2022). These introduce an added burden to the health and nutrition situation of the country as they are interrelated. Since women are mostly responsible for familial matters in Pakistan, the health of mother and child are intertwined and are affected by women's ability and liberty to make an informed decision and seek help. With the shocks and risks associated with climate and disease, the health landscape of Pakistan can further deteriorate, especially for women because of not being able to speak up or decide on the right treatment for their own and their child's health.

Pathfinder's Initiative on Climate and Health through Women-Led Climate Resilience (WLCR) Project

According to The United Nations Population Fund (UNFPA, 2022), 650,000 pregnant women and young girls have been affected by 2022 floods and approximately 73,000 women among them were expected to give birth. Climate change is increasing the vulnerability of women and girls and expanding the gender gap. Building upon Pathfinder's experience in climate programming through the *Dharti Ammar* project where women and girls' resilience to drought was increased through systems and practices that promote climate adaptive practices (including demand and access to SRH services), Pathfinder embarked on implementing a four-year project titled, 'Advancing the Leadership of Women and Girls toward Better Health and Climate Change Resilience'. This Takeda Pharmaceuticals-funded WLCR project led by Pathfinder intends to ensure that women and girls in low-resource settings have reliable access to quality health services including antenatal care, institutional delivery, postnatal care, family planning services, and ensure communities and health systems are resilient to emergency shocks,

particularly drought. The project targets families and individuals through improved community health workers and health facilities and would develop an integrated framework among multiple stakeholders for collaborative learning and informed decision-making. Overall, the project emphasizes on women as change agents, strengthening their knowledge and access to equitable quality health services alongside building community resilience to future shocks.



Pathfinder, in partnership with the government of Sindh, is implementing a Women-led Climate Resilience (WLCR) project in five districts of Sindh: (1) Badin, (2) *Kambar Shahdadkot* (3) Sanghar (4) *Thatta*, and (5) *Umerkot*.

Female climate champions were purposively selected based on specific criteria: being residents of the project area, having a minimum education of eight years of schooling, aged between 18 and 50 years, preferably married, having family support to perform assigned duties, willingness to conduct house-to-house visits, willingness to attend training and stakeholder meetings, and willingness to accompany referrals when applicable.

Based on the above criteria, 600 climate champions (120 from each district) were selected for four years of the project. The TAKEDA Surmi project is on a mission to empower climate champions by enhancing their skills and knowledge in various critical areas. These areas include Disaster Risk Reduction (DRR), Sexual and Reproductive Health and Rights (SRHR), Family Planning (FP), the impact of climate change, and gender-based violence (GBV), with a particular focus on preventing child marriages.

The Surmi team is actively connecting these climate champions with government officials through Multisectoral Committee (MSC) meetings. In these forums, the climate champions have the opportunity to voice the concerns of their communities to relevant stakeholders. Climate champions will receive training on Gender sensitivity, climate, and health to work in their community to raise awareness on climate and health and also influence the community through community meetings, individual counseling, etc. to reduce repressive gender norms towards women and girls. Once trained, these champions will return to their communities to share their knowledge. They will educate both men and women on these vital topics, ensure referrals to hospitals for necessary services, and serve as representatives in MSC meetings to continue advocating for their communities' needs.

After onboarding the Climate Champions, a baseline study was conducted among 600 climate champions in five intervention districts in Sindh Province to estimate their knowledge, attitudes, and behaviors towards climate change and drought, adaptation and mitigation to climate change, maternal healthcare, family planning (FP) and seeking sexual and reproductive health (SRH) services during crisis. This paper describes their knowledge on above mentions areas with background characteristics of climate champions in the Pathfinder WLCR project to promote equitable health services and combat harmful gender norms in climate-affected communities in Sindh province.

2. METHOD AND MATERIALS

As a part of the project ‘Surmi’ in Pakistan, a Baseline study was conducted among all 600 recruited climate champions through a structured questionnaire in five project intervention districts of Sindh province, namely *Kambar Shahdadkot*, *Sanghar*, *Umerkot*, *Badin*, and *Thatta*. The number of climate champions is equally distributed among all five districts 120 each.

Data was collected through a structured questionnaire which was divided into different sections covering the demographics of respondents, knowledge of existing health services, self-efficacy, agency, and knowledge attitudes. The questionnaire was developed and deployed by using the Kobo Toolbox, a digital data collection platform that helps to maintain the quality check of the data and real-time data validation. Trained female enumerators conducted the data collection, obtaining informed consent from each participant before proceeding with interviews.

