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CLIMATE CHANGE RESILIENCE AND URBAN WATER GOVERNANCE (A CASE STUDY OF PAKISTAN)

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By

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Abstract

Climate resilience and urban governance are critical to water management and sustainability in Pakistani cities, particularly in light of the country's accelerating urbanization and climate change. In order to meet the increasing demand for water and adapt to hydrologic changes brought on by climate change, there will be about three billion more people living in cities by 2050. Pakistan is a prime example of the pressing need for efficient urban management strategies due to its diverse geography and serious vulnerabilities. Lahore, an urban center that is developing rapidly, has particular problems with governance, sanitation, and water resource management. The quantity and quality of water are seriously hampered by rising temperatures and changing participation patterns, according to analysis of how climate change is affecting urban water resources. However, integrated water resource management (IWRM), green infrastructure, and community involvement are the proposed strategies for managing urban area in a climate-resilient manner. The current study also discusses how water management fosters peace and sustainable development, especially in areas where water resource conflicts are more common. Lahore can effectively manage the challenges of urbanization, climate change, and peace building by giving priority to sustainable development goals and cooperative governance frameworks, which will help them create more resilient and peaceful communities. The study promotes and leads towards all-encompassing strategy for managing urban water resources that takes equity, peace building, and climate resilience into account.

Keywords: Climate Change, Urban Water Management, Peace, Climate Resilience

1. INTRODUCTION

Water management plays a critical role in urban sustainability particularly in the context of urban governance and climate resilience (Marlow et al., 2013). Pakistan, with its varied topography and climate, is confronted with serious challenges as a result of climate change (Rana et al., 2018). It is imperative that effective urban management strategies be carried out because of the nation’s susceptibility to

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extreme weather events, water scarcity, and environmental degradation. Pakistan is the sixth most populous country in the world and 36th largest country in terms of area, covering about 881,913 sq. km (Rana et al., 2018). It is vulnerable to flooding as a result of social, economic, and climate change factors, as the country has seen numerous floods in recent years (Khan et al., 2021). Pakistan has consistently been listed as one of the most climate-affected nations over the past few years, both in terms of the long-term Global Climate Risk Index (GCRI) and the GCRI for the specific year. With an average Climate Risk Index (CRI) score of 28.83 between 1998 and 2019, Pakistan was ranked fifth in the list of the ten economies most vulnerable to climate change over the previous two decades. It is rapidly transitioning from water-stressed to a water-scarce economy, with annual per capita water availability falling below 1000 cubic metres, putting the country on the brink of water crisis (Ahmed et al., 2020).

Over the past few decades, Lahore's population has increased dramatically. It rose from 1.12 million in 1951 to 11 million in 2017 (now in 2023 is 244 million), according to the census report (Rana et al., 2018). Lahore is the most developed of the province's major cities in terms of providing households with better water resources, but it lacks adequate waste water treatment facilities. Instead, industrial and domestic waste are carelessly dumped into rivers and canals, contaminating the water aquifer in the process. Better sanitation facilities are another area where the city needs special attention (Rana et al., 2018). The governance of city is complicated by the lack of an integrated and consolidated administration with distinct roles and responsibilities, jurisdictional boundaries, and a concentrated plan for urban growth. One major problem is the poor implementation of building regulations, which is necessary for controlled growth in the direction of desired future (Rana et al., 2018). Urban temperature has been significantly impacted by the massive developments in transportation, infrastructure, urban population growth, and residential and industrial zones. Cities are thought to be the main cause of the 2 - 4.58 ºC rise in global average temperature that occurs every century. It is also widely acknowledged that human activity causes the global climate to warm over the coming decades, mostly as a result of greenhouse gas emissions into the atmosphere and primarily from the burning of fossil fuels (Sajjad et al., 2009).

