

# **Water at Risk: A Qualitative Study on Climate Change and Water Consumption Patterns in Rawalpindi**



**Submitted by:** Soha Lodhi

**Supervisor:** Dr. Majid Hussain

**BSS 8<sup>th</sup> DS**

**Enrollment:** 01-122551-026

**Department of Humanities and Social Sciences, Bahria University**

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**Bahria University  
Islamabad Campus**

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The topic of Research "Water at Risk: A Qualitative Study on Climate Change and Water Consumption Patterns in Rawalpindi"

Name of Student: Soha Lodhi

Enrollment No. : 01-155221-026

Program: BSS DS

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Thesis Supervisor

Dr. Majid Hussain

A handwritten signature in blue ink, appearing to be "Majid Hussain", written over a horizontal line.

Internal Examiner  
Dr. Zartasha Anwar Khan

A handwritten signature in blue ink, appearing to be "Zartasha Anwar Khan", written over a horizontal line.

A handwritten signature in black ink, appearing to be "Abdul Rasheed", written over a horizontal line.

External Examiner  
Dr. Abdul Rasheed

A handwritten signature in black ink, appearing to be "Irfan Qaisrani", written over a horizontal line.

**Dr. Irfan Qaisrani**  
Head of Department  
Humanities & Social Sciences



**Bahria University  
Islamabad Campus**

Dated: 25-11-25

**FINAL APPROVAL OF RESEARCH PROFICIENCY**

It is to certify that we have read the research proficiency of Thesis by Soha Lodhi. It is our judgment that this paper is of sufficient standard to warrant its acceptance by Bahria University, Islamabad for the award of degree (BS Social Sciences, Development Studies)

**EXAMINING COMMITTEE**

1. Name: Dr.Zartasha Anwar Khan  
Internal Examiner
2. Dr.Abdul Rasheed  
External Examiner

A blue ink signature of Dr. Zartasha Anwar Khan, written over a horizontal line.

A red ink signature of Dr. Abdul Rasheed, written over a horizontal line.

**Thesis SUPERVISOR**

Name of Supervisor :-  
Dr. Majid Hussain

A black ink signature of Dr. Majid Hussain, written over a horizontal line.

**COUNTERSIGNED**

Dr. Irfan Qaisrani  
Head of Department  
Humanities & Social Sciences

A black ink signature of Dr. Irfan Qaisrani, written over a horizontal line.

## **Dedication**

This work is dedicated to my parents who have shown me utmost support and have been my pillars throughout the process which made this work possible. Their faith in me has motivated me to make this work possible.

I would also like to thank and dedicate this research to the people of Dhoke Mustaqeem and the respondents who opened the doors of their houses for me and helped me out in understanding the crisis of water that they suffer from.

## **Acknowledgment**

I believe I owe a lot to Allah Subhan Allah. It is only through His mercy and love that I have managed to finish this thesis with determination, wisdom and patience. I attribute all my success to Him since without His numerous blessings it is not possible that I could have achieved so high academic success.

I would also wish to say my utmost thanks to my supervisor, Dr. Majid Hussain, who has accompanied me and guided me as well as provided constructive comments all through the course of conducting this research. The experience, which he has taught me, has altered my attitude to life and has made me want to luxuriously treat myself and to do my job to the best of my abilities.

To this extent, I have been successful due to my parents who have showered me with love, support and prayers. I like the unwavering faith and encouragement in me without which I could not overcome all the obstacles on my way to my life.

It is merely an acknowledgment of my extreme appreciation of everyone who has been supporting, guiding me, praying on my behalf, and loving me. I dedicate this work to them, and may they live happy forever and be blessed with blessings.

## **Abstract**

This paper examines the impact of climate change and the high rate of urbanization on water consumption in Rawalpindi, Pakistan. In the further future, unpredictable weather conditions and the growth of the city subject water sources to more and more pressure, which can undermine their availability and sustainable development. The paper takes into consideration the impact of changing climate, population pressure and mismanagement of water resources on its supply and usage. The qualitative methodology was used whereby data were gathered on four categories of people viz. households, officials of Water and Sanitation Agency, local government employees and environmental experts. According to the respondents, changeable rainfall, increase in temperatures and wearing out infrastructure reduced the reliability of the water supply. Such uncertainty is pushing a good number of households towards domestic supplies and occasional supply. There is a low level of awareness by the people on the need to conserve water and poor coordination among the institutions dilute the policy implementation. This paper proposes that urban water management requires climate adaptation, better governance and community-level behavior change to achieve sustainable water management in the city. The research in this respect proposes combined policy change, robust infrastructure investment and citizen-specific enlightenment aimed at encouraging reasonable water consumption. The lesson is to repair the systems, followed by assisting people in altering habits.

## **List of Abbreviations**

Integrated Water Resource Management	IWRM
Sustainable Development Goals	SDGS
Socio-Ecological System	SES
Glacial Lake Outburst Floods	GLOFs
Water and Sanitation Agency	WASA
Rawalpindi Cantonment Board	RCB
Participatory Irrigation Management	PIM

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# **Chapter No. 01**

## **Introduction**

This chapter introduces the study and preconditions the perception of the research issue. It begins by providing the background on the significance of water as a vital resource in the survival and development of the human population and how these problems such as climate change, urbanization and improper utilization of the water have led to the problem of water scarcity. The problem statement is then stated in the paper which defines the key issues that the people living in Rawalpindi are experiencing regarding the availability and consumption of water. It also identifies the objectives and research questions that have been used to direct the research, which is how climate change impacts the consumption behavior and conservation practices in relation to the household level. Lastly, the organization of the thesis is described to give a clear structure of how the study progresses from the introduction and literature review to the methodology, findings, and recommendations. Through this outline, the chapter provides readers with a clear understanding of the research focus, purpose, and overall direction of the study.

### **1.1 Background**

Water is not simply a natural resource but it is the cornerstone through which the civilizations have climbed and fallen. Human societies have since times been constructed around rivers, lakes and other water bodies and understand the central role of water in agriculture, trade and the everyday existence (Rad, 2024). The great civilizations of Mesopotamia, Egypt, the Indus Valley, and China thrived by the great rivers, the Tigris and Euphrates rivers, the Nile, the Indus and the Yellow rivers (Wheeler, 2024). Irrigate, transport and grow using water as a tool. However, history also teaches us that the failure of water management and water depletion have also led

to the decline of once flourishing societies. It is believed that the changing patterns of the monsoon and the drying up of the major water sources were the reasons that led to the collapse of the Indus valley Civilization. Similarly, long durations of drought and un-sustainable utilization of water has also been cited as the cause of decline of the Mayan culture (Vienna University, 2016). These history lessons expose one of the best ever facts, which is that the life span and other survivability of human settlements depend on access to water.

In the modern world when people are becoming more and more globalized and urbanized, the issue of water scarcity is becoming one of the most pressing developmental problems (UNESCO, 2023). Cities of today, like before its predecessors, depend on a constant water supply to sustain their economies, health, and the infrastructure of its citizens. Nevertheless, the growth of water use in urban areas, as well as the destruction of the environment and climate change, threatens to push many regions into the state of critical water stress. The failure in governance, unequal resource allocation including non-sustainable management practices also contribute to this crisis in developing countries like Pakistan (Hossain, 2024).

Water security issue is increasingly facing the threat not just of the physical scarcity but also socio-political factors such as poor policies, ineffective infrastructure and urban sprawl (Zeshan, 2025). Despite the importance of Integrated Water Resource Management (IWRM) as a path to sustainability, as emphasized in the world frameworks, there remains the issue of implementation particularly in the urban centers where there is imbalanced allocation of waters. The water crisis in Pakistan is of particular concern due to the outdated water infrastructure, weak institutional control and disruption by climatic factors. Urbanization has been high in cities like Rawalpindi and it has led to the tremendous strain on the available water resources that has further complicated the issue of water accessibility, affordability and quality (Ahmad, 2014).

The climate change has transformed water scarcity not only to a socio-economic crisis but also a problem of the environment. In addition to reducing water supply through unpredictable weather patterns, prolonged droughts and rising temperatures, changing patterns and access to water are modifying the behavior of consumption (Webber & Brutus, 2025). The trend of unequal access to water in cities can be seen in Rawalpindi, where the rising reliance on groundwater extraction, the markets of underground water and the unsuccessful consumption habits are witnessed (Khattar, 2025). The development literature is concerned with the reality that water scarcity is so highly inter-dependent with government failures, economic imbalance and infrastructural constraints that it determines who gets access, at what price, and how (N. Ahmad, 2014).

The information about the way citizens cope with the water scarcity in Rawalpindi is crucial to getting the idea on the problem of urban resilience and the policies that do not lead to resolving the problem. Although there are certain communities that turn to informal substitutes such as private water tanker and borewells, there are communities that are getting away with ineffective municipal supply (Ahmad, 2024). The paper provides the dynamics of the role being played by the climate change in informing the water consumption practices in Rawalpindi and how the socio-economic variables determine the adaptive response. It will also influence the policies of creating equity to acquire water, to distribute resources effectively, and to possess climate-resilient metropolises by diving in the perspective of development.

The research has made its contribution to the literature that considers the problem of sustainable urban development through highlighting the intersections among climate vulnerability, water governance, and socio-economic adaptation. Lived experiences on water insecurity in Rawalpindi were unveiled using a qualitative method to provide policy implications that can be strategic to manage water to be more inclusive and effective.

The study represents one element and segment of the attainment of the United Nations Sustainable development Goal 6: Clean Water and Sanitation (United Nations, 2024), that acts to provide access and affordable access to water by all citizens. In the sense that it considers the contribution of climate change in the water consumption habits in the region of Dhoke Mustaqeem, Rawalpindi, the research met the important SDG 6 goal, making water usage more efficient and sustainability of the water management at the community level. It is also useful in the preservation of the local water resources, isolation of unsustainable trend of usage, and emphasis of necessity of adaptive and conservation-based strategies. The practice of the research as development-based has some lessons that can be applied in developing more inclusive and stronger water governance strategies.

**Figure No. 1.1: SDG Goals**



*Source:* (United Nations, 2025)

## **1.2 Problem Statement**

A looming problem of water scarcity in Rawalpindi is being experienced owing to the processes of climate change, urbanization and poor management of water. Increased temperature, change in rainfalls and demand has put the water resources of the city under tremendous pressure. Nevertheless, most individuals in the city are still using water just like they used to consume it without taking any action to cut down their consumption. This forms a significant issue since as the supply of water is declining, the demand remains high. The problem is that there is a disclosure between the deteriorating conditions of the environment and the way people are adapting to them that is aggravating the water crisis even more. With such a trend, it is possible even that

the city might experience even more water shortages in the coming days, increased costs, inequality, health risks, and strain on already fragile infrastructure.

### **1.3 Research Objectives**

1. To examine how aware are households of climate change and the various ways they can use the information to make daily decisions on whether to use water or not in and around Dhoke Mustaqeem.
2. To analyze how residents perceive and respond to water scarcity, their conservation habits and how these understandings can be used to create policies to manage water sustainably.

### **1.4 Research Questions**

1. How climate change is impacting the supply and use of water in Rawalpindi?
2. How do residents prioritize water conservation, and how do their consumption behaviors and patterns reflect this?

### **1.5 Organisation of the Study**

This thesis is divided into five chapters to give logical development of the research problem background to the conclusions and recommendations.

#### **Chapter One: Introduction**

This chapter introduces the background of the study, problem statement, research objectives as well as research questions. It also mentions the importance, extent and constraints of the study which forms the background of the research.

#### **Chapter Two: Literature Review & Theoretical Framework**

The second chapter is a review of the available literature regarding global water distribution, the connection between climate change and water scarcity, the water crisis in Pakistan, and the problem of Rawalpindi in particular. It also explains the theoretical approaches that will be used to conduct this study especially the Environmental Possibilism and Socio-Ecological Systems (SES) Framework.

### **Chapter Three: Study Area & Research Methodology**

The chapter outlines the research design and research methods in the study. It addresses the study area, the sampling procedures and the data collection instruments, such as interviews with key informants, participant observation, in depth interviews, field notes and audio-visual records. The data analysis procedures and ethical considerations that were observed during the research are also discussed in the chapter.

### **Chapter Four: Findings and Analysis**

The fourth chapter describes the findings of the fieldwork that are arranged according to the new themes. It examines the impacts of climate change on the pattern of water consumption in Rawalpindi, the adaptation mechanisms used by the households and the role of governance and institutions. These results are then addressed in the context of the literature and theoretical frameworks examined.

### **Chapter 5: Conclusion and Recommendations**

The last chapter is a conclusion and summary of the main findings and conclusions and policy recommendation on how the water scarcity in the urban centres such as Rawalpindi can be resolved. It also provides recommendations on future studies on climate change and water management.

By doing so, the study is structured to progress systematically in the identification of the research problem to reviewing the relevant literature and methods, to the analysis of the results and giving the recommendations.

## **Chapter No. 02**

### **Literature Review & Theoretical Framework**

This chapter presents an in-depth review of existing literature related to global and local water challenges, the impacts of climate change on water availability, and the growing water crisis in Pakistan, with a specific focus on the city of Rawalpindi. It also starts by looking at the distribution of water resources across the globe to point to the abundant scarcity of available freshwater and then it goes on to discuss how climate change has increased the scarcity of freshwater by altering the weather patterns, melting the glaciers and poor quality of water. The chapter then directs its attention to the Pakistan regarding the fact that the country has become more vulnerable to water stress, inefficient management, and water shortages in urban areas, especially in Rawalpindi where the population growth rate has increased and the infrastructure is poor, aggravating the situation. Based on this background information, the second half of the chapter reports the theoretical background of the research, with references to Environmental Possibilism and Socio-Ecological Systems (SES) Framework explaining the way people and communities respond to environmental challenges. Collectively, these discussions offer a general background of understanding and conceptual basis of examining the effects of climate change in shaping water consumption behavior and practices in Rawalpindi in water management.