Constant data quality assurance was the key to obtaining accurate data

at the field and the MEL team ensured data quality through regular checks and daily reviews of uploaded forms on the Kobo Toolbox on a regular basis, and monitoring personnel made systematic visits to the field to ensure data reliability.

Ethical approval for the study was obtained from Institutional Review Boards (IRB) in accordance with Pathfinder International's policy, ensuring that the research adhered to ethical standards and protected the rights and well-being of the participants. The study obtained IRB certificates from the National Bioethics Committee for Research on November 14, 2023. Data was exported from the Kobo Toolbox into Microsoft Excel for cleaning and then imported into SPSS for analysis with results presented in tables, graphs, and comprehensive narratives for the final report.

This paper uses simple statistical methods to analyze the data by using descriptive analysis, a Likert scale (in ordinal scale on likability/agreement) based on the responses from the study participants. This is analyzed at the aggregate level i.e., at the project level and also a disaggregated analysis is presented at the district level to show the diversity of the respondent and their environmental effect. To estimate the economic status of the respondent a self-reported Likert scale where the question was asked on their perceived current economic status on a five-point scale (1 as poor to 5 as rich). This was not assessed through any other methods and considered as perceived/reported economic status.

2.1 Findings from the survey:

There are 120 Surmi climate champions were recruited from the community from each project district which constituted a pool for 600 climate champions for the project. The sociodemographic characteristics of the Surmi Climate Champions are diverse across the districts (Table 1). When looking at all Climate Champions surveyed, the majority were adults 25 years and older (69%) who had a secondary education level or higher (71%) and were married (81%). Half of Climate Champions had 3 or more living children, and the majority were in the middle and lower steps of the socioeconomic ladder (86%). Similar sociodemographic characteristics were seen across the five project districts. However, *Umer Kot* had the highest proportion of youth climate champions (45%). In addition, *Thatta* had the highest proportion of study participants with only primary education level (30%). Finally, *Thatta* and *Badin* had the highest proportion of climate champions in the middle and

lower steps of the socioeconomic ladder, 96% and 95% respectively.

Table 1: Percentage of Surmi Climate Champions by their Sociodemographic Characteristics

Sociodemographic characteristics	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
Age (in completed years)						
<25 years (youth)	28	33	18	27	45	30
25-34 years (young adults)	36	31	39	38	33	35
35+ years (adults)	36	37	43	35	23	35
Educational level						
Primary	26	33	16	39	24	28
Secondary	48	33	63	43	49	47
Higher Secondary	18	21	10	11	22	16
University	8	13	11	8	5	9
Marital Status						
Never married	18	29	12	14	18	18
Currently Married	82	71	85	86	82	81
Divorced	0	0	1	0	1	0
Widow	0	0	3	0	0	1
No. of Living Children						
0	9	6	12	10	8	9
1	12	14	19	7	16	14
2	18	11	16	19	10	15
3	21	20	19	16	15	18
4+	39	49	34	49	51	44
Economic Status						
Step 1 (Poorest)	8	13	11	14	1	10
Step 2	59	30	28	38	40	39
Step 3	27	39	38	43	44	38
Step 4	6	14	18	4	15	11
Step 5 (Richest)	0	3	5	1	0	2
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

Table 2 presents climate change awareness among the Surmi Climate Champions.

Among all surveyed climate champions, most agreed that permanent changes in the environment were consequences of global warming (67%) and

believed that floods would occur if the temperature of the world increased (62%). Scientific understanding of climate change was quite strong in this group: close to three-quarters agreed that CO2 emissions by humans are caused using fossil fuels (73%) and that N20 from gasoline or engines used in vehicles increases global warming (72%). Of important note, most study participants would like to improve their knowledge of combating climate change (83%). Similar climate change awareness was seen among climate champions across the 5 project districts; however, study participants from the district of Thatta seem to have a higher proportion (above the total average) who agreed with the different climate change statements.

Table 2: Percentage of Surmi Climate Champions Having Climate Change Awareness

Can you tell me if you agree with these statements*:	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
Permanent changes in the environment - consequences of global warming	68	41	69	91	67	67
Floods will occur if the temperature of the world increases	58	64	43	82	64	62
CO2 emissions by humans are caused by the use of fossil fuels	69	53	68	93	84	73
N2O from gasoline or engine used in vehicles increases global warming	54	67	67	91	84	73
I would like to improve my knowledge on combating climate change	84	83	78	98	73	83
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