The complex relationship that exists between urban management, peace, and climate change necessitates immediate attention and proactive steps. The intensifying threats caused by environmental degradation, fast urbanization, and population growth make it crucial to create strategies that address climate resilience, sustainable urban development, and peace building. Through a comprehensive and cooperative approach to these problems, we hope to clear the path for an urban future that is more equitable, resilient, and peaceful for both Pakistan and beyond. In this paper, we aim to examine how climate change affects urban water management, evaluate the difficulties Pakistan faces specifically, and suggest novel approaches to improve resilience, sustainability, and peace.

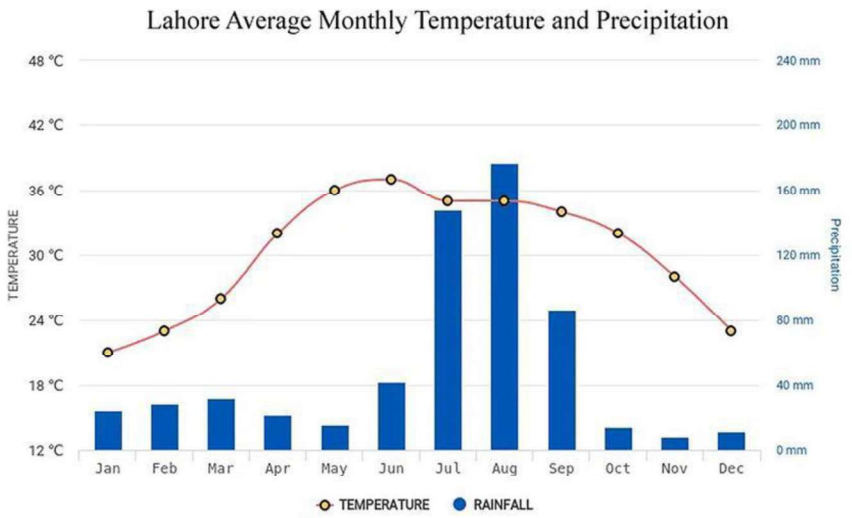


Figure-1: Average monthly precipitation and temperature in Lahore (Ahmad et al., 2022).

2. IDENTIFYING CLIMATE CHANGE IMPACTS ON URBAN WATER RESOURCES IN PAKISTAN

The effects of climate change, which include changing precipitation patterns, more frequent extreme weather events, and rising temperatures, pose serious challenges to urban water resources (Kundzewicz et al., 2014). The availability, quality, and distribution of water in urban areas are all significantly impacted by these changes (Kundzewicz et al., 2014).

Climate change can cause shifts in precipitation patterns, such as changes to the frequency, magnitude, and distribution of rainfall events. More intense rainfall events may occur in some regions, increasing the risk of flash floods and overloading urban drainage systems in urban areas (Hassan et al., 2022). Pakistan, ranked 70th on the list, is among the countries most vulnerable to the consequences of climate change. The change in climate contributes to the growth of multiple vector species and increase the potential for spread of many infectious diseases.

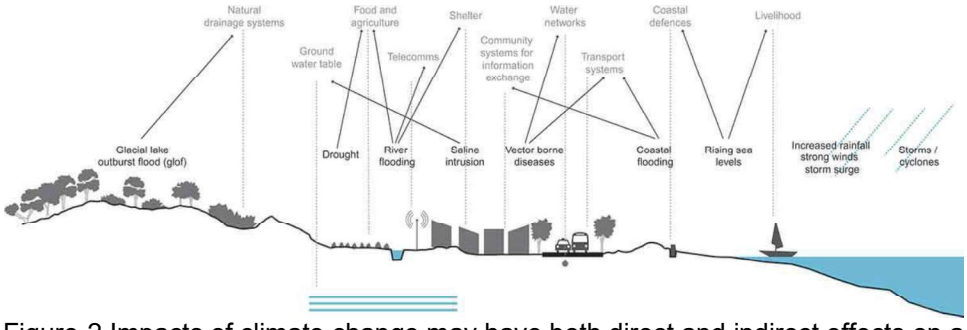


Figure-2 Impacts of climate change may have both direct and indirect effects on a number of significant urban functions (Da Silva et al., 2012).

Humidity, precipitation, temperature, and other climate variables all have an impact on the transmission of infectious diseases throughout biological processes and among living organisms and in the spreading of epidemics. Geographically, there was a higher frequency of dengue fever cases with little to no green spaces and complete urbanization. Seasonal and water-borne illnesses like dengue, malaria, and diarrhoea were common in Rakaposhi Valley. There has also been a rise in typhoid and flu cases, which could be related to declining weather patterns, contaminated water sources, and air pollution. The KPK province reported 1600 deaths in total in 2010 as a result of flooding and heavy rains. Nearly 14 million people were affected by illnesses and dangerous infections in these flooded areas. Infectious disease outbreaks in 2022 caused by extreme weather struck millions of flood victims in Sindh and South Punjab (Zeb et al., 2023).

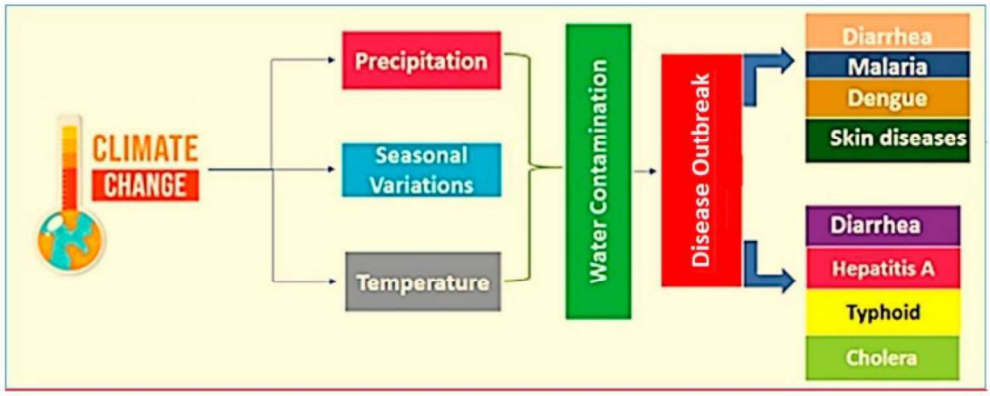


Figure-3: Pathway from climate change-related disease outbreaks (Zeb et al., 2023).

The fluctuating patterns of precipitation and snowmelt, which are essential for river runoffs, are also the factors that impact water supplies. River flows are also impacted by uncertainty surrounding multi-year cyclic weather patterns. Concerns about declining water supplies in the nation due to climate change exacerbate these issues of water insecurity. In addition, Pakistan's limited water storage capacity and ineffective irrigation infrastructure pose a threat to water security. As a result, another barrier to sustainable development is the reliance on ground-water extraction, which contributes 40 per cent to total supplies at the farm gate. Urban water stress can be made worse by rising temperatures linked to climate change, as this can lead to higher rates of evaporation and less water available from surface water sources. Increased temperatures also lead to the growth of heat islands in urban areas, placing additional demand on water supplies and aggravating the health risks associated with heat (Mastrandrea et al., 2014).

Climate change without adaptation is expected to have a negative impact on production for the three major crops grown in tropical and temperate regions: wheat, rice, and maize. However, individual locations may benefit. Local temperature increases of 2°C or more over late-20th-century levels are predicted to have a negative impact (Mastrandrea et al., 2014).

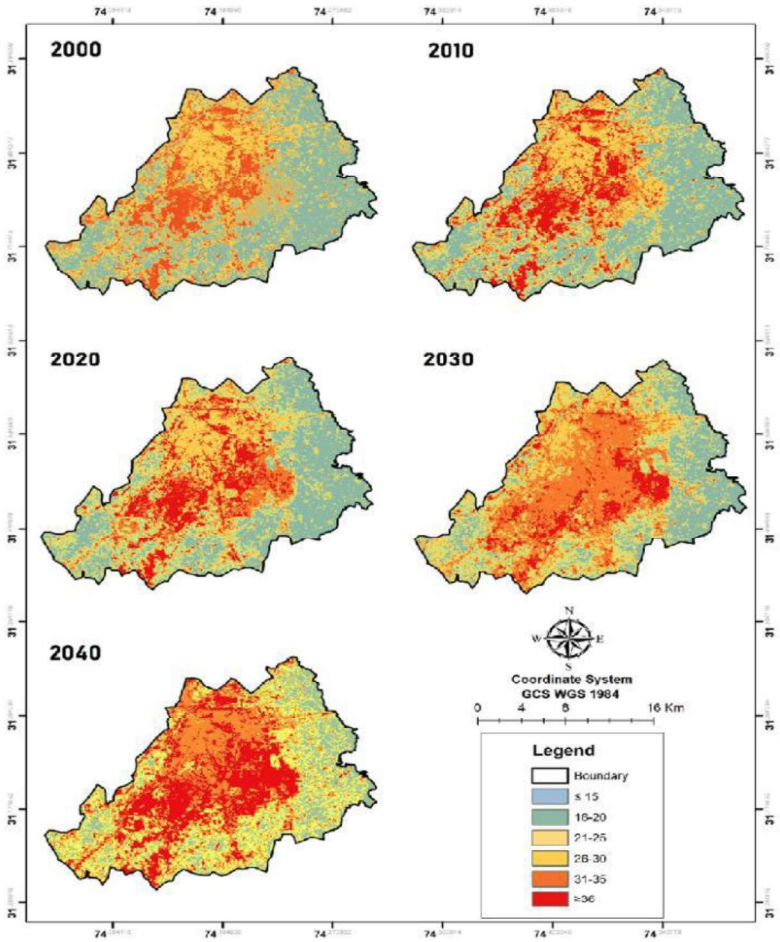


Figure-4: Land Surface Temperature (LST) historical data and projected LST using cellular automata-artificial neural networks (CA-ANN) for 2030 and 2040 (Ahmad et al., 2022).

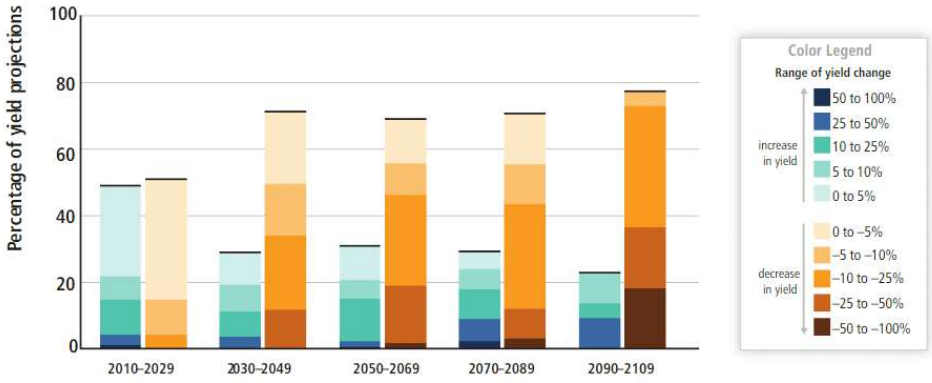


Figure-5: An overview of the anticipated shifts in crop yields brought on by climate change in the 21st century (Mastrandrea et al., 2014).

3. CHALLENGES IN URBAN WATER MANAGEMENT

Pakistan's situation is particularly precarious because, unlike other regional countries that can meet their water needs from rainfall and several basins, the country depends solely on the water supplies of the Indus Basin. On the one hand, this is because the security of the basin is at risk due to Indo-Pak water disputes (IPR1., 2021). Till 2030, Pakistan will be among the top 33 countries experiencing extreme water stress as the ranking will worsen further to an extremely high level (IPR1., 2021). The Figure-6 makes this clear.

Urban water management is confronted with a myriad of challenges, including aging infrastructure, population growth, delivery of drinking water supply for growing cities, water for sanitation versus sanitation without water, recycling of wastewater nutrients, wastewater irrigation, urban agriculture, water to feed depleted aquifers, and competing demands for water (Pahl-Wostl., 2015) (Niemczynowicz., 1999). Social injustices are made worse by unequal access to water resources, which can also spark conflict in urban areas. Addressing these challenges requires innovative approaches that prioritize sustainability, equity, and cooperation among stakeholders.

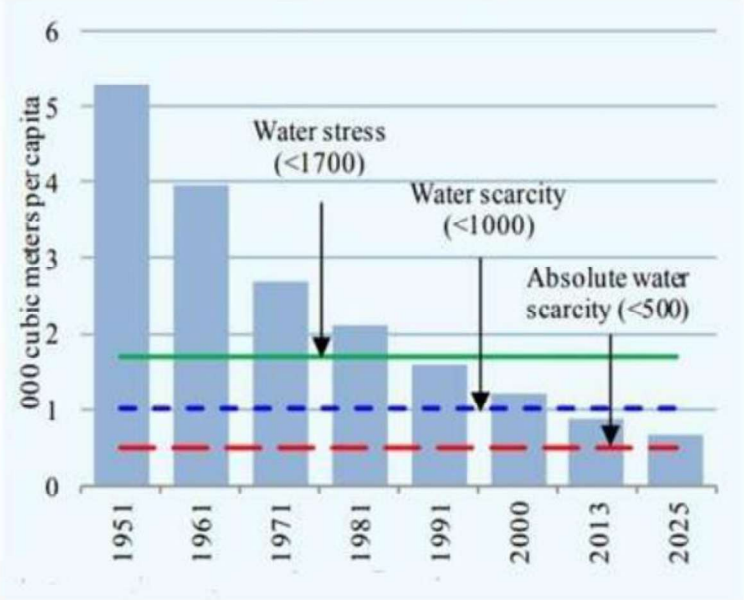


Figure-6: Water stress level of Pakistan (IPR1., 2021).

With 21 million people out of 207 million having access to contaminated drinking water, Pakistan was ranked ninth out of ten countries in the world with the least amount of access to safe drinking water. In this case, the availability of clean drinking water in Pakistan is correlated with the socioeconomic standing of the population with 98 per cent of people in higher social classes have easy access to clean drinking water, whereas overall 39 per cent of people have access to safe

drinking water. One of the challenges to managing water resources is the energy crisis, which also places financial limits on the development of water infrastructure.

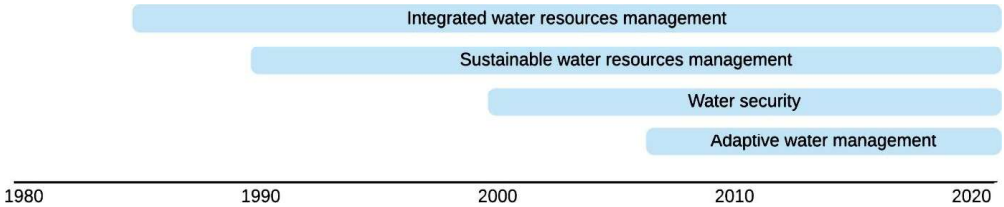


Figure-7: New ideas for water management becoming apparent over time (Hoekstra., 2018).

Out of Pakistan's ten largest cities, which account for 54 per cent of the country's urban population, only 65.2 per cent of urban households have access to a community water supply system. Growing populations have caused massive growth of urban areas, transforming suburbs into extensions of cities. The poor waste disposal and sewerage management system in all Pakistani cities have resulted in environmental pollution and contamination exposure to surface and ground water systems. These approaches and obstacles in managing urban water demand are alarming. Urban areas also have a high poverty ratio; in Pakistan, six of the ten largest cities have double-digit rates of poverty. Quetta has the highest poverty rate, at 46 per cent, while Islamabad has the lowest, at 3 per cent, of the population living in poverty (Zahra & Khan., 2019). With the exception of irrigation, the majority of human uses of water merely contaminate it rather than "destroying" it in terms of quantity (Niemczynowicz., 1999).

Furthermore, Pakistan faces a number of additional difficulties in managing urban water sustainability, including lack of a framework for regulations and laws, dissonance between the principle financier (Provincial Government) and WASA's owner (LDA), institutional limitations, inability to finance services locally and recover costs, which is made worse by widespread incorrect allocations between capital and ongoing expenses, inappropriate pricing of resources and services based on obsolete data and unrealistic development plans, inadequate capacity and strength of personnel within the current organizational structure, restricted engagement and a depressing outlook on private sector and local community involvement, and insufficient working conditions, wages and recognition of staff's work (Putrajaya., 2008). For sustainable social development, it is necessary to apply innovative technologies in a constructive manner and adopt an approach grounded in reality, along with adaptive economic policies.

4. STRATEGIES FOR CLIMATE RESILIENT URBAN MANAGEMENT

According to recently released UN Environmental Programme documents, 400 million people currently suffer from a severe water shortage, and by 2050, that number will rise to four billion. An Integrated Water Resource Management (IWRM) strategy is required to address the intricate problem of water management. This will comprise the following:

- The creation of substitute water resources.
- Safeguarding water resources to enhance and stabilize their quantity and quality,
- Demand control measures put in place at the river basin level.

Cities can optimize resource allocation, reduce environmental degradation, and increase resilience to the impacts of climate change by implementing an integrated approach to water governance and planning. Urban environments have a significant influence on people's consumption pattern, behaviours, and lifestyles. For this reason, sustainable development is essential to preserving urban ecosystems as well as making cities more habitable. Sustainable urban development (SUD) is viewed as the answer to reducing the environmental harm that comes from extensive human activity (Yigitcanlar & Teriman., 2015). Compact development, mixed-use zoning, and the preservation of green spaces are examples of sustainable urban planning techniques that help to improve water infiltration and lessen the impact of the urban heat island. Pakistan can reduce the risk of flooding, preserve natural ecosystems, and encourage water-sensitive design techniques by integrating the concepts of sustainability, equity, and resilience into their land use decisions. Pakistan should implement water management policies in the wake of the natural disaster, which should include building dams, creating freshwater lakes, reclaiming land for wetland cultivation, managing water resources and building sea-banks.

Urban water management and green infrastructures (GI) are becoming more closely associated in the quest for both immediate solutions and long-term shifts towards sustainability. In order to replicate more natural flows, the urban landscape should be transformed from the linear nature of traditional urban water management to a more cyclic approach that treats ecosystems, drainage, and water supply as one cohesive system. The implementation of a city-wide system based on GI for supply; pilot projects such as multifunctional parks and reservoirs, eco-districts and green-building programmes; city-wide strategies for urban water management with technical design and implementation guidelines as well as cross-sector effort, stakeholder involvement, awareness-raising campaigns, rain gardens, green roofs, permeable pavements which help absorbs rainfall, recharge ground water, and lessen the impacts of urbanization on water resources are examples of GI that Pakistan should be putting into practice (Liu & Jensen., 2018).

Developing communities' ability to adapt to climate change and involving them in decision-making processes are fundamental elements of climate-resilient urban management. Participatory planning, citizen science projects, and environmental education programmes are examples of community-based initiatives that enable locals to identify vulnerabilities, identify local resilience efforts, and co-create solutions that meet their needs. Pakistan has the potential to increase social capital, improve adaptive capacity, and stimulate collective action towards climate resilience by promoting collaboration and knowledge sharing among variety of stakeholders.

5. PROMOTING PEACE THROUGH WATER MANAGEMENT AND SUSTAINABLE DEVELOPMENT

It is natural for conflicts to arise among parties who are concerned with sharing and managing common water resources. These conflicts can sometimes become so severe that they have the potential to impact the prosperity and peace of those involved. This is true whether it is farmers sharing the waters of a small watercourse or riparian countries sharing a river basin. In water relations, self-interest often dictates the attitudes and positions of the parties involved. While customary laws or special water laws of a country govern the water relations of the parties within a country, there is no universally accepted international river law or legal framework to govern the use and development of international river basins by riparian countries. To pursue their claims on the water resources of an international river, riparian countries have relied on certain theories which have received varying degrees of acceptance over the years (Kirmani., 1990).

The International Law Commission was established by the United Nations to develop a comprehensive set of principles and regulations for the sharing of water resources in international river basins and the management of riparian conflicts. Despite multiple conferences on international river law, the Commission has yet to achieve its objectives. However, numerous international water treaties and agreements have been successfully executed by riparian countries through either direct negotiations or with the aid of a third party. While the former type of treaty usually occurs between developed countries (such as the U.S.A. and Canada) or between a developed and a developing country (as in the case of the U.S.A. and Mexico), the latter is more common among developing countries (like India and Pakistan). The successful features of these water treaties are vital in considering the strategies for managing conflicts, given that over 200 separate river basins, comprising approximately 50% of the earth's land, are shared by at least two countries, and many involve existing or political conflicts between developing countries. The case studies of national and international conflicts in utilizing water resources from river basins in developing countries, as discussed in this paper, highlight that successful management of conflicts hinges on three key factors. Firstly, there should be an urgent need for an agreement and a realization by the concerned parties that the lack of such an agreement would inflict harm on them. Secondly, given the often competing and conflicting demands, both existing and potential, that frequently exceed available resources, the assistance of a third party is necessary to facilitate compromises. Lastly, the third party should mobilize the required funds to finance the works necessary for developing the water resources to meet the parties' needs to the greatest extent possible (Kirmani., 1990).

6. RECOMMENDATIONS

Sustainable development is a challenging task not only in Pakistan but also in many post-colonial states where issues of governance, corruption, nepotism, and the absence of the rule of law and justice system remain unresolved. The challenges of peace and conflict management cannot be met unless the process

of sustainable development is unleashed so that Pakistan, which has a population of more than 200 million, becomes productive and denies space to extremist and violent groups. To address these challenges, the following recommendations related to peace, conflict management, and sustainable development in the context of Pakistan are presented, these recommendations are valid not only for Pakistan but also for other South Asian countries (Ahmar., 2018):

- There is a need for political will and determination on the part of the state and society.
- Leadership that is educated, clear, visionary, dynamic, and of integrity is crucial.
- Planning and its execution must be given priority.
- A mechanism for peace and conflict management should be established.
- Control over corruption and nepotism is essential.
- Focus on human and social development is necessary.
- The rule of law and justice system must be strengthened.
- Quality education should be a top priority.
- Extremism, intolerance, militancy, radicalization, violence, and terrorism must be controlled through socio-economic and political reforms.
- Lastly, focus on promoting the culture of research is recommended.

7. CONCLUSION

In conclusion, the case study of Lahore highlights how urgent it is to address the intricate interactions between urban water governance, peacebuilding, and climate change in Pakistan's quickly urbanizing landscape. Innovative approaches like IWRM, green infrastructure, and community involvement emerge as crucial pathways towards climate resilience, sustainable development, and social cohesion as the nation faces increasing challenges from extreme weather events, water scarcity, and environmental degradation. In order to ensure effective water management and promote peace through sustainable development, it is imperative that governance inefficiencies, political will, and socioeconomic disparities be addressed. Lahore and other Pakistani cities can successfully manage the challenges of urbanization and climate change by adopting comprehensive strategies that place a high value on equity, cooperation, and adaptive policies. This will pave the way for resilient, inclusive, and peaceful urban communities.

Terminology

1.	GCRI	Global Climate Risk Index
2.	CRI	Climate Risk Index
3.	LST	Land Surface Temperature
4.	IWRM	Integrated Water Resources Management
5.	SUD	Sustainable Urban Development
6.	GI	Green Infrastructure

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