#### **2.1 Literature Review**

The water scarcity and climate change literature demonstrate a complicated worldwide issue that influences the natural ecosystems as well as human societies. Scholars worldwide have looked at how unequal distribution of water, the accelerated population growth, and the development of industries as well as fluctuating climatic conditions have put pressure on the freshwater resources. Some of the outcomes of this review include the incorporation of global, national and local views to appreciate the various ways in which these challenges take place at various levels. It introduces a global

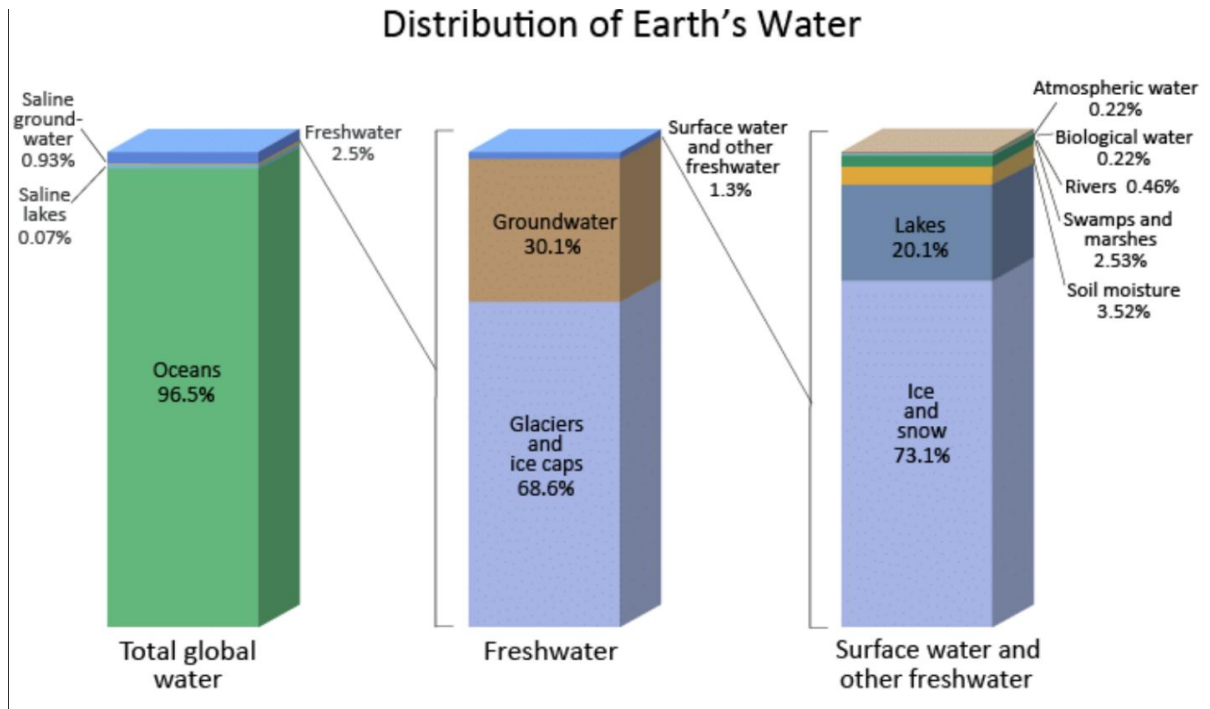
overview of how water is distributed and used with a focus on the increasing discrepancy of supply and demand. The discussion is then brought down to the contribution of climate change to water scarcity and degradation before the increasing water crisis in Pakistan and the situation in Rawalpindi. This review provides the empirical and conceptual base of analysis of the interaction between climate change and human activities to influence the patterns of water use and management in the study area.

### **2.1.1 Global Water Distribution**

Despite the fact that water occupies about 71-percent of the earth surface, little more than 96.5-percent of this water is saline water, present in oceans and seas (Gleick, 1993). Freshwater, necessary to drink, farm, and sanitize, constitutes no more than 2.5 percent of total water supply. But this fresher water is not readily available, because almost 69 percent is held in glaciers and ice caps, and an additional 30 percent is groundwater and it has to be extracted (UNESCO, 2021). This leaves just 1 percent of total freshwater in surface water including rivers, lakes, and reservoirs, which are the major sources of human consumption (UNESCO, 2023).

The diagram below illustrates the distribution of water on Earth and points to the small share of it that is usable. Water may cover the earth but only 2.5 percent is freshwater. Of that, approximately 68.6 is locked up in glaciers and ice caps, and 30.1 is groundwater, not always readily available. That leaves only 1.3 per cent as surface water and other easily available sources. Of that little, a good part of it remains trapped in ice and snow. Only a small fraction is comprised of lakes and rivers that we depend most upon. This demonstrates just how scarce is the water we do have and why we need to take special care with it.

**Figure No. 2.1: Distribution of Earth's Water**



*Source: United States Geological Survey (USGS, 2019)*

With the world population rising at quite a high rate there has been an ever-increasing demand on fresh water. As the population in need of water to drink, to wash, to feed, to perform industrial activities grows, the strain on available water resources has led to increased pressure. Today, agriculture is the biggest freshwater consumer consuming about 70 percent of all freshwater withdrawals worldwide (UNESCO, 2024). This water is needed to irrigate and raise livestock as well as crops needed to feed billions of users.

Besides agriculture, industrial processes use a lot of water as well and they consume about one-fifth of the entire fresh water resources (Worldometer). Manufacturing, energy production, and mining industries use lots of water to cool and process raw material and produce power. With the spread of industrialization, especially in third

world countries the need to have more water in this sector is projected to increase further.

The last 10 percent of the world fresh water consumption is household consumption that is composed of various basic tasks such as drinking, bathing, cooking, cleaning, and sanitation (UNESCO, 2024). Although this is a small percentage in comparison to agriculture and industry, the right to clean and safe drinking water is a basic human right and a sustainable availability of clean drinking water to households is a global agenda. As climatic change, pollution, and over-extraction threaten to reduce the amount of water available, there is a pressing need to adopt improved water management practices to help ensure that the next generation will have access to this essential resource (World Bank, 2022). But, climate change and human activities are putting an increasing strain on the availability of this limited freshwater.

### **2.1.2 Water on the Brink: Climate Change and Scarcity**

The effects of climate change on the world water cycle are monumental and widespread, affecting centuries-old natural patterns (Atawneh et al., 2021). Among the greatest impacts of the warming global temperatures is the rise in the rates of global evaporation leading to faster loss of moisture in the oceans, lakes, rivers and soil. Not only does this increase evaporation and decrease surface water supply, but also impacts on groundwater recharge and makes it more difficult to ensure a steady supply of water in many areas.

In addition, climatic changes have led to different rain patterns that are unpredictable and unevenly distributed to different areas in the world (NASA). Long dry seasons and severe droughts are now being experienced by others that dry up reservoirs, rivers and farm water. Lack of irrigation also impacts the farmers in these regions as there is less production and food shortages and losses due to crop failures. In the meantime, other parts of the world receive excessive rainfall and congest the drainage channel causing landslides and looming catastrophic floods (FAO). All these extreme weather events

are not only dangerous to lives and livelihoods but also they damage essential facilities, roads, water treatment, irrigation systems etc. which further exacerbates water issues.

As such upheavals continue, uncertainty is building up on the availability and reliability of freshwater resources. The regions which were already facing water shortage are worsening and regions which get too much rainfall are facing more issues, such as pollution of drinking water sources and population settlement. The rising imbalance in the water distribution demonstrates a significant shortage of practical water management plans, climate adaptation and sustainable policies so that the current generation and the future generation could afford to get this precious resource (IPCC, 2023).

One of the worst impacts of climate change is the melting of glacier and ice caps. Since glaciers provide a natural source of water, their immediate melting under the impact of increase in temperature is a threat to the water supply of the millions of people who rely on glaciers as the origin of their rivers (Hock & Rasul, 2019). There has also been a shift in rain patterns resulting in a rise in droughts in certain areas, especially in areas that already are water stressed like parts of Africa, the Middle East, and South Asia (UNESCO, 2022).

Moreover, climate-change and human actions are seriously impacting the quality of freshwater and threatening human health and the environment (US EPA, 2022). Warmer climate and less water flow, combine pollutants like heavy metals, industrial chemicals, and pesticides, making water hazardous to drink and to use in agriculture. Higher temperatures also encourage the expansion of poisonous bacteria, viruses and harmful algae, which can pollute water sources and put marine life at risk (US EPA, 2013). Standing water is a breeding area of mosquitoes and other insect vectors that carry disease risks. Other effects of poor water quality have also included the spread of water-borne diseases like cholera, dysentery, typhoid in the face of dwindling water quality, especially in communities that are most vulnerable as they lack access to clean drinking water and sanitation. To fix these problems, greater attention should be given

now to the problem of water treatment plants, the pollution prevention approach and the sustainable use of water and freshwater as the source (WHO, 2023).

### **2.1.3 The Growing Water Crisis in Pakistan**

It has been ranked as one of the most susceptible nations to climatic change as far as water security is concerned. The population of the country is large with an agricultural dependence hence posing a great problem in management of water resources (Abubakar, 2019). The climate change has intensified these problems by altering the rainfall patterns, having more drought and floods and melting glaciers in the Himalayas which serves as the largest water source in Pakistan. According to United Nations Development Programme (UNDP), the per capita water supply within the country has reduced significantly rendering the country one of the most water stricken nations in the globe (UNDP, 2020). Its water management has led to poor management, effective irrigation and over extraction of ground water which has contributed to the crisis. This is because access to clean drinking water is a problem in most of the rural regions that has led to health complications and economic setbacks to the farming communities. To address these issues, urgent intervention must be taken which involves enactment of superior water conservation strategies, investment in new irrigation techniques and improvement of water storage systems and facilities to secure the future water in Pakistan (UNDP, 2017).

Indus River System of Pakistan Himalayan glacial meltwater is among the significant sources of water. However, the melting glaciers lead to an increase in the tempo of water flow and the increase in water flow is short term. Even though this might be a short term relief, serious concerns are raised on whether water will ever be sustainable in the long term (Afzal et al., 2025). As the glaciers are shrinking, it is also possible that water supply in the country will reduce in future and a threat to the agricultural sector, drinking water supply and hydropower generation. In addition to this, accelerated glacier melting increases the probability of glacial lake outburst floods (GLOFs), which may cause disastrous downstream effects on societies and

infrastructure. As Pakistan increasingly relies on the Indus River System to irrigate its lands and ensure day to day water supplies, it is imperative that there be an adoption of water management strategies such as proper storage, making improvements in irrigation methods, and adapting to climate changes in case of water scarcity in future (Adeel, 2021). Meanwhile, changing monsoon cycles have made rain unpredictable, both in terms of productivity and in water storage.

These changes are especially relevant to urban areas such as Rawalpindi, where there is a tremendous strain on already scarce resources due to population growth and increasing demand on water resources. There is a serious water shortage in the city and many people are being compelled to depend on groundwater mining which is depleting the aquifers at unsustainable rate (Margalla Tribune, 2025). Excessive groundwater abstraction reduces water levels as well as predisposes soil to land subsidence and water pollution, rendering the remaining water unfit to drink (Alao et al., 2024). Also, the old infrastructure, water pipes that leak and inefficient water distribution systems cause considerable losses which worsen the crisis even more. Due to poor water management as well as the impacts of climate change, clean and adequate water has become a challenge to the people of Rawalpindi especially those living in low-income areas. To tackle those obstacles, there is an immediate need to invest in water conservation, updated infrastructure, and sustainable management practices to provide a reliable water supply to the ever growing population of the city (Maqbool, 2022).

#### **2.1.4 Rawalpindi's Water Dilemma: Usage and Challenges**

The city of Rawalpindi is a densely populated place with peculiar water problems because of such factors as a quick urbanization and climate change. Water supply is delivered to the city via various means, such as groundwater and surface water supplied by the Rawal Dam and municipal water supplied by the local authorities such as Water and Sanitation Agency (WASA Rawalpindi). Nonetheless, with the ever increasing population and growing industrial activity, water demand has reached very high levels and therefore shortages are more common. This is exacerbated in summer when

temperatures are extremely hot resulting in increased water usage which puts extra strain on already scarce resources. Pakistan Bureau of Statistics released information that water shortages in Rawalpindi have turned into a regular occurrence in both the home and businesses. Irregular supply of water is a common phenomenon among many inhabitants, making them turn to other sources like water tankers, which further increases the price and overburdens low-income neighborhoods (Shirazi, 2024). The water crisis in the city will keep on increasing without any immediate response, which will pose a risk of economic stability and illness among the population.

The water use in households in Rawalpindi is influenced by a number of factors such as socioeconomic status, availability of water infrastructure, and season. In some cities, especially the less developed ones, private borewells are still a source of water supply to many homesteads because of unreliable municipal water (N. Ahmad, 2014). However, over reliance on borewells is fast exhausting ground water stocks, causing water tables to subside and increasing chances of contamination. Along with domestic consumption, industrial and commercial life also causes excessive water consumption, with no proper regulatory supervision in many cases (Cooper, 2018). There are numerous factories and companies that exploit groundwater without appropriate permits and conservation actions, that only contributes to depletion. Poor management practices coupled with ineffective utilisation of water result in unnecessary wastage and to curb this problem, there is a need to increase stricter policies on the use of industrial water. These problems need a complex solution encompassing the improvement of infrastructure, more effective control over the extraction of water, and education to encourage people, both citizens and companies, to conserve nature.

Climate change effects are increasingly taking effect in the water crisis in Rawalpindi. The patterns of unpredictable rainfall over the years have led to less water in the reservoir and long periods of heatwaves have boosted demand greatly (Webber & Brutus, 2025). The increase in temperature translates to an increase in the rate of evaporation and result in additional decrease in the available water supplies. In addition, extreme weather conditions like droughts and flash floods interfere with the

water infrastructure in the city, and access to clean water becomes even more difficult. Due to the heavy rainfall in certain regions, drinking water sources get contaminated thereby raising the risk of water borne illness (Aziz, 2005). All these environmental changes show that there is a dire need of adaptive measures like better rainwater harvesting mechanisms, better water storage, and climate resistant infrastructure. It is important to comprehend the effects of climate change on water consumption patterns in Rawalpindi to come up with sustainable solutions that will help alleviate the water shortages in the future.

Besides the local environmental and infrastructural issues, geopolitical conflicts are also beginning to affect the water security in Rawalpindi and in Pakistan. At the beginning of 2025, India again threatened to cut off the water supply to Pakistan under the Indus Waters Treaty, as the political enmity escalated (Al Jazeera, 2025). Despite the treaty being signed in 1960 and mediated by the World Bank, recent events have questioned its survival in the long term as it has survived various regional conflicts in the past. In the case of water-stressed urban cities such as Rawalpindi, where surface and groundwater networks rely on a combination of Indus basin flows, even a break could lead to much aggravation of the already existing shortages. Lower inflows would not only affect the municipal supply, but also would enhance pressure on overexploited groundwater. This dynamic geopolitical threat highlights the need to invest in resilient infrastructure, water sources diversification, and water diplomacy to protect water security in the future.

Water being a limited resource is getting scarcer as a result of climate change and increased demand. Although water crisis is a worldwide problem, it is worse in water stressed countries such as Pakistan (Abubakar, 2019). The cities such as Rawalpindi are struggling to ensure a sustainable supply of water as population growth, urbanization, and climate variability keeps piling up demands on the available resources (Khattar, 2025). Unless the issue of water management are solved, the effects may be devastating, such as economic imbalances, societal health emergencies, and social strife over water availability. The water future of Rawalpindi needs sustainable

water management policies such as the improved conservation methods, investment in the modern infrastructure and improved governance (Maqbool, 2022).

This paper discusses how climate change and water use patterns in Rawalpindi relate to the way the inhabitants are adjusting to the fluctuation of water supply. The qualitative method used to study these patterns provides the insights into the general implication of the water management in terms of the climate change. The policy recommendations are corrected based on the knowledge of the problems affecting the population like low to middle income households to ensure that water distribution is done in a more efficient and fair way. The paper further specifies potential initiatives that can be adopted to promote sustainable consumption of water and these include community conservation and investment in alternative water sources. This study generates useful knowledge to support the long-term realization in having a sustainable and secure future of water supply in Rawalpindi.

## **2.2 Theoretical Framework**

The problem of water scarcity is becoming more and more popular in most regions of the world and especially in urban areas where climate change is making an impact on the supply and demand of water. The pressure exerted on the water resources of cities like Rawalpindi due to increased population and the change in the environment is of interest and it is relevant to observe how the same would impact how people utilize and manage water.

The theoretical explanation that this paper is based on is the idea of Environmental Possibilism, the idea of French geographer Paul Vidal de la Blache (Vidal, 2015) in the early 20th century. It was built as a conceptual paradigm of human geography where even though the physical environment may be capable of influencing the conditions under which people live, the physical environment does not always predetermine human actions and social evolution. On the contrary, Environmental Possibilism implies that people can make their choices, be innovative, and practice other cultures to react to the environment and its challenges (Bansal, 2025).

Essentially, Environmental Possibilism is concerned with the way the environment limits the capability of humans. It takes into account technological progress, society, cultural values, and political decision-making as major mediators of the manner societies react to their geological and climatic environments (Enviroliteracy, 2024). The theory points out that as much as nature might present some possibilities or constraints, it is the human decision, action and the instatements reaction which decides the fate.

The theoretical perspective which is more applicable in the current study is to examine how people in Dhoke Mustaqeem, Rawalpindi are changing their water consumption behavior in reaction to the changes in climate. The physical environmental pressures include unpredictable rainfall, seasonal water scarcity as well as limited natural water storage but within the framework of these pressures, people are not mere spectators. Rather, they are viewed as operating actors, developing and using a set of adaptive strategies, such as hoarding water, rationing, rain-harvesting or relocating to alternate sources, such as groundwater or tanker truck services.

Environmental Possibilism is one of such responses in behavior and practicality which can be examined in terms of Environmental Possibilism. It helps the study to find the climatic stress as not a cause, but as a hurdle that can be manipulated through local knowledge, adaptive behavior and social participation. This perception gives further credence to the developmental dimension of the paper in establishing the importance of community agency, awareness and resilience in addressing the impact of climate change on water security. It is this theoretical framework that enables understanding of interaction between environmental realities and human decisions in a better way to develop sustainable urban life in Rawalpindi.

Moreover, there is also the application of the more modern and comprehensive framework Socio-Ecological Systems (SES) Framework in this study (Berrouet et al., 2018). Originally formulated by Elinor Ostrom and others in the early 2000s (Ostrom, 2009), the SES Framework emphasizes the dynamic, interrelated nature of human

systems (communities, institutions and governance) and ecological systems (water bodies and natural resources). In contrast to Environmental Possibilism, SES does not suppose that the environment directly governs human behavior but rather focuses on feedback responses of how humans influence ecosystems and the reverse.

The SES Framework has several fundamental elements: resource systems (such as a local water network), resource units (such as water availability), governance systems (such as public institutions), actors (such as individuals or communities), and the results of their interactions. Specifically, this study is interested in governance regimes and interaction between actors, and how formal organizations, such as WASA (Water And Sanitation Agency) and informal neighborhood groups are addressing water insecurity in Rawalpindi.

A key idea that arises in this context is social capital, meaning the systems of trust, reciprocity and cooperation existing in a group of people (Barnes-Mauthe et al., 2015). Social capital is very crucial in resource-deprived settings since it is normally a determinant of how the people are able to effectively mobilize towards tackling the collective problems like water. Rawalpindi might have no formal infrastructure to assist the communities to share water resource, deliver tankers, or informally ration water and powerful social networks can do this. This analysis attempts to provide answers to this question; the research seeks to find out how water stress responds on the social cohesion and mutual support as resilience measures. The research problem of the study is the effects of the variation in the degree of social capital in the different neighborhoods in the city of Rawalpindi as compared to the collective resilience standards with the view of facilitating the development of water sharing, tanker services, and informal rationing during the water stress.

## **Chapter No. 03**

### **Study Area & Research Methodology**

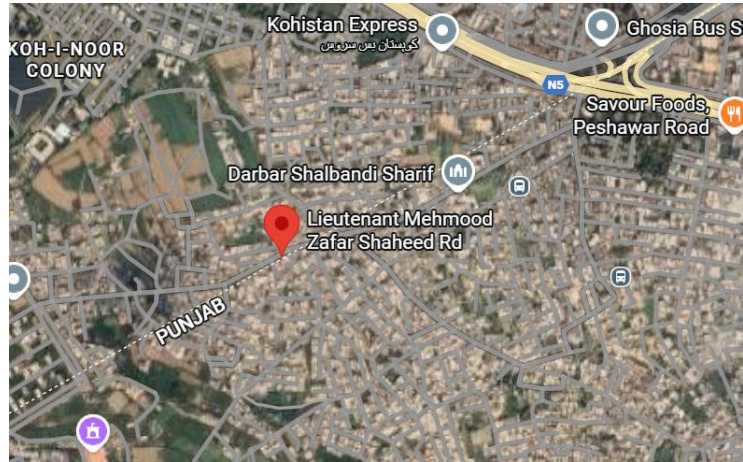
This chapter describes the geographical background and methodology applied in conducting the study. It starts by explaining the area of study, Dhoke Mustaqeem in Rawalpindi, its socio-economic diversity, urban state, and the suitability of this area to the problem of water scarcity. The chapter goes ahead to describe the research design and methods of data collection and analysis, including the sampling strategy, data collection instruments, and the methods of analysis. Different qualitative techniques are discussed including in-depth interviews, participant observation, key informant interviews and field notes to portray how rich and reliable data were collected. Other aspects of the chapter are the steps involved in the data analysis by use of thematic interpretation and the ethical concerns that are upheld during the research. Generally, this chapter offers a detailed description of the way the study was designed and executed in order to allow its credibility, validity, and applicability to the goals of the research.

#### **3.1 Study Area**

The specified study is conducted within the territories of Dhoke Mustaqeem residential area that is situated within the city of Rawalpindi, Pakistan. It is a place that was selected with the consideration that it is a combination of the socio-economic set up, with the lower, middle and slightly better-off income households all within the context of the water crunch. Dhoke Mustaqeem is the region that turns out to be topical due to the changes of climatic conditions, the rapid urbanization process, and the lack of infrastructure development that does not allow the communities within this region to adapt to the pressure imposed by the environment. The area is a micro-cosm of the bigger water problems that Rawalpindi city is grappling with. It is based on the analysis of this locality that insights can be acquired that would be tentatively projected to the

similar urban environments experiencing the effects of water crisis due to the impact of climate changes.

**Figure No. 3.1: Dhoke Mustaqem**



*Source: Google Maps*

The selected study area is located near the main Peshawar Road on the GT Road, this area has multiple well established housing societies located around it like British Homes and Westridge and it also includes a commercial area where the local people, shop for their daily essentials, therefore, it is a small eco system of its own with people from various social and economic backgrounds. This locality proves to be of essence for this study because it can provide data about all three different socio-economic backgrounds at once and this qualitative study is enriched with them.

### **3.2 Sampling and Sample Size**

The research uses the purposive sampling methodology to guide the decision of people with first hand and lived experiences of water inadequacy and adaptation measures. The sample size (22 interviewees) is sufficient and has an adequate mix of different socio-economic levels (low, middle, and high-income residents) or such key participants of the institution as the local government officials, the representatives of the WASA (Water And Sanitation Agency) and RCB (Rawalpindi Cantonment Board), and environmental specialists. This sample provides adequate data because it does not

only focus on one class of the society, rather represents every class, from the people who can afford luxury to the people who even find affording basic necessities of life hard. It is not to achieve statistical representativeness, but a rich diversity of opinions that helps bring light to the experience, perception and management of water scarcity. This type of selective process makes the findings of qualitative data deeper and more relevant. Each and every respondent was picked purposefully to keep the quality of this research top notch by targeting different household classes within a selected area by observing the kind of lifestyles they lived.

### **3.3 Data Collection**

In depth and rich information is known to be collected using various qualitative methods.

#### **3.3.1 Key Informant Interviews**

Key informants interviews were taken from people who have special knowledge and experience of water management, climate adaptation, and governance. These informants include two informants related to water agencies, one from WASA and one from RCB (Rawalpindi Cantonment Board) along with environmental researchers and local policy advisors. They were interviewed because what they have observed provides a macro-level perception of the structural and policy effects of water scarcity and the adaptive measures made in the city of Rawalpindi and their knowledge is very specific to this study. Their opinions are very important in bridging the gap between the personal experiences and greater systems of governance. Along with that, a key informant was also chosen to be able to access the households easily, so that trust could be built within the community where interviews were being taken.

### **3.3.2 Rapport Building**

Before the actual interviews were carried out, the researcher interacted with the members of the community in an informal way to build rapport and trust, the researcher did that by spending quality time at their homes and this was made easier because of the key informant. It serves as a significant step in qualitative research and in discussing such sensitive topics as resource insecurity, while doing that, the researcher was able to observe the surroundings and daily habits which also proved to be a crucial part to understand the behaviors of the people in depth. Chatter, greetings and informal visits were used to reduce anxiety among the participants and encourage the free and honest exchange in the case of formal interviews. It also allowed the researcher to be more aware of the cultural norms and styles of communication as the researcher was dealing with people coming from low-income backgrounds as well and they get anxious when being interviewed in a formal setting, therefore, it was crucial to build rapport beforehand.

### **3.3.3 Participant Observation**

Participant observation was used in order to gain a more contextual interpretation of the water-related behavior and practices. The researcher was able to spend a major time in Dhoke Mustaqeem and was able to study the water-fetching, domestic practices of water storage and even informal water sharing system like joint tanker. These observations were used to document realities about actual life that would not be realized in interviews and give an insight into the silent and mundane methods of doing things, which affected water shortage. Even the surroundings of the area and the usual chore routine of people played an important role in establishing what kind of behaviors people show in their daily lives which were observed silently.

**Figure No. 3.2: Water Fetching Practices**



*Source: Field Data*

### **3.3.4 Interview Guide**

In the effort to make sure that all the interviews cover crucial themes in respect to the purposes of the research studies, a semi-structured interview guide was developed which provided flexibility enough to enable any new topics to be brought up by the participants. These domains are central in terms of the attitude to water availability, local and domestic adaptive mechanisms, the relationships to the governmental and non-governmental interventions, as well as the further anxieties about the water scarcity. This model provides consistency in comparison of interviews, but leaves the participants at liberty to narrate their own life stories.

### **3.3.5 In-depth Interviews**

The personal experiences related to the water shortage were collected through conducting face-to-face interviews with individual residents. Long sessions of around 20 minutes time to contemplate details of real challenges related to in availability of water, coping strategies of using private water sources, and perceptions of institutional help. By doing so, the study has taken the opportunity to value the emotional, social, and practical dimensions of the sufferings related to water as experienced by the people

first hand by diving into deep discussions around the participant's daily routine around water usage and their expectation from the government while also looking at their perceptions about climate change and its affects on water availability.

### **3.3.6 Daily Diary**

The researcher maintained a journal during the week, making daily observations, experiences and thoughts on water access and use in Dhoke Mustaqeem but not only that, detailed accounts of the encounters with respondents and the impacts that it had on the researcher were also mentioned. Through the water-fetching rituals and facing the hardships of the problem under question, the researcher was hoping to get a sympathetic insight as to the lived experience of scarcity. The diary entries follow the variations in the availability of water both in the details of the days and the adjusting behavior of the residents. Through the practice of daily diary writing, the researcher was able to navigate her own feelings as well about the encounters with the respondents.

### **3.3.7 Field Notes**

Part of data collection were field notes. Interviews, informal talk, participation observations and mere walking around the locality were observed in detail. Such notes are descriptive notes (what went on), analytical (why it may have gone on) and personal thoughts. Field notes also capture non-verbal messages, tonal attributes and the physical environment that would otherwise have been missed in audio recording and thus provide more depth to additional data analysis.

### **3.3.8 Audio-Visual Methods**

The respondents were requested to give their permission in capturing short audio records of most significant features of such water management practices like pictures of water tanks, collective tankers services, or storage containers with drought effects. These visual and audio materials recognize the informational information in the text and are supportable evidence of environmental and social conditions under the study.

They can as well be used to visualize the infrastructure and coping mechanisms that the occupants apply to the water shortage.

**Figure no. 3.3: Storage Containers of Low Income Households**



**Source: Field Data**

### **3.4 Data Analysis Techniques and Tools**

Data is collected and analyzed by using thematic analysis. The hand-transcribed and coded field notes and interviews are coded. Themes and sub-themes are formed of groups of codes, which reflect the primary areas of enquiry such as climate effects, household water management, community adjustment and governance reaction. A critical description is given to the trend, inconsistencies and anomalies. In the process of an iterative coding, the study goes on to interpretative analysis, which compiles a deeper understanding of the social processes supporting the water scarcity adaptation.

### **3.5 Research Ethics**

Ethical research principles were adhered to in this study. Informed consent was also taken and informed prior to the study both verbally and in writing and the participants were fully aware of the study purpose and their participation as well as their rights. Anonymity was assured to the study subjects and their names and information that could identify them was not disclosed, who did not want it disclosed. This study is based on voluntary involvement whereby the participants can give up at any time

without being punished. In addition, specific attention was paid to working with personal accounts of struggle or frailty. No audio-visual materials were collected without express and prior permission and it was openly agreed as to the use with the participants.

## **Chapter No. 04**

### **Findings & Analysis**

This chapter presents and analyzes the key findings of the research conducted on water scarcity, climate change, and urban water management in Rawalpindi, with a particular emphasis on the community of Dhoke Mustaqeem. The research is based on the findings of twenty-two semi-structured interviews conducted with four different categories of respondents, namely household residents, representatives of Water and Sanitation Agency (WASA), the representatives of the local government, and environmental experts. These divergent views are expected to unite the chapter in a comprehensive way of understanding the perceptions, experiences, and responses of the challenge of water at both the individual and the institutional level.

The analysis is framed based on the main questions of the research and informed with the theoretical perspectives of Environmental Possibilism and the Socio-Ecological Systems (SES) approach. With these theories, there is a conceptual framework in the study of the dynamic interdependence between human behavior, the government and environmental constraints which focus on the adjustment mechanism employed by communities in reaction to the evolving climatic and water conditions.

Based on both empirical and theoretical evidence, the chapter, in addition to establishing the amount and reason of water scarcity in Dhoke Mustaqeem, deals with the response mechanisms, governance problem, and institutional response to the management of the urban water management at Rawalpindi. Verbatim quotes of the participants who participated in the interview are also employed throughout the discussion in order to be able to receive genuine local narratives and as a method pre-empting the lived experiences of the people who are directly affected to the issue of water scarcity. This qualitative data contributes to the analysis, giving finer data concerning the social, environmental, and political aspects of water management in an urban setting where it is more vulnerable to the climatic vulnerability area.

**Table No. 4.1: Table of Verbatims**

<b>Sr. No.</b>	<b>Theme</b>	<b>Verbatim</b>	<b>Respondent</b>
1	Fragmented and Unequal Water Supply Systems	<i>“This was financially manageable at the time. However, overtime the supply dwindled further. Water which used to arrive every other day began to arrive after three or four days and then a week and now not at all. The time also got shorter, it was coming in an hour, an hour later half an hour, now it is coming in only a few minutes. Such a low supply was no longer sufficient to survive.”</i>	Mrs. Zubair
2	Fragmented and Unequal Water Supply Systems	<i>“We only get water for one hour every other day. If we miss that hour, we have to buy a tanker.”</i>	Naila
3	Fragmented and Unequal Water Supply Systems	<i>“There is no proper supply line in our street. We rely entirely on tankers.”</i>	Zubair Aslam
4	Declining Groundwater and Changing Rainfall Patterns	<i>“Ten years ago, water could be found at 150 feet. Now we dig beyond 300.”</i>	WASA Official
5	Declining Groundwater and Changing Rainfall Patterns	<i>“There has been a huge difference in rainfall patterns, winters are drier, and summers come early.”</i>	Environmental Expert
6	Declining Groundwater and Changing Rainfall Patterns	<i>“Earlier, there used to be plenty of water, but now the quantity has reduced due to changes in weather and rising temperatures. These days, even with the borewell, we sometimes have to rely on water tanker services.”</i>	Farwa Ijaz

7	Economic Burden and Social Inequality	<i>“Each tanker costs around 2,000 to 3,000 rupees. We can’t afford it every week.”</i>	Shazia Aurangzeb
8	Economic Burden and Social Inequality	<i>“We divide the tanker with our neighbors, but even then it’s expensive.”</i>	Naila
9	Economic Burden and Social Inequality	<i>“There is no structured support for poorer communities to manage water shortages. They rely on informal sharing.”</i>	Malik Mehboob Ilahi
10	Awareness and Perception of Climate Change	<i>“Temperature is on the increase, the summers are becoming longer, the winters shorter and the rainfall is becoming erratic. Our water sources are getting smaller and our population is growing. When this goes on it will be 10 years down the road and a tanker that is currently costing Rs. 2,000 would cost 10,000. People can be more concerned with water rather than food. Hopefully I am wrong, but that is what it appears to me.”</i>	Kashif Khalid
11	Awareness and Perception of Climate Change	<i>“The weather has been transformed significantly, the level of ground water has decreased, and the rainfall has become unpredictable. Although population growth has an impact on water availability, climate change has aggravated it. Our dams and our store systems are not taken care of, and the natural water process appeared to be broken.”</i>	Aqsa
12	Awareness and Perception of Climate Change	<i>“No, never. There has been no communication, awareness campaign, or guidance from them in our area.”</i>	Zubair Aslam
13	Household Adaptation and Gendered Responsibilities	<i>“I think that women are more conscious about water than men. Men usually they do not even see the details, they simply do not care and only take showers or do ablution but</i>	Mrs. Zubair

		<i>women control the household, so we know how much water is required in washing, cleaning, and cooking. When there's a shortage, we reduce cleaning, we don't wash, we don't do laundry every day. We only use as much water to make it last longer."</i>	
14	Household Adaptation and Gendered Responsibilities	<i>"Yes, definitely. It's exhausting and unfair. We don't even have clean drinking water easily available. I feel that in the coming years, this stress will increase because the situation seems to be worsening. May Allah have mercy on us."</i>	Farhana
15	Household Adaptation and Gendered Responsibilities	<i>"As for women, we do want to go and complain ourselves, but the men in our families don't allow us."</i>	Mrs. Zubair
16	Water Quality and Health Impacts	<i>"The drinking water was supplied by the government supply which was there one to one and half hours per day. We stored drinking water of that. However, we started experiencing health complications with time, stomach, and occasional smelling water, which was most likely the result of chlorine."</i>	Minahil
17	Water Quality and Health Impacts	<i>"The water smells like sewage sometimes, so I can't imagine using it for my children or myself."</i>	Farhana
18	Water Quality and Health Impacts	<i>"I would suggest implementing a comprehensive water conservation and leakage reduction program. This means repairing and replacing old infrastructure, promoting water-efficient practices, and using smart metering technology to reduce losses and improve overall efficiency."</i>	Environmental Expert

19	Institutional Weakness and Corruption	<i>“The officer who was in charge of opening the valves started taking bribes. Houses that were giving money got more water. We did not know it at first, but when we learned and made a complaint, the Cantonment team arrived and put us on the wrong. Nothing changed after that. We therefore ceased to rely on it and began to use tankers.”</i>	Farhana
20	Institutional Weakness and Corruption	<i>“When you consider it, we are spending approximately around Rs. 6,000 per month in tankers- that is a lot of money spending in the basic essential such as water. If the water supplier of the government is not financially well off, we can pay him 1000 rupees every month, he must make sure of supplying us water.”</i>	Mrs. Zubair
21	Institutional Weakness and Corruption	<i>“The problem of illegal water connections is not new in the Cantonment only but in Rawalpindi as well. This is not often witnessed in the other parts as they have a higher water table and water is more abundant. However, in this case, with such a severe shortage 37 MGD, as I had indicated, people feel compelled to have illegal connections, out of desperation. Our population is continuously growing, yet we still get the same amount of water brought by Khanpur as in 2002. Human beings attempt to satisfy their needs through stealing water and they would steal it mostly during night or during holidays. We also have Water Revenue Branch which keeps records and they visit such areas regularly to inquire about such cases. In the event of finding illegal connections, it is</i>	RCB Officer

		<i>penalized and the illegal connections are severed.”</i>	
22	Community Solidarity and Collective Challenges	<i>“Some of the residents do come together as a small group to raise concerns but most people do not want to be involved. Concerning such initiatives as rainwater harvesting, we are so overcrowded, that cars can barely fit into the neighborhood, not to mention a system of water storage. It is also because people are not eager to spend money thinking that it is cheap to purchase only a tanker a month. Therefore, the level of income, attitude and absence of communal cooperation render it extremely hard to initiate such projects.”</i>	Komal Khan
23	Community Solidarity and Collective Challenges	<i>“Yes, they do — good people do help each other, but there are very few of them.”</i>	Shagufta Hameed
24	Cultural Beliefs and Water Use Practices	<i>“The more you limit yourself, the less you appear to have. By the grace of God, we have never been afraid of using water. It is a necessity- how much you may attempt to save yet you must use it. In summer, in particular, you can not be too confined.”</i>	Ghulam Zara
25	Cultural Beliefs and Water Use Practices	<i>“You can live without many things, but not without water. It’s a gift from Allah, and we must respect it.”</i>	Kashif Khalid
26	Cultural Beliefs and Water Use Practices	<i>“My thought is that we should never lose hope. The water is a gift of Allah it is not only on the ground that it comes from. Millions of people have existed before us, and Allah was able to take care of them too. Technology is evolving on a daily basis. I think we are going to manage water more with the new innovations.”</i>	Mrs. Zubair

27	Environmental Degradation and Urban Planning Gaps	<i>“Even in northern areas, trees are being cut down, which worsens the situation. Trees have the ability to store water and maintain balance in the ecosystem, so deforestation has been disastrous.”</i>	Ammara Saleem
28	Environmental Degradation and Urban Planning Gaps	<i>“Several reforms are needed. Such institutions as WAPDA and irrigation departments ought to be reorganized making them transparent and efficient. A more holistic approach that should be embraced is the Integrated Water Resource Management (IWRM). This can be assisted through Participatory Irrigation Management(PIM). The utilization of surface water, wastewater treatment, and rainwater harvesting should be improved, as well as the clear policy structure with quantifiable results. There are also requirements to have capacity building and effective monitoring and evaluation systems to monitor progress.”</i>	Safina Ali

#### **4.1 Fragmented and Unequal Water Supply Systems**

In all the household interviews, the irregularity of water supply was among the most urgent issues, which signifies the system failure in the management of urban water. A good number of respondents were saying that the water supply provided by the government came at long intervals, at times every first or third day and that too only in small quantities as one of the female respondents, Mrs. Zubair who is a member of a high income household of around 54 years of age, who has been living in Dhoke Mustaqeem along with her family of 6 for 20 years stated:

*“This was financially manageable at the time. However, overtime the supply dwindled further. Water which used to arrive every other day began to arrive after three or four days and then a week and now not at all. The time also got shorter; it was coming in an hour, an hour later half an hour,*

*now it is coming in only a few minutes. Such a low supply was no longer sufficient to survive.”*

This anomaly brings disturbances to the normal lives of the residents and makes families find alternative ways to fulfill their minimum needs such as private water tankers, borewells, and commercial filtration plants. The use of these alternatives does not only raise domestic costs, but also worsens water access inequalities.

One such female respondent, Naila who is a 25 year old female belonging to a low income family with a mother as the only earner of the house, working as a house help in other households and living in a rented house pointed out the acute time pressure that is caused by the scarcity of supply by stating:

*“We only get water for one hour every other day. If we miss that hour, we have to buy a tanker.”*

It makes this statement important to highlight the fact that the houses have to be always adaptive to the water supply at the expense of other activities like hygiene, cooking, and child care. On the same note, one of the male respondents, Zubair Aslam who was part of a middle income house hold, and who is a 45 years old and only bread winner of his house, highlighted inadequacy of infrastructures in his neighborhood, by saying:

*“There is no proper supply line in our street. We rely entirely on tankers.”*

His experience gives us an idea of how a want of a continuous municipal supply causes total reliance on expensive and frequently intermittent private service.

**Figure No. 4.1: Private Water Tanker**



*Source: Field Data*

This broken water distribution system is unequally distributed and mostly affects low-income households and tenants who cannot afford to invest in storage tanks or boreholes. Richer families can cushion themselves against the lack of supply with the help of private infrastructure, which points to the sharp socioeconomic disparity in the access to the basic commodity. Effectually, water distribution in these societies lacks uniformity, in addition to being inequitable, as the availability and accessibility depend on financial ability. Furthermore, a dependence on privately available sources causes the question of water quality whereby unregulated tankers and filtration plants might not uphold safety protocols thus exposing the households in dangerous health conditions.

The further ramification of these results refers to the systemic issues of governance. Poor infrastructure, ineffective distribution systems, lack of proper maintenance makes it a vicious circle of scarcity, which disproportionately affects the most vulnerable population groups. In addition to the direct inconvenience, unpredictable water supply facilitates structural inequalities, minimizes the chances of households to organize their daily lives and creates a financial burden that could otherwise be used in education, healthcare, or livelihood improvement. It is very important to comprehend the lives of

people living in these communities in order to come up with fair urban water policies that will provide good, safe, and affordable water to everyone.

## **4.2 Declining Groundwater and Changing Rainfall Patterns**

The precise agreement with respect to reduction in the amount of ground water and the reduction in the number of rainfalls in Dhoke Mustaqeem and the Rawalpindi region in general was found across all the respondent groups. This unity of perceptions between households, WASA authorities, local authorities, and environmental specialists points to the fact that water scarcity is not considered an isolated or seasonal issue anymore but it is a systemic and long-term environmental issue. Technical and practical evidence supports the same tendency the growing exhaustion of water resources and the growing uncertainty of precipitation patterns.

The environmental specialists as well as WASA officials confirmed these observations using technical data and personal experience of operation by noting that the borewell depths have increased almost twofold over the last 10 years. The words of one of the WASA officials:

*“Ten years ago, water could be found at 150 feet. Now we dig beyond 300”*

This is the summary of this fact. This quantitative change is not only a sign of physical stress of the aquifer system but also an increased cost and energy expense of extracting water. These are symptomatic of unsustainable use of groundwater, increased urbanization and lack of recharge due to lower rainfall and lack of planned development.

Environmentally, scholars explained these changes by the changes in the climatic patterns of the regions. According to one ecologist:

*“There has been a huge difference in rainfall patterns, winters are drier, and summers come early.”*

This observation is in line with the larger climatic data of the temporal shifting of monsoon seasons and growing temperature deviations in northern Pakistan. The fact

that the expert focuses on modifying rhythms in seasons represents the localized expression of the climate-induced hydrological variation, in which delays or reduced rainfall cause a direct decrease in natural groundwater recharge rates.

On the domestic level, the respondents were very much climate conscious, and they usually attributed water scarcity to a larger environmental change. Thus, an example of a young respondent, a 21-year-old woman, Farwa Ijaz, residing in the underprivileged part of Dhoke Mustaqeem, together with her parents and siblings, revealed that she is very concerned about the sustainability of water resources and said:

*“Earlier, there used to be plenty of water, but now the quantity has reduced due to changes in weather and rising temperatures. These days, even with the borewell, we sometimes have to rely on water tanker services.”*

Her story displays how the self-reliance of water availability is replaced by an existing reliance on outside, usually expensive, sources, which depict the social and economic effects of environmental strain.

This observed practice brings out the relationship between climate variability, infrastructural constraints, and the social vulnerability. The need to drill deeper borewells and the reduction of rainfall force the population to adapt financially, behaviorally and emotionally to a place, where water, hitherto abundant, is becoming scarce. In the context of the Socio-Ecological Systems (SES) approach, this change can be characterized as the break of the balance between the human activity and ecological capacity, which implies that the system is being placed in a stressful condition and, at the same time, the adaptive processes can be observed. Similarly, in the perspective of the Environmental Possibilism, the human agency such as the investment in borewells or tanker services that residents utilize to confront the constraints of the environment is one possible solution to the environment but not sustainable in the long term.

Overall, the findings suggest that there is overall awareness of the ecological change and also shows that different actors have unequal capacity to respond. Despite the institutional level actors knowing about the problem, the very practical effects of the

issue such as the growing cost, the growing uncertainty, and increasing exposure to the vulnerability of daily access to water become evident at the household level. Together, those stories show that the issue of water scarcity in Rawalpindi is not just the problem of physical or technical underperformance but a complex socio-environmental event that is preconditioned by the challenge of climate change, urbanization, and the issues of governance.

### **4.3 Economic Burden and Social Inequality**

The economic and social impacts of water scarcity in Dhoke Mustaqeem are far-reaching and imbalance the poor people who are the ones who can not afford it. Another layer of inequality in society has been formed by the financial cost of obtaining water by using tankers, filtration units, and personal storage systems. Although such coping strategies are essential to survival in everyday life, they are both high and repeated costs that increase the socioeconomic gap between affluent and poor citizens.

One of the female respondents, Shazia Aurangzeb who is forced to finance her financial outlays because she has to seek a family of the four children since her husband died. She has exemplified this fact by explaining:

*“Each tanker costs around 2,000 to 3,000 rupees. We can’t afford it every week.”*

Her quote emphasizes how the right to a fundamental need has been monetized and commodified to turn water into an item of the state and a commodity. To the families with lower income, tanker water is a trade-off with other basic requirements and this means that the families have to trade off between food, medical costs or even school costs just to get a good water supply.

Naila on another occasion shared:

*“We divide the tanker with our neighbors, but even then it’s expensive.”*

This comment is a pointer of the emergence of informal group organization within communities as one of the adaptive behaviors. These strategies can be considered as a

stage of social power and teamwork, yet they also demonstrate the absence of institutional support. Shared tanker schemes are used to reduce the economic burden in the short-term, but increase the influence that water insecurity has on increasing social dependency and shifting the burden of managing it onto the community instead of the state.

The governmental representatives and local authorities were very transparent when recognizing the unequal nature of the water shortage as they were not afraid to admit that it is impacting the households with low income. Lack of certain subsidies, policy interventions or relief mechanisms developed, enhances the existing vulnerabilities. As the neighborhood chief Malik Mehboob Ilahi observed:

*“There is no structured support for poorer communities to manage water shortages. They rely on informal sharing.”*

In his quote, there is a sense of institutional impotence and policy abandonment that can be said to typify the larger governance challenges in urban water management.

The findings could be interpreted in the light of the Socio-Ecological Systems (SES) approach, according to which, economic vulnerability is combined with ecological stress, which results in a chain of inequality and environmental harm. The families that are better off can invest in technological solutions such as borewells, filtrations and rooftop storage, which continue to drain resources of ground water and the poor families still depend on unreliable or informal sources. This creates a sort of two-level water access: in it, the economic ability is the only determinant of not only the comfort, but also the right to the water security.

In the context of the Environmental Possibilism, it is evident that the adaptive mechanisms that have taken place such as shared tanker and neighbourhood coordination are how human ingenuity and group action have been able to respond to environmental constraints. These adaptations are however, reactive, as opposed to transformative, that is, they are symptomatic and not structural. These community-based responses can become unsustainable unless there are policy reform,

infrastructural investment and social protection measures, as the depletion of ground water and climatic changes become more severe.

The economic aspect of water scarcity in Dhoke Mustaqeem explains the fact that climate stress increases the existing levels of social inequality and transforms the environmental issues into the economic and ethical ones. The fight to secure water does not only make life more and more unaffordable but also diminishes the sense of equality and belief in the existence of institutions, demonstrating that the only way out is to have water governance that is inclusive and considers the environmental and socioeconomic reality.

#### **4.4 Awareness and Perception of Climate Change**

Most of the household respondents were found to have a clear understanding of the changing patterns in temperature and rainfall variability, although their perception of climate change was largely based on the experience they lived with the phenomenon and not on scientific information. This differentiation shows that there is a significant error between subjective experience and abstract understanding. The people experience climate change in the form of more long summer days, rain variability, falling ground water socially but find it difficult to access technical and institutional explanations and guidance that would enable them turn their awareness into positive adaptation behaviors.

As Kashif Khalid, the father of two children, who lives with his mother and wife in a decent area of a rented house in Dhoke Mustaaqem, explains:

*“Temperature is on the increase, the summers are becoming longer, the winters shorter and the rainfall is becoming erratic. Our water sources are getting smaller and our population is growing. When this goes on it will be 10 years down the road and a tanker that is currently costing Rs. 2,000 would cost 10,000. People can be more concerned with water rather than food. Hopefully I am wrong, but that is what it appears to me.”*

His commentary depicts a regional yet insightful knowledge of the interconnections between climate variability, demographic pressure and financial susceptibility. Although his view does not contain technical terminology, it reflects the most important dynamics of climate stress: growing demand and declining resources. The fact that his forecast on increasing water price highlights a mounting level of anxiety and foresight, is indicative that average citizens are not only cognizant of the problem of environmental degradation, but also forecasting its possible future socioeconomic consequences.

Likewise, another respondent, Aqsa, belonging to a well-off family Dhoke Mustaqeem 30 years old and an educated woman who spent all her life in Dhoke Mustaqeem said:

*“The weather has been transformed significantly, the level of ground water has decreased, and the rainfall has become unpredictable. Although population growth has an impact on water availability, climate change has aggravated it. Our dams and our store systems are not taken care of, and the natural water process appeared to be broken.”*

In her statement, she refers to the realization that goes beyond domestic level of difficulty to institutional and infrastructural levels. The remarks made by Aqsa support the idea that individuals are already aware that climate change does not work individually but is combined with human governance failures, maintenance failures, and inadequate urban planning. This is a good example of the highly sophisticated level of interdependence at the systemic level; a primary concept in the Socio-Ecological Systems (SES) approach; the interplay of ecological processes and human systems in creating vulnerability and resilience.

These understated perceptions notwithstanding, critics and experts have indicated that knowledge alone rarely results in any sustainable behavioral change. People do not have much ability to alter their consumption patterns or install conservation efforts even when environmental education, community involvement programs, or state incentives are not in place. This observation has been corroborated by the fact that with regards to the Environmental Possibilism theory, human adaptation is constrained not by

ignorance but by social, institutional, and technological factors. Although individuals have the desire to change, the ability to take meaningful action requires the supportive systems and knowledge systems, which are frequently lacking in urban settings of low and middle income.

Also, the stories of both Kashif and Aqsa are indicative of emerging climate awareness based on ambiguity and fear of the future. These expressions indicate a change of passive acceptance to critical thinking whereby citizens are starting to understand the long-term consequences of climate instability on water security and economic affordability and the overall quality of life. Nevertheless, the lack of organized schooling and mass mobilization makes this knowledge highly individualized and divided so that it cannot be translated into organized action on the community or policy levels.

The comparison of the expert analysis and the opinion of the population also demonstrates the communication gap in the understanding and treatment of climate change at the local level. Whereas professionals use technical information and models, the communities sense climate change based on the senses and memory, the summers are becoming hot, the rains arrive late, and the wells are becoming drier. Such experiential knowledge, being non-scientific, is of great importance because it is able to capture the human aspect of environmental change, which is focused on the emotional and social reality that cannot be quantified by quantitative data alone.

Overall, the results indicate that the people in Dhoke Mustaqeem have an implicit yet unfinished level of knowledge about climate change, knowing its direct impacts but lacking the institutional, educational, and material means to act in response to it as one of the respondents named Zubair Aslam stated:

*“No, never. There has been no communication, awareness campaign, or guidance from them in our area.”*

This disconnect between knowledge and action underscores the dire necessity of inclusive environmental communications, community based education and

participatory water governance whereby local knowledge and scientific knowledge can be used to complement one another to create a long-term resilience to the water scarcity that is caused by climate change.

#### **4.5 Household Adaptation and Gendered Responsibilities**

Women came out as key players in the household water management, as their role in the water management is vital in the rationing of supplies, collecting and making sure that the scarce resources are shared among the family members. They are not only involved in this, but also highly institutionalized into the gendered division of domestic labor, in which they are the ones bearing the brunt of dealing with scarcity. This is because the interviews revealed that the daily practices of women are organized based on the availability of water; thus, showing that environmental stress is directly applied to the organization of daily living within the household.

As Mrs. Zubair explained:

*“I think that women are more conscious about water than men. Men usually they do not even see the details, they simply do not care and only take showers or do ablution but women control the household, so we know how much water is required in washing, cleaning, and cooking. When there’s a shortage, we reduce cleaning, we don’t wash, we don’t do laundry every day. We only use as much water to make it last longer.”*

Her narrative is not only a gendered sense of responsibility, but also invisible work of adaptation that women carry out due to water scarcity. Such control is characterized by continual surveillance, adaptation, and emotional work, as women have to make tough choices concerning the necessity to prioritize the needs of a domestic environment and preserve the hygiene and pride in the circumstances of limitation.

The other respondent such as Farhana at the age of about 50, who had come up from a middle income family, and also was given the responsibility of doing all the water related chores in her home, and at times even in the outside world reflected on the emotional and psychological aspect of this burden, according to her:

*“Yes, definitely. It’s exhausting and unfair. We don’t even have clean drinking water easily available. I feel that in the coming years, this stress will increase because the situation seems to be worsening. May Allah have mercy on us.”*

Her words give the emotional toll and helplessness that women undergo as they bear not only the physical burden of dealing with limited water but also they bear with them the worry of environmental degradation. This feeling of fatigue explains the connection of environmental strain with gender inequality where women are the frontline managers and the primary victims of water shortage.

Gendered character of water management in water management in Dhoke Mustaqeem portrays bigger dimensions as seen in the South Asian urban situations where women are usually the water managers but not the decision makers, and they are not included in resource planning, as observed in another interview, in the words of Mrs. Zubair:

*“As for women, we do want to go and complain ourselves, but the men in our families don’t allow us.”*

Although they are experts and have first-hand experience on the household consumption habits, they are not often involved in communal/community or even institutional debate concerning the water governance. This exclusion makes the gender hierarchies in systems more systemic and the people who are the most affected by scarcity also have least say on how scarcity is attended to.

This dynamism has in the Socio-Ecological Systems (SES) framework indicated the influence of gender roles in adaptive capacity. Such women micro-level water management can be viewed as a version of local resilience, which enables households to operate within scarcity. It however, also points at the unbalanced allocation of adaptive loads with one gender receiving an unbalanced amount of environmental adaptation and not being awarded or supported structurally. In the same manner, using the prism of Environmental Possibilism, the human agency and flexibility can be seen in the creative reactions of women who reuse greywater, change the time of cleaning, or arrange the sharing of possessions. However such coping strategies are still confined

by the larger institutional and cultural constraints and are therefore reactive rather than transformative adaptive strategies.

The results also give the emphasis on emotional ecology of water scarcity in which stress, fatigue, and frustration join the experience of environmental change of women. This emotional aspect is not a subject of discussion in often limited policy-making that gives attention to infrastructure or supply only but is an important aspect of social sustainability. Once the scarcity turns into a norm, unpaid work and emotional labor of women keep the system running, covering structural irregularities in metropolitan water management.

Finally, the unrecognized managers of water security in Dhoke Mustaqeem are women who negotiate scarcity by being on constant alert, sacrificing and resisting emotionally. As they have been through, water scarcity is not merely an issue of environment or economy but also a gendered social phenomenon by which the lack of responsibility, power, and recognition is revealed. The solution to the urban water issues would thus be that a gender sensitive approach be incorporated into the policy and governance of water issues to ensure that the voices of women, their knowledge and needs are addressed in designing equitable and sustainable water management systems..

#### **4.6 Water Quality and Health Impacts**

Nearly all respondents identified deteriorating water quality as a major and growing concern in Dhoke Mustaqeem, linking it directly to health risks and infrastructural decay. The issue of poor water quality emerged not merely as an inconvenience but as a public health hazard that has eroded community trust in the municipal water supply. Household reports involved recurring complaints of unpleasant smell, discoloration, hazy look, and over use of chlorine, which are indicative of microbial contamination in addition to overcompensation of the treatment facilities trying to purify a deteriorated system.

One of the young female respondents, Minahil, 25 years of age, undertaking her studies in dentistry, with high knowledge about the environmental issues, with her parents having a high income household also told about her experience:

*“The drinking water was supplied by the government supply which was there one to one and half hours per day. We stored drinking water of that. However, we started experiencing health complications with time, stomach, and occasional smelling water, which was most likely the result of chlorine.”*

Her testimony reflects a wider trend in diminishing confidence in the communal supply, in which the user links water at government sources to sickness instead of health. Such perception leads to behavioral change, like buying bottled water or buying filtration systems, which are an imposition of extra financial costs on families that are already strained by scarcity.

For Farhana, this feeling of mistrust was increased on her part when she said:

*“The water smells like sewage sometimes, so I can't imagine using it for my children or myself.”*

What she said is referring to a higher level of environmental stress on the psychological and emotional level: fear and disgust at something that is supposed to be a fundamental need. Bad-smelling or discolored water symbolizes institutional reliability and this is referred to as a sensory experience. In the time when the most basic of the numerous public services is a matter of concern, water, this force that binds a people to a state, is undermined as is the sense of group welfare.

WASA officials admitted that old pipelines, lines leakages and cross-contamination between drinking and sewage lines are the key contributors to poor water quality. The distribution systems are leaky and this means that the water supply will leak the pollutants and pathogens especially in the low and intermittent pressure areas. This type of infrastructural breakdown is representative of a history of underinvestment and neglect with maintenance being a response and not a proactive action. The outcome is

the effect of a contamination and chlorination cycle wherein chemical treatment merely covers underlying structural problems but does not remove the cause of the pollution.

Environmental experts emphasized that these problems cannot be addressed by only a temporary solution but a comprehensive rehabilitation of infrastructure. As one expert emphasized:

*“I would suggest implementing a comprehensive water conservation and leakage reduction program. This means repairing and replacing old infrastructure, promoting water-efficient practices, and using smart metering technology to reduce losses and improve overall efficiency.”*

This recommendation places the problem in a governance and planning framework by noting that the management of water quality needs to be part of the overall strategies of urban sustainability and resource efficiency.

The discussion of the Socio-Ecological Systems (SES) lens shows that the degradation of water quality in Dhoke Mustaqeem is one of the main indicators of a significant failure in the human management systems and the ecological systems interaction. The supply sources, the aquifers and surface source, are ecologically strained and the human systems involved with the distribution of the supply are limited to bureaucratic inertia, limited finances and scattered accountability. What emerges is a failure system, both ecologically and socially and the outcomes are that of perpetuating vulnerability.

Within the Environmental Possibilism framework, the reaction of the residents, including filtering, boiling, or buying tanker water, portrays an adaptive behavior and human agency to environmental limitations. These adjustments, however, are confined to domestic level and hence are personal reactions to government failures. Ability to adapt is based on income, awareness and availability of resources, implying that poorer households remain in the most health risks. This replicates inequality in the environment, as quality of water that a person consumes is highly dependent on his economic status.

The aggregate evidence confirms that water scarcity and pollution are not two different problems but two issues that are related. Limitation of clean water also leads to the increased use of either unsafe or costly water supplies increasing social inequality and health risks. Also, the quality of water is not good, leading to additional non-monetary costs, including higher healthcare expenses, time lost through ill health, and mental health stress.

To summarize, the lowering of water quality in Dhoke Mustaqeem is not an environmental or technical problem, but a side effect of governmental failure and social abandonment. This issue cannot be resolved by repairing the infrastructure itself but involves a holistic policy approach involving the inclusion of the community, the environmental management and the community. Water safety should thus be seen as a developmental concern as well as a moral issue whereby access to clean and safe water should be viewed as a right and not a privilege that is dictated by socioeconomic status.

#### **4.7 Institutional Weakness and Corruption**

The issue of institutional governance turned out to be one of the most important and challenging determinants of water access in Dhoke Mustaqeem. Patterns of negligence, favoritism, and outright corruption were also often characterized by participants as contributors to water scarcity, and as well as exacerbators of it. These stories indicate that failure of governance is not a marginal issue but rather, a key factor that compromises allocation, increases costs, and loss of public confidence in formal systems.

The account by Farhana sums up the unequal access by local gatekeeping. She reported that:

*“The officer who was in charge of opening the valves started taking bribes. Houses that were giving money got more water. We did not know it at first, but when we learned and made a complaint, the Cantonment team arrived and put us on the wrong. Nothing changed after that. We therefore ceased to rely on it and began to use tankers.”*

Demonstrates a number of mutually reinforcing dynamics. Firstly, bribery transforms the governmental service into a personal discretionary commodity as those with money or contacts are favored. Second, poor supervision and inefficient solutions transform complaints into a token gesture, which subsequently generates the disengagement of citizens through official channels. Third, the transition to reliance on tankers is privatization of water access and itself a market reaction to privatization, which has made vulnerable families poorer.

The other coping measure that Mrs. Zubair refers to when she says that a water supplier asking 1000 rupees a month would be a logical way of coping in case he supplies water, is the way human beings adjust to perverse incentives in a failed system of governance. She stated:

*“When you consider it, we are spending approximately around Rs. 6,000 per month in tankers- that is a lot of money spending in the basic essential such as water. If the water supplier of the government is not financially well off, we can pay him 1000 rupees every month, he must make sure of supplying us water.”*

Her reasoning is sensible yet at the same time disclosing. It demonstrates that in case of failure of the formal provider, households internalize irregular payments to achieve reliability. Such informalization of payments undermines the rule of law, introduces repetitive out-of-pocket costs and is institutionalizing inequality. It also creates a moral hazard where frontline workers or contractors have strong incentives to maintain scarcity or limit transparency in order to extract rents.

At the same time, the RCB officer’s perspective adds critical context to this picture. He explained:

*“The problem of illegal water connections is not new in the Cantonment only but in Rawalpindi as well. This is not often witnessed in the other parts as they have a higher water table and water is more abundant. However, in this case, with such a severe shortage 37 MGD, as I had indicated, people feel compelled to have illegal connections, out of desperation.”*

*Our population is continuously growing, yet we still get the same amount of water brought by Khanpur as in 2002. Human beings attempt to satisfy their needs through stealing water and they would steal it mostly during night or during holidays. We also have Water Revenue Branch which keeps records and they visit such areas regularly to inquire about such cases. In the event of finding illegal connections, it is penalized and the illegal connections are severed.”*

This is an institutional aspect of the crisis, and is not only characterized by mismanagement, but profound structural limitations. The RCB officer highlights the fact of an imbalance in supplies and demand: the quota of water in the city has not increased during the last twenty years and the population has proliferated exponentially. Even the good intentioned systems of governance are put to the test in such a situation. Illegal connections, in turn, are not only an indicator of the lack in the system as a whole but also a cause of the further inefficiency since they destabilize the fair distribution and decrease the pressure in the formal pipelines.

The combination of the citizen and institutional narratives will illustrate a vicious cycle of scarcity, mistrust, and informal adaptation. In the perspective of the residents, the failure of the governance occurs in the form of corruption, favors and neglect. In the perspective of the RCB, rampant illegal tapping and dwindling supply controls the operation and resource planning. What emerges is a system between a moral economy and institutional constraint citizens have to justify their act of breaking rules in order to survive, and authorities have to enforce the rules in order to restore order, and collectively create the problem.

The result of this interaction is a typical governance trap. In case formal systems are not able to satisfy the basic needs, informal practices (bribery, illegal tapping, tanker reliance) become a means of survival. These practices eventually erode the legitimacy of formal institutions, and it becomes even more difficult to reform. Punitive actions of the officials toward the illegal ties though, which are logically correct in the administration, can only cause more alienation of the communities particularly when the people feel that the administration is discriminating or unfair in enforcing the

action. Distrust between inhabitants and government therefore turns out to be a social and functional obstacle to sustainable water management.

**Figure No. 4.2: Community Water Filtration Plant**



*Source: Field Data*

Further analysis of political economy indicates that scarcity of water in Dhoke Mustaqeem is not only technical but also institutional. A complex network of interconnected issues is corruption, ineffective infrastructure, fixed water rates and population pressures. Since 2002 structural underinvestment has driven the residents and officials into short term, reactive responses instead of systematic reform. In this regard, governance failure can be seen as a driver (corruption and mismanagement) and a multiplier (informal adaptation, disengagement of citizens), of water scarcity.

This can be solved in two ways; institutional accountability and social inclusion. On the one hand, reforms should aim at transparency, minimizing leakages, and fair rationing e.g. by automating the valves systems, real-time control, and schedule of distributions so that they are accessible to the public. On the other, communities are important to be engaged in order to restore confidence and deter unlawful activities by participatory systems, sensitization efforts, and equitable system of grievances redressing mechanisms.

Finally, to reform governance in the water sector, it is necessary to reform it not only by policing but also by reforming the structure to match the institutional incentives with the common good. It is only in the case when both parties, the service provider and the citizens, feel a sense of fairness, reliability and share of the problem, that the chronic water crisis facing Rawalpindi would stop being the cycle of desperation and mistrust to become the cycle of accountability and cooperation.

#### **4.8 Community Solidarity and Collective Challenges**

Although there are examples of the cooperative behavior in Dhoke Mustaqeem, there is a weak and uneven collective action. The small-scale efforts characterized by the respondents include small neighborhood committees and casual cost-shared arrangements, but these measures are occasional and weak. One female respondent, Komal Khan, a working woman and a mother of two, burdened by the office work as well as house chores observed:

*“Some of the residents do come together as a small group to raise concerns but most people do not want to be involved. Concerning such initiatives as rainwater harvesting, we are so overcrowded, that cars can barely fit into the neighborhood, not to mention a system of water storage. It is also because people are not eager to spend money thinking that it is cheap to purchase only a tanker a month. Therefore, the level of income, attitude and absence of communal cooperation render it extremely hard to initiate such projects.”*

Her account illustrates that while social capital is present, structural constraints and heterogeneous motivations limit its potential to generate durable collective action.

From a collective action perspective, the barriers identified by respondents fit well-known patterns. First, there are material constraints. High population density and lack of physical space restrict the feasibility of infrastructural interventions such as rainwater harvesting or communal storage. Second, there are economic disincentives. Many households evaluate the short-term cost of community investment as higher than the perceived benefit, especially when tanker purchases appear as a simpler and

immediate solution. Third, there are social and behavioral obstacles. The prevalence of free-riding, low levels of trust in neighbors and authorities, and a general preference for avoiding conflict reduce willingness to participate in public goods provision.

The uneven distribution of engagement described by Shagufta Hameed, a mother of 3 children, relying on her husband for her needs to be fulfilled, while trying to stand by him and manage household burdens:

*“Yes, they do — good people do help each other, but there are very few of them,”*

Points to a key feature of localized resilience: it is often dependent on a small number of highly motivated individuals. Action can be created with such leadership but the leadership is weak as it is based on individual commitment as opposed to institutionalized obligations. As these leaders burnout / shift or are de-motivated by recurring failures, the programs that they are driving are likely to fail. This produces sporadic and not permanent collective action and it renders solutions by communities hard to scale.

According to the Socio-Ecological Systems framework, the lack of collective action is a gap in governance at the community level. Social capital, such as networks of mutual aid and reciprocity give it a certain buffer power in case of acute shortages. The assistance of neighbors to their neighbors when they are in need alleviates the instant suffering and indicates latent community resources. But, social capital cannot replace formal institutions and technical investments that are needed to have systemic water security. The lack of convergence between micro-level cooperation and macro-level governance remains due to the fact that local measures are not supported by regulatory support, financial solutions, and technical assistance which would help them shift between coping solutions and long-term adaptation systems.

Environmental Possibilism focuses on the human agency and ingenuity in reaction in response to environmental constraints. The types of community practices identified like cost-sharing and raising issues through small groups are also some of the clear example

of agency at work. Nonetheless, without facilitating conditions like the availability of finance, technical advice, safe land or roof area and legal appreciation, such acts of agency cannot take place. This leads to a trend of reactive adaptation that responds to short-term demands without changing the structural causes of scarcity of watershed management, supply-side shortages and unfair allocation practices.

Social implications of erudite collective action are great. In the case where the community cooperation is not strong and is not united, the adaptation pressure is once more thrown over to individual families, as a rule, contributing to inequality. Better off households can afford to self-have borewells, storage, or just buy a tanker occasionally, whereas poorer households are still reliant on infrequent government supply, or informal sharing of limited resources. In addition, lack of community advocacy renders solidarity to push institutions to action, hence, the lack of cohesion in terms of actions further propagates institutional neglect and diminishes the chances of participatory governance resolutions.

These findings have implications on policy and practice in that to enhance collective action, interventions to be made at multiple fronts are necessary. External seed funding of small-scale pilot projects can help to reduce the economic barrier to entry and make some success stories visible. Space constraints could be mitigated with technical assistance of harvesting rainwater with a compact or low-footprint, or shared storage solution. Social transaction costs or demotivating people to engage can be minimized by creating trust through open grievance redressal, involving them in decision-making, and by conducting close liaison with the community to allow more people to participate. Finally, formalizing neighborhood committees and making them part of the municipal planning would aid in institutionalizing the local leadership in such a way that social capital is used to create sustainable and scalable solutions instead of short-term alleviation.

Overall, social capital in Dhoke Mustaqeem can be said to be a partial safety net but it cannot substitute effective governance. Collective action is limited by the barriers of

physical, economic and social nature and its existing type has the tendencies of being episodic and leader-based. It will take both bottom up mobilization and top up enablement to build upon such limited cooperative practices and create strong community-led water management that will align the local agency and the institutional resources and accountability.

#### **4.9 Cultural Beliefs and Water Use Practices**

Household water behavior is an important factor that cultural and religious norms influence its consumption habits and sense of responsibility. The attitudes toward the use of water were characterized by a variety of views on water, which is a conflict between the need to use this resource in practical terms and social norms and moral and spiritual concepts. Some households consider a lot of water consumption with hospitality, cleanliness, and social status whereas others view water conservation as a moral, religious, or ethical obligation. These norms do not work independently but they interrelate with structural scarcity to either limit or enable adaptive behaviors in a given context.

A 65 year old Ghulam Zara, who is living with her husband and married children in a less privileged area of Dhoke Mustaqeem explained her thoughts stating:

*“The more you limit yourself, the less you appear to have. By the grace of God, we have never been afraid of using water. It is a necessity- how much you may attempt to save yet you must use it. In summer, in particular, you can not be too confined.”*

Her quote is a pragmatic understanding of water as a commodity that a person cannot do without, and it is a part of culture. According to this world view, extreme frugality is not only unrealistic but can be socially or psychologically unacceptable since the consumption of water is closely associated with the standards of hygiene, comfort, and hospitality. This knowledge can serve as a limitation to the water-saving programs, as home residents might view conservation messages as a challenge to existing cultural beliefs or habits.

Kashif Khalid on the other hand stressed the religious approach in what he said:

*“You can live without many things, but not without water. It’s a gift from Allah, and we must respect it.”*

Water in this case is not simply a utility but is a divine gift and comes with moral responsibility. These beliefs may open up behavior change opportunities, because conservation behavior may be characterized as stewardship and moral duty, instead of an economic or technical necessity. The households can be more open to the idea of wastage reduction, water reuse, or engaging in other environmentally-friendly activities when the campaigns are supported by religious beliefs, and the behavior becomes even more subtle when it is backed with both spiritual and moral beliefs.

Mrs. Zubair was hopeful of both faith and technology and she said:

*“My thought is that we should never lose hope. The water is a gift of Allah it is not only on the ground that it comes from. Millions of people have existed before us, and Allah was able to take care of them too. Technology is evolving on a daily basis. I think we are going to manage water more with the new innovations.”*

Her opinion reflects both a religious belief and a modern optimism, which is also an example of a cultural mentality that balances in terms of being dependent on the provision of a higher authority, with accepting technological solutions. It is implied that faith-based thoughts do not necessarily contradict the interventions in water management, but, on the contrary, may be turned to promote the acceptance of the newly developed interventions, including rainwater harvesting, water filtration systems, or energy-saving appliances.

These cultural and religious frameworks have a twofold impact as far as behavior is concerned. On the one hand, the societal norms that celebrate heavy consumption or immediate convenience can be used to enforce an unsustainable consumption behavior, and a household can be resistant to conservation campaigns that seem to be externally enforced or, wrongly aligned with societal norms. Conversely, ideologies that make water holy or morally valuable would offer a powerful change agent because the

household would be willing to conserve water not necessarily out of financial or medical necessity, but as part of an ethical, spiritual or community obligation.

The application of the Socio-Ecological Systems (SES) approach to the analysis of these dynamics allows viewing cultural norms as a set of social feedback and mediate human-environment interactions. They determine the ways in which households feel scarcity, distribute water and how they are going to react to the institutional or technological intervention. Likewise, the Environmental Possibilism emphasizes the way human agency is worked out within an environmental and cultural context; households do not passively receive scarcity, but is a process of water use being interpreted and negotiated within a social, religious, and moral context.

These have serious policy and behavioral campaign implications. Efficient water conservation programmes in Dhoke Mustaqeem must learn to accommodate and appreciate the cultural and religious practices of the population, to package messages in a manner that will appeal to spiritual orientation, social values and acceptable practices. Campaigns that do not follow these norms will be viewed as culturally foreign or morally inconsequential to their adoption and sustainability in the long term. On the other hand, interventions that are consistent with faith-based stewardship, which emphasize the sanctity of water or that appeal to shared ethical obligation can result in increased engagement since they are reaching very deep motivational frames.

To sum it up, cultural and religious beliefs in Dhoke Mustaqeem become both limiting and facilitating factors of sustainable water behavior. These norms are the key to the design of culturally sensitive and behaviorally effective interventions using local values to encourage conservation without disrespecting social practices and lived realities. This approach will allow policymakers and community leaders to develop strategies that appeal to the world views of households, and which can address the issue of scarcity in a purposeful and sustainable way.

#### 4.10 Environmental Degradation and Urban Planning Gaps

The specialists and authorities always associated deforestation, haphazard building and the decrease in the natural infiltration areas with the decrease in the groundwater recharge in Dhoke Mustaqeem and the whole Rawalpindi region. These aspects define the ecological aspect of urban water stress, which shows the multifaceted interrelations of human activity, land use, and hydrological cycles. Ammaara Saleem is a well educated woman with strong knowledge on the issues related to the environment living in a large family of 8 members explained:

*“Even in northern areas, trees are being cut down, which worsens the situation. Trees have the ability to store water and maintain balance in the ecosystem, so deforestation has been disastrous.”*

As she observes, forest cover and vegetation are extremely important in ensuring the sustainability of ground water as a result of rain fall interception, soil stabilization and infiltration facilitation. Ecological processes are interfered with by the elimination of trees, which means that the time of runoff is shortened, the aquifer is not recharged as quickly, and the area becomes vulnerable to drought and water scarcity.

On the same note, Safina Ali who is an environmental expert remarked that the only way to change circumstances was through systemic reforms, she said:

*“Several reforms are needed. Such institutions as WAPDA and irrigation departments ought to be reorganized making them transparent and efficient. A more holistic approach that should be embraced is the Integrated Water Resource Management (IWRM). This can be assisted through Participatory Irrigation Management (PIM). The utilization of surface water, wastewater treatment, and rainwater harvesting should be improved, as well as the clear policy structure with quantifiable results. There are also requirements to have capacity building and effective monitoring and evaluation systems to monitor progress.”*

In her view, the ecological degradation is attributed to institutional failures, which implies that both environmental and managerial aspects of water scarcity are interwoven.

The analysis reveals a number of important points. To begin with, deforestation and land use alterations decrease the ability of the natural ecosystem to store and absorb water, which in direct proportion stops groundwater recharge. This is aggravated in cities where unplanned developments substitute permeable surfaces with impermeable ones like concrete and asphalt, increasing surface flow and flooding as well as decreasing subsurface water recharge. All these factors have the cumulative impact on the hydrological cycle shifting the system of its operation toward causing scarcity and increasing variability in the availability of water.

Second, it is not an environmental issue but is also institutional and policy-oriented. The recommendations of Safina Ali represent a more general understanding of the fact that disjointed and ineffective water governance increases ecological stress. Indicatively, there is lack of coordinated strategies of managing water sustainably where the agencies that are involved in irrigation, urban planning, and water supply usually operate in silos. Such fragmentation prevents the implementation of combined solutions, like IWRM, which is based on the recognition of surface and groundwater resources, ecological conservation, and human demand as one.

Third, the social vulnerability is met by the ecological effects of the deforestation and urbanization. The decreasing ground water recharge compels households to use deeper borewells, tanker water or intermittent municipal supply at higher economic costs and social inequity. The marginalized poor neighborhoods, who have a limited ability to invest in private water systems, are discharged at a greater rate, disclosing the overlap of environmental decay, governance breakdown and social injustice.

Participatory and technology led solutions should thus be adopted. Participatory Irrigation Management (PIM) can enable communities to have control over the use of water and guard against recharge areas and rainwater harvesting and wastewater

treatment can be used to complement shrinking sources. Open policy frameworks that have quantifiable deliverables, robust monitoring and capacity-building in the institutions can make sure that ecological interventions achieve a physical transformation in the water security of urban areas.

Considering the concept of the Socio-Ecological Systems (SES) framework, the case in Rawalpindi can be seen as the interplay of the anthropogenic factors of deforestation, urban sprawl, and uncoordinated governance returning to the lack of resources. In the same kind of fashion, Environmental Possibilism highlights that in spite of the environmental limitations, human agency in the form of policy reforms, community involvement, and technological advances can influence more sustainable water results. Nevertheless, it does not work without solving the underlying causes of the ecological imbalance and harmonizing the institutional capabilities with the environmental realities, since adaptation is reactive and inadequate.

To sum up, the decreasing rate of groundwater recharge in Dhoke Mustaqeem demonstrates the ecological context of the urban water crisis, wherein the overlay of environmental degradation, uncontrolled urbanization and fragile governance culminates in a phenomenon of multidimensional crisis. To overcome all these problems, there should be an integrated multi-faceted consideration that will restore the ecological functionality, at the same time, to empower institutions and to involve the communities in the sustainable practices of water management. This points out the fact that the subject of urban water scarcity is not only an ecological and policy issue but also a technical or economic issue.

## **Chapter No. 05**

### **Conclusion & Recommendations**

This final chapter is a conclusion of the main findings of the study and the conclusion that was reached after the examination of the climate change and water consumption patterns in Rawalpindi. It renews the original objectives of the research by reintroducing the impacts of environmental degradation, population explosion as well as bad governance that have acted in synergy towards the rising water crisis in the city. It is also the elicitation in the chapter in the adaptive behaviours that exist in the inhabitants of Dhoke Mustaqeem and the institutional responses that dictate local water management. Through these observations, the chapter gives a row of viable recommendations that would improve the management of water, the community-oriented activities, and sustainable use of the water resources in the face of the ongoing climatic dilemmas.

#### **5.1 Conclusion**

The purpose of this study was to explore the impacts of climate change on water consumption patterns and the management practices in the water consumption in Dhoke Mustaqeem, Rawalpindi. The findings show that the water deficiency in the city is not a mere outcome of the physical scarcity but an outcome of a complex interaction between the environment, social and institutional aspects. Climate change problem has turned into a major source of stress and is what has caused the abnormalities in the rainfall, prolonged dry seasons and temperatures which have greatly disrupted the water supply. These changes in the environment have not only imitated the physical supply of this very important resource, water, but also changed the way the households perceive, use and conserve the valuable resource.

According to the study, the water shortage is experienced across the income levels but the effects are more deplorable among the low and middle-income families who do not have proper infrastructure, storage facilities and finances to manage the water shortage.

On the other hand, the comparatively more favorable households are able to pay with the assistance of personal tankers or borewells or storage facilities, and the difference in access is even bigger. Most of the inhabitants have come up with informal coping strategies that include water rations, reuse of water, which may be used to carry out various domestic tasks, and reliance on social networks of sharing in order to attain their everyday needs. This adaptation trend indicates that the resilience of communities and collaboration is an important factor in addressing the effects of scarcity, particularly in institutions with low levels of support.

The crisis has also been enhanced by institutional inefficiencies. Ineffectual coordination among agencies involved, spillage in the aging water pipes and a lack of monitoring of the extraction of the ground water has led to wastage and mismanagement. The Water and Sanitation Agency (WASA) is very important, yet this has not been sustainable due to the lack of long-term urban water planning and implementation of regulations. More so, the general perception of water saving and adaptation to the climate is low, which means that it is necessary to conduct behavior change programs on the community level.

This paper concludes that the water situation in Rawalpindi has been turned into an acute developmental and environmental problem due to the combination of climate change and excessive urbanization coupled with poor governance. Sustainability solutions need to be therefore incorporated with institutional changes, technological advancements, and active communities. A balanced policy, infrastructure and local action correlation are needed in order to make sure that the population of the city has the availability, equity and sustainability of water resources.

## **5.2 Recommendations**

To encourage sustainable water management and make Rawalpindi more resilient, the recommendations to the research findings and conclusions are as follows:

- Develop a comprehensive urban water management plan to bring together government agencies, local authorities and communities to respond to water

scarcity by ensuring integrated planning and sharing of planning data and long term sustainability objectives.

- Modernize the water infrastructure, repair the leaking pipelines, develop better water storage facilities, and adopt the use of efficient means of water distribution to minimize the losses and provide equitable access.
- Encourage massive household, institutional, and municipal water harvesting and groundwater replenishment to boost water supply and lessen the reliance on external supplies.
- Strengthen institutional responsibility and control: to achieve this, tight control over groundwater extraction, illegal borewells practices and open water management are all to be imposed under WASA management.
- Introduce community-based awareness and education activities that will promote responsible water use, reuse and conservation practices, and develop local ownership of water resources management.
- The implementation of urban planning that is climate resilient by incorporating green spaces, pervious surfaces, and nature-based solutions to enhance the absorption of water, decreasing the runoff, and reducing the impact of extreme weather events.
- Encourage water management research and innovation by university, local governments and environmental organizations to develop cheap technologies, enhance data on water trends and assess the effect of climate change of urban water systems.

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# **Annexure 1**

## **Interview Guide for Households**

### **1. General Background**

- Can you tell me a little about your family and your household structure (how many members, ages, occupations)?
- Who usually manages water-related tasks in your home (fetching, storing, paying bills, contacting tanker services)?
- How long have you been living in Dhoke Mustaqeem? Has the water situation changed since you first moved here?
- Compared to your relatives or friends in other areas, how is your water situation different?
- Do you feel your family size affects your water needs more than others around you?

### **2. Perceptions of Water Availability & Climate Change**

- In your view, how has the weather changed in recent years (temperature, rainfall, seasons)?
- Do you feel these changes are natural, or do you connect them with climate change/global warming?
- How often do you experience water shortages now compared to 5–10 years ago?
- Do you think the water table or groundwater has changed in this area?
- Can you recall any specific year when water shortage felt extreme? What happened that year?
- Do elders in your family talk about how water availability used to be in their time? What stories do they share?
- Do you see any link between hotter summers, erratic rainfall, and the water you receive?

### **3. Water Usage & Consumption Patterns**

- Walk me through your household's daily routine — how much water is needed for cooking, washing, bathing, laundry, etc.?
- Which activity do you think consumes the most water in your home?
- Do men, women, and children use water differently in your house? How so?
- How do you prioritize water use when supply is limited?
- What are the first activities you cut down on when water is scarce?
- Do you notice wastage of water in your home or by neighbors? How do you feel about it?
- Have you adopted any new habits (like reusing water, shorter baths, washing clothes less often) because of shortages?
- If water was unlimited, how would your consumption look different?

### **4. Coping Strategies**

- When water is not available, what do you and your family do?
- How do you decide between tanker service, borewell, or other methods?
- Do you store water at home? If yes, how (drums, bottles, underground tanks)?
- Has your family made any investments (new tanks, filtration systems, pumps) to deal with shortages?
- What difficulties have you faced when calling a tanker (availability, cost, delays)?
- Do women or children face extra burden (like carrying water, waiting for tankers, adjusting routines)?
- How do water shortages affect your cooking, cleaning, and personal hygiene routines?
- Have you ever had to borrow water from neighbors or relatives? What was that experience like?

## **5. Economic & Health Impacts**

- Approximately how much do you spend on water every month? Has this cost increased over time?
- Do you feel that buying water creates financial stress in your household?
- Have you or anyone in your family faced health problems related to water (diarrhea, skin issues, stomach infections)?
- Do you think the quality of water from WASA, tankers, or borewells is safe?
- Have you ever had to choose between spending money on water versus other needs (school fees, groceries, healthcare)?
- Do you boil, filter, or treat your water before drinking? Why or why not?
- Have doctors ever advised you about water-related illnesses?

## **6. Role of Government and Awareness**

- How do you see WASA's role in solving water shortages in your area?
- Have you ever contacted them to complain about water supply? What response did you get?
- Do you think the government cares about your community's water issues? Why or why not?
- Have you ever heard campaigns, TV/radio programs, or community meetings about saving water?
- What specific actions would you like the government to take?
- Do you think politicians only visit during elections, or do they follow up on promises about water?
- If authorities invited residents to discuss solutions, would you participate?

## **7. Community Practices**

- Do neighbors help each other during water shortages? How?

- Have you seen collective efforts like pooling money for tankers, rationing water, or repairing borewells together?
- Are there any conflicts in your area because of water (fights over tanker turns, storage, or distribution)?
- Do you think community unity is strong enough to handle the crisis?
- Do women in your area gather and discuss water issues?
- Are younger people more active in finding solutions, or is it left to elders?
- If your community had a chance to manage water locally (community tanks, rainwater harvesting), would people cooperate?

### **8. Future Outlook**

- Do you think the water situation will get better, worse, or stay the same in the next 5–10 years? Why?
- What are your biggest fears about water in the future (health, costs, migration)?
- Would you consider moving out of Dhoke Mustaqeem because of water shortages?
- What kind of solutions do you dream of — at household level, community level, or government level?
- Do you think your children will face more difficulties with water than you?

## **Annexure 2**

### **Interview Guide for Local Government Official**

#### **1. Urban Growth and Water Demand**

- How has population growth affected water demand in Rawalpindi?
- What challenges does urban expansion pose for water services?
- Are there particular neighborhoods where population pressures on water are more severe?
- How does the influx of rural-to-urban migration shape the demand for water?
- Do you see informal settlements contributing to higher water demand, and how are they managed?

#### **2. Policy and Planning**

- Are there any active policies or urban plans addressing water scarcity?
- What coordination exists between WASA and local government for water management?
- Do you feel existing policies are sufficient to tackle future water challenges? Why or why not?
- What are the gaps between policy design and policy implementation in the water sector?
- How are long-term water needs integrated into city master planning?

#### **3. Crisis Response & Monitoring**

- How does your department respond to water crises in low-income areas like Dhoke Mustaqeem?
- Are there any systems for monitoring household-level access?
- How do you prioritize which communities receive urgent water assistance during shortages?
- What mechanisms exist for reporting and resolving water supply disruptions?
- Can you share an example of how your office handled a recent water-related crisis?

#### **4. Community Engagement**

- How does the local government engage with the public on water conservation?
- Are there platforms for residents to voice their concerns?
- What role do community leaders or union councils play in water management?
- Do you conduct awareness campaigns or training programs on water use?
- How do you handle cases where residents resort to illegal connections or tanker mafias?

#### **5. Budget & Resources**

- Is funding a limitation in improving water infrastructure?
- Are there any donor or NGO-supported programs in place?
- How much of your water budget goes to maintenance versus new projects?
- Do you feel that revenue collection from water bills is adequate to sustain services?

- Are there opportunities for public-private partnerships in water infrastructure?

## **6. Climate Resilience Strategy**

- What role does climate change play in your urban water strategy?
- Are you integrating climate resilience into infrastructure projects?
- How do seasonal changes (heatwaves, heavy rains, floods) affect water planning?
- Is groundwater depletion being addressed as part of your climate strategy?
- What innovations (e.g., rainwater harvesting, recycling, smart monitoring) are being considered?

## **7. Institutional & Governance Challenges**

- What are the main bureaucratic hurdles in managing urban water systems?
- How effective is the coordination between provincial and municipal governments on water issues?
- Do political pressures influence water allocation decisions?
- Are there accountability systems in place for officials handling water management?
- How do you ensure transparency in water-related decision-making and budgeting?

## **8. Future Outlook**

- What is your vision for Rawalpindi's water management in the next 10–15 years?
- If given unlimited resources, what would be your top three priorities to solve water scarcity?
- Do you see technology playing a bigger role in future water governance?
- How do you plan to balance Rawalpindi's urban growth with sustainable water supply?

## **Annexure 3**

### **Interview Guide for Water Management Officials**

#### **1. Water Supply Systems**

- Can you describe how water is sourced and supplied to Dhoke Mustaqeem (surface water, groundwater, pipelines, tankers)?
- Approximately how much water is allocated to this area compared to other neighborhoods?
- How do you decide on priority areas when supply is limited?
- Are there differences between informal settlements and planned housing in terms of supply reliability?
- Can you share a typical day-to-day operational routine for organisation in ensuring water reaches households?
- Have you faced complaints from Dhoke Mustaqeem specifically? What are the common ones?

#### **2. Climate Change Impact**

- Have you observed any disruptions in water supply patterns due to changing weather (irregular rainfall, drought, intense heat)?
- How has the organisation adapted to weather irregularities like floods or droughts?
- Are there long-term trends in groundwater depletion or rainfall dependence that concern you?

- Do you think climate change is already affecting Rawalpindi, or are the issues more linked to population growth and urbanization?
- Can you recall a recent crisis (flood, prolonged dry spell) and how organization managed it?
- Does climate variability affect surface water sources differently than groundwater?

### **3. Infrastructure & Management**

- What condition is the water distribution infrastructure currently in (pipelines, pumps, storage tanks)?
- Are there leakages or inefficiencies in the system? How significant are they?
- How old is the existing infrastructure, and how often is it upgraded or maintained?
- What challenges do you face with illegal connections or tampering of pipelines?
- Are there areas in Rawalpindi where infrastructure is collapsing faster than others? Why?
- How do you manage coordination with electricity load-shedding, since pumps rely on power supply?

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### **4. Governance & Regulation**

- How is groundwater extraction regulated in Rawalpindi?
- Is there any licensing system for private borewells? If so, is it enforced?
- How does the organisation monitor private tanker operators?

- Are tanker operators seen as partners or competitors to the organisation?
- Have there been attempts to formalize or regulate the tanker business?
- What challenges exist in enforcing rules against illegal borewells?

## **5. Public Communication**

- How do you communicate with the public during water crises or disruptions?
- What methods are used — notices, social media, community meetings?
- Do you receive feedback from residents, and how is it managed?
- Can you give an example of a recent communication campaign and how people responded?
- Do you think the public trusts the organisation information during crises? Why or why not?
- Have you collaborated with schools, mosques, or local leaders for awareness about water conservation?

## **6. Economic & Financial Dimensions**

- How does the organisation fund its water supply operations — is it mainly from government budgets, user fees, or external donors?
- Are water tariffs in Dhoke Mustaqeem sufficient to cover costs?
- Do unpaid bills or illegal usage affect organisation's financial health?
- How much financial loss do leakages and theft cause annually?
- Do tanker operators make more profit compared to organisation's revenue collection?

- Has the organisation considered public-private partnerships to improve supply?

## **7. Human Resource & Capacity Issues**

- Does the organisation have enough trained staff and engineers to manage growing water demands?
- Are there skill gaps in climate adaptation, GIS mapping, or modern water management?
- How do you build staff capacity to respond to emergencies?
- Is staff morale affected by limited resources or public criticism?
- Have there been training programs supported by NGOs, international donors, or the government?

## **8. Future Planning**

- Are there any ongoing or planned projects to upgrade water infrastructure in Rawalpindi?
- Are there expansion plans for Dhoke Mustaqeem specifically?
- Is the organisation involved in climate adaptation planning at the city or provincial level?
- Are rainwater harvesting or recycling systems being considered for Rawalpindi?
- Do you see potential for technology integration (smart meters, sensors, GIS mapping)?
- How do you envision Rawalpindi's water system in the next 10–20 years?

## **9. Institutional Coordination**

- How does the organisation coordinate with local government, housing authorities, and disaster management bodies?
- Are there overlaps or conflicts in responsibilities between agencies?
- Do you collaborate with universities or research organizations on water studies?
- What role do provincial or federal authorities play in water governance here?
- Have donor agencies (like World Bank, ADB, or UNDP) funded water-related projects? What were the outcomes?

## **10. Reflections**

- What is the hardest part of your job when it comes to water management?
- If you had unlimited resources, what would be the first change you would make to Rawalpindi's water system?
- Do you think Dhoke Mustaqeem's residents understand the challenges the organisation faces?

## **Annexure 4**

### **Interview Guide for Environmentalists**

#### **1. Climate Change & Urban Water Systems**

- How is climate change currently impacting urban water cycles in Pakistan?
- Could you highlight the specific climate-related risks and vulnerabilities for a city like Rawalpindi?
- Have you observed any seasonal changes or irregularities (e.g., rainfall, droughts, floods) that directly affect water availability in urban areas?

#### **2. Groundwater Depletion & Ecosystem Health**

- What ecological consequences arise from the over-extraction of groundwater in cities?
- Are there long-term environmental or public health concerns associated with growing dependence on private water tankers?
- In your view, how does urban expansion and unplanned development contribute to groundwater stress and ecosystem imbalance?

#### **3. Policy & Governance Assessment**

- How would you assess Pakistan's national and local water governance frameworks in terms of effectiveness?
- Are the current policies sufficiently climate-responsive and adaptable to emerging water challenges?
- What gaps or weaknesses do you see in policy implementation at the municipal level (e.g., Rawalpindi)?

- In your opinion, how could coordination between environmental agencies, local government, and water authorities be improved?

#### **4. Water Conservation Practices**

- What conservation practices would you recommend at the community and household levels in Rawalpindi?
- Are there any successful examples of urban water conservation strategies from other regions or countries that could be adapted here?
- How can technological innovations (e.g., water recycling, smart metering) contribute to more sustainable water use in Pakistan's urban settings?

#### **5. Role of Social Capital & Community Engagement**

- In your view, what role does community behavior, awareness, and informal networks play in building water resilience?
- How can civil society organizations and local communities be better engaged in water conservation initiatives?

#### **6. Future Directions & Recommendations**

- What immediate steps should be prioritized to ensure sustainable and equitable water access in Rawalpindi?
- Looking long-term, what policy or institutional reforms do you consider most critical for improving urban water management in Pakistan?
- If you had to suggest one key intervention that could make the biggest difference in Rawalpindi's water security, what would it be?