**Study participants that respond with agree and strongly agree*

Table 3 presents self-efficacy among the Surmi Climate Champions. Among all the climate champions surveyed, most were confident in achieving life goals despite challenges (58%), speaking about women's and girls' problems in the community (61%), and working for money if they wanted to (64%). About half of the study participants were confident in achieving the desired education (51%) and accessing healthcare if ill (54%). A smaller proportion of Climate Champions were confident about accessing psychosocial support if needed (39%), leaving home if needed without permission (35%), refusing marriage if not desired (28%), and working for money if the family objected (43%). Similar self-efficacy levels were seen among climate champions across the five project districts; however, study participants from the district of Thatta seem to have a higher proportion (above the total average) who were confident with all the self-efficacy statement

Table 4 presents agency among the Surmi Climate Champions. Among all surveyed climate champions, a slight majority were confident in deciding their daily schedules (63%), their job or paid work (56%), and attending community meetings (59%). Close to half of the study participants were confident in deciding whether to visit friends or family (47%) or attend a social gathering within the community (49%). About one-third were confident in their ability to decide on agricultural work (34%). Similar agency levels were seen among climate champions across the 5 project districts; however, study participants from the district of Thatta seem to have a higher proportion (above the total average) who were confident with most of the agency statements.

Table 3: Percentage of Surmi Climate Champions who have shown Self-Efficacy

** Study participants that respond with fairly confident and strongly confident*

Can you tell me how confident you are about*:	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
Achieving life goals despite challenges	43	56	51	87	55	58
Achieving desired education	36	54	48	70	50	52
Accessing healthcare if ill	41	49	58	63	64	55
Accessing psycho-social support if needed	28	42	47	46	37	40
Leaving home if needed without permission	29	25	48	45	32	36
Speaking about women and girls' problems in community	48	58	59	86	54	61
Refusing marriage if not desired	24	28	23	37	29	28
Working for money or in income generation if wanted	54	67	57	79	65	64
Working for money or in income generation if family objected	52	27	46	57	38	44
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

Table 4: Percentage of Surmi Climate Champions Agency

**Study participants that respond with medium extent and high extent*

To what extent do you decide on the following activities*	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
Your daily schedule	46	53	69	78	74	64
Your agricultural activities	24	34	44	23	48	35
Your job or other paid work	45	52	52	77	57	56
Visiting a friend or family member	38	56	53	49	42	48
Attending a social gathering within the community	35	68	48	50	48	50
Attending a community meeting	46	67	53	75	58	60
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

Table 5 presents knowledge of select health topics among the Surmi Climate Champions. Among all surveyed climate champions, the great majority were quite knowledgeable about statements related to reproductive health and family planning – most have heard about the term menstruation (95%), injectables (88%), implants (89%), IUDs (83%), and know where they can obtain family planning methods (86%). Topics related to sexually transmitted infections (STI) were not as well known within this group – less than half have heard about HIV/AIDS (46%) and the term STI (44%). Similar health knowledge was seen among climate champions across the 5 project districts; however, study participants from the districts of Thatta and Umer Kot seem to have a higher proportion (above the total average) who were more knowledgeable about the topics related to reproductive health and family planning.

Table 6 presents family planning attitudes and beliefs among the Surmi Climate Champions. Among all the climate champions surveyed, the great majority agreed that using contraceptives is much more desirable than having an abortion (64%) and that couples should talk about contraception before intercourse (73%). Less than half of study participants believe that it is wrong to use contraceptives (41%) and would feel embarrassed discussing contraception with friends (46%). A minority of climate champions agreed that contraceptives encourage promiscuity (33%), reduce sex drive (20%), and are difficult to obtain (38%). Similar family planning attitudes and beliefs were seen among climate champions across the 5 project districts; however, half of study participants from the district of Sanghar believe that it is wrong to use contraceptives (50%) while a slight majority of study participants from the district of Umer Kot believe that contraceptives are difficult to obtain (57%).

Table 5: Percentage of Surmi Climate Champions who have shown Knowledge of Health Topics						
Have you heard of / do you know about:	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
The term "menstruation" or "having one's period"	99	98	88	100	93	96
HIV or AIDS	43	37	54	50	49	47
STI	33	23	48	58	60	45
Injectables or Depo-Provera	86	73	92	99	93	88
Implants	89	71	93	97	96	89
IUD	82	65	88	89	91	83
A place where you can obtain a method of family planning	88	77	83	96	90	87
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

Table 6: Percentage of Surmi Climate Champions who have shown Family Planning Attitudes and Beliefs

if you agree with these statements*:	Badin	Kambar Shahdad Kot	Sanghar	Thatta	Umer Kot	Total
I believe that it is wrong to use contraceptives	43	39	50	32	43	41
Contraceptives encourage promiscuity	37	19	35	17	56	33
Contraceptives reduce the sex drive	38	17	24	6	13	20
Using contraceptives is much more desirable than having an abortion	65	40	75	63	74	64
I would feel embarrassed discussing contraception with my friends	43	40	41	49	58	46
Contraceptives are difficult to obtain	39	23	42	31	57	38
Couples should talk about contraception before having intercourse	65	47	70	92	89	73
Total No. of Climate Champion	**120**	**120**	**120**	**120**	**120**	**600**

3. DISCUSSION AND WAYS FORWARD

Under the Surmi project, Pathfinder has been designed to build the capacity of climate champions on SRH including Contraceptive methods, GBV, Nutrition, and referral mechanisms to generate referrals to the health facilities. This is a community-led approach to raising awareness in the community through community-based activities. Results of the baseline study clearly show that more than fifty percent of climate champions are aware of climate change. However, there is a spatial difference in knowledge and attitude and in self-efficacy including agency. Badin has on the lower scale for climate champions self-efficacy and agency compared to other districts. A similar study in Canada also shows deploying climate champions in the community and assessed their knowledge and attitude towards climate change. The paper also focused on changing self-efficacy and knowledge of climate champions over time with efficient communication (Gislason et.al, 2021). Moser and Pike (2015) also discussed growing capacity need for the community on climate change adaptation.

As the results revealed, only 40% of study participants in Kambar Shadad Kot agree that permanent changes in the environment are consequences of global warming while only 43% of study participants in Sanghar agree that floods will occur if the temperature of the world increases. These findings are in line with the hypothesis of the program that the region required intervention to raise awareness of climate change in the community. Therefore, the program has designed several awareness-generation activities in the community through these climate champion during intervention.

In addition to that self-efficacy is found low among the climate champions who are also from the community. only 28% of study participants feel confident they can refuse marriage if not desired and only 34% feel confident to leave home if needed without permission. To improve the self-efficacy among the climate champions, Pathfinder has designed training with gender transformative approach sessions with their male allies. Including male partners in the Gender transformative approach has been found useful in other countries to improve self-efficacy among women.

Only half of the climate champions have heard of HIV/AIDS therefore the program has focused on building capacity through training the Climate Champion and then increasing the awareness among individuals and communities related to this important health topic. This training also includes promoting positive attitudes toward family planning beliefs and attitudes and

providing social support as 38% of study participants believe that contraceptives are difficult to obtain – this should be much lower (<20%) to promote better access to FP methods.

Overall, there is a difference between the region and among the districts on different aspects like self-efficacy, knowledge of climate, family planning, HIV, etc among climate champions. This is also correlated with the background characteristics of climate champions. The program has designed the implementation plan through training of climate champions in the above areas to build their capacity, but the implementation also considers the diversity of climate champions' background characteristics and knowledge to provide supportive supervision and handholding to complete their tasks.

4. CONCLUSION

The results from the baseline survey show the current scenario where the community needs awareness of climate and health. The program intends to train Climate Champions from the community through this program who will play the role of change agents in climate-affected communities. These women climate champions will be working to reverse deeply entrenched gender norms that are pervasive in this community. This will require concerted efforts to address, both for CCs and the communities that they support. As the program desires to create a favorable environment through these climate champions in the community with gender transformative approaches and improve self-efficacy among women and girls. This is not possible without support from the local government. Therefore, the program will work closely with the local government to encourage climate champions to raise awareness in the community. Additionally, the local health facility preparedness for adverse climatic conditions is also required as the climate champion will refer the community in the nearby health facilities for emergency. This women-led climate resilience model needs multi-sectoral support for sustainability and scalability in the future. These results also revealed that within Sindh there are differences in awareness and self-efficacy among the climate champions. This also calls for targeted intervention within the project geography. This baseline survey results show a glimpse of the community's awareness of climate and health, which will be evaluated at the end of the program.

The baseline study is conducted with climate champions from the community. This was based on certain selection criteria and expected to have their willingness to work on climate and health. This had a probability of bias of selection as the climate champions may have higher knowledge and understanding than the entire community. Their self-efficacy may be on the

higher side of the scale than the women living in the community with different socio-demographic backgrounds. As this is a cross-sectional study and found that the majority of climate champions belong to poorer and middle economic sections of society and have up to the secondary level of education, the responses may be biased and need further examination at the community level. Therefore, the results from the study are used for the capacity building of the climate champions rather than generalizing the knowledge, attitude, and practice of the women living in the entire project area.

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