

**Climate Change Vulnerability, Water Insecurity and Poverty in Urban Cities:
The Case of Karachi and its Implications for Pakistan's Sustainable
Development Goals 2030**



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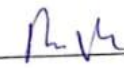
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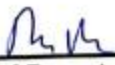
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In fond memory, this thesis is dedicated to my dearest friend, Muhammad Bilal Kayani, who left us on 28th April 2023. May his soul find eternal peace in Jannah.

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ABSTRACT

While numerous studies have explored sustainable development issues at a national level, this research takes a focused approach by examining the interconnected dynamics of human security and sustainable development within the context of Karachi. Specifically, the study investigates prevailing challenges related to water insecurity, climate adaptability gaps, and pockets of poverty. Given Karachi's pivotal economic role in Pakistan, the study's premise is that the interplay of these three major human security issues could impact Pakistan's prospects of achieving upper-middle-class status by 2030. The research builds upon prior studies concerning the aforementioned issues in Karachi. Moreover, the study employs expert interviews to delve deeper into the underlying causes of the lack of climate resilience, climate change impacts, water insecurity, and poverty. The analysis presented in this paper aims to elucidate the root causes of these challenges in Karachi, contextualizing them within the broader framework of Pakistan's human security and sustainable development agenda. By adopting a multifaceted approach that intertwines human security and sustainable development, this research strives to contribute a nuanced understanding of Karachi's complex issues. It underscores the importance of addressing these challenges comprehensively to strengthen the human security outlook in the city meanwhile paving the way for the city's sustainable development and on a broader level Pakistan's sustainable developmental agenda 2030.

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INTRODUCTORY CHAPTER

Introduction

Karachi, the megacity of Pakistan, has an estimated population of approximately 17 million, making it the highest populated city in Pakistan (World Population Review, 2023). Karachi has been growing at a very fast rate and is known as the principal industrial, commercial, and financial center of the country. Karachi produces about 30 percent of value added in large-scale manufacturing, 20% of the GDP, the World Bank identified Karachi as the most business-friendly city in Pakistan (Citiesabc, n.d). However, despite these overwhelming statistics, the megacity is plagued by numerous problems like acute water insecurity, extreme climate change variations, and poverty within Karachi and especially within the informal settlements also known as ‘Katchi Abadi’. Studies suggest that poor governance, bad decision-making by the provincial and municipal governments, Tanker mafia, dry dams, lack of safe drinking water, inadequate drainage and sewerage system, incorrect population census, industrial consumption of water, and political instability are among the major causes of prevailing climate vulnerabilities, water and poverty-related challenges in the city. There have been multiple debates in academia regarding building climate resilience strategies compatible with poverty alleviation and resolving water-related crises in the city however the city. However, the city has yet not seen any credible development over the resolution of these issues. The fruition of the SDGs is paramount for all states and Pakistan is no exemption. Like others, Pakistan must considerably achieve the set SDGs by 2030 without leaving behind any parts of the goals. It is of pertinent importance to build a strong climate adaptation strategy, water security, and zero poverty in the densely populated city of Pakistan in order to secure Pakistan’s agenda of sustainable development goals for 2030. This study will discuss SDG 1, 6, and 13 which resonate with all the three challenges troubling the city of Karachi.

Problem statement

The largest city of Pakistan, Karachi is known to be the hub for industry and the financial center for Pakistan. The megacity contributes almost 20% of the GDP, 50% of the total revenue, and around 47% of direct tax revenue. It accounts for almost 95% of Pakistan’s foreign trade and contributes 30 % of Pakistan’s industrial production. Although despite being the largest populated

city in Pakistan and being the sole supplier of the highest revenue to the national exchequer the city is facing a multitude of serious problems like lack of strategies for climate adaptation and resilience, absence of a sustainable water management system, and disaster preparedness, water shortage, poverty, unplanned urbanization, and overpopulation. Karachi's provincial and municipal governments have failed miserably to address these issues which is directly hampering the development in the megacity. These mega problems in the megacity which have been worsening since the 1990s, may bring strong implications for Pakistan's agenda of sustainable development goals (2030) and could affect the likelihood of joining the league of upper middle-class nations by 2030. Several studies have investigated the causes and issues related to climate change, water insecurity, and poverty in Karachi and its informal settlements, however, there is very limited debate in academic literature over how the deteriorating and incorrigible status of climate change resilience, poverty, water insecurity in Karachi would impact SDGs implementation in Pakistan.

Research objectives

This research analyses the existing situation of three major issues i.e., extreme climate variations and lack of climate adaptation, water insecurity, and spaces of poverty within Karachi. It provides a multi-dimensional approach toward understanding the prevailing causes that are aggravating the climate, poverty, and water-related challenges in the city. This research uses a conceptual lens of human security and sustainable development hence the discussion is directed upon the three major human security issues i.e. climate vulnerability, water insecurity, and poverty which also complements the sustainable development goals 1, 6, and 13. In addition to that the research explores the nexus between the deteriorating conditions of the water crisis, climate change, and poverty in the city and this will be connected to Pakistan's sustainable development goals 2030 agenda. By establishing a strong rational ground, this research proves crucial for the readers in order to understand the significance of climate adaptation, water security, and poverty alleviation in Karachi to secure the country's agenda of implementing the sustainable development goals of 2030.

Research Methodology and Data collection plan

The study's methodological framework is based on qualitative research techniques. This includes primary data collection through expert interviews, using the purposive sampling technique. The non-probability sampling technique known as "purposeful sampling" is used when the researcher makes the decisions about which items to include in the sample. Researchers frequently think that by using excellent judgment and obtaining a representative sample, they may save time and money (Black, 2004). The semi-structured interviews were guided by open-ended questions, which were adaptive in nature. The criteria for selecting respondents comprised several key factors. Firstly, the interviewee had to be based in Karachi. Secondly, they were required to have expertise in the chosen themes and subject matter. Thirdly, they should have a background in policy-making or entail extensive knowledge of the selected issues. To further ensure the quality of responses, the interviewees were selected based on their minimum number of years of experience in the relevant field or a particular professional background that aligned directly with the research study. Interviews were conducted with experts from Karachi particularly environmental experts, researchers, professors, and water and Sustainable development goals experts. Potential candidates were approached via phone and email. The interviews were conducted and recorded online via Zoom meeting for a maximum of 30-40 minutes. Participants were given the assurance that the information obtained would only be used by the researcher and would not be shared or used for non-academic purposes, thereby ensuring that a high level of confidentiality would be upheld. The agreement of the participants was requested to address ethical issues, and it was also asked if they would like to be acknowledged in the study. Additionally, it was made clear to them that, prior to or during the interview, they do have the following rights: (1) to revoke their consent and stop participating in the activity at any time without consequence; (2) to refuse to answer a specific question; (3) to assume anonymity for a specific opinion; that is, to declare it to be "of the record"; and (4) to check the accuracy of the information and quotations that have been attributed to them. In the second step, the interviews were conducted using 7 open-ended questions that prompted participants to provide comprehensive insights on the potential causes of climate, water, and poverty-related challenges in Karachi and their broader impact on Pakistan's Sustainable Development Agenda 2030. The interviews were held from December 2022 – May 2023. A total of 17 interviews were conducted, but only 8 were included in the analysis due to the credibility of the arguments. The data from the 17 participants who fulfilled the previously mentioned conditions

were therefore included for analysis. Finally, the last step involved the analysis of the collected primary data from the interviews.

Research Limitations

- The originally planned field visits for primary data collection were hindered by resource constraints during the research phase. Consequently, the interviews were conducted via online platforms like Zoom.
- To ensure the quality of the data, a careful selection process was employed, leading to the inclusion of 8 out of 17 interviews for analysis, considering factors like credibility and avoiding redundant arguments.
- Despite the researcher's intention to engage a larger pool of experts for interviews, substantial challenges were encountered. Some experts did not respond or declined participation, presenting a significant limitation to the study.
- The chosen method for data collection might have restricted the study's capacity to comprehensively evaluate the findings.
- Sensitivity to certain topics, such as the presence of a tanker mafia in Karachi, led to instances where interviewees either declined to comment or provided indirect responses. These situations potentially impacted the depth of analysis in the study.

CHAPTER 1

Literature review

1.1 Climate Resilience and Urban Cities

In the field of urban studies and climate change, the concept of resilience has emerged with significant consensus and attention towards it. The concept of resilience within a broader consensus entails two major assertions: i). cities must fortify themselves to withstand the ‘perturbations’ and ‘stressors’ if they are to deal with climate change ii) if cities are to promote climate change resilience, they must integrate the efforts along with a considerable focus on strengthening urban development and sustainability. The advancement of resilience is now widely accepted to be the primary goal for cities to ameliorate the mitigation and adaptation efforts to deal with the complex challenges posed by climate change (Twigg, 2007). According to Rafael (2015), the EU strategy for Adaptation to Climate Change as charted by the Committee of the Regions (Directive 2013/C 356/07), views adaptation as a ‘holistic approach’ that spans various systems, sectors, spatial and time scales. In addition, it recognizes adaptation as a crucial part of a broader strategy of making European cities and regions more resilient. Furthermore, adaptation is considered a pre-emptive process that involves identifying and mitigating risks related to climate change stressors with the ultimate objective to minimize the impact of such shocks.

To gain a comprehensive understanding of climate resilience, it is essential to explore the concept of climate vulnerability in urban settings. The primary research streams on the concept of urban vulnerability are rooted in a broader context of environmental change connecting the vulnerability analysis to natural stressors, political economy (or ecology), and ecological resilience. (Romero Lankao & Qin, 2011) (O’Brien et al., 2009). Within the scope of urban vulnerability research, the impact lineage delves into understanding how cities are being impacted by changes as a consequence of natural stressors, particularly under the context of climate change. This lineage entails two primary areas of research, the first area studies the correlation between variations in specific parameters or combinations such as temperature, air pollution, and precipitation including their potential impacts on crop productivity, exposure to air pollution and mortality rates, etc. In conjunction with that, these studies also explore the geographical aspects of the urban settlements, such as the low-lying coastal areas, water scarcity, and steep slopes which contribute to the vulnerability of city residents to the impacts of climate change. The second area encompasses the

application of downscaled global climates within the urban settings and assists the researchers to study the key parameters such as temperature and sea level rise and how they would impact the urban context. (Rafael, 2015)

The reality of Climate change

In order to build urban resilience to climate change it is pertinent to discuss the existing debates surrounding climate change discourse and investigate public perspective on the subject. The existing literature on climate change and global warming reports a major discontent between the public views and the scientific community on the subject. Firstly, the complex nature of anthropogenic global warming (Gifford, 2011; Norgaard, 2011; Pidgeon & Fischhoff, 2011; Weber, 2010) serves as a challenge for the policymakers to formulate and implement the measures to help control the effects of global warming (Lazarus, 2009). Secondly, these complexities have led to discontent between the general public's opinion on human-caused global warming and the scientific community's views (Weber & Stern, 2011) and a policy stalemate (Pooley, 2010). Rehman (2004) has mentioned three types of climate skepticism i.e., i) Global warming is not happening ii) Humans are not causing global warming and iii) climate impacts are not serious. The existing skeptical views regarding the human contribution to climate change are closely associated with various forms of skepticism about climate issues (Akter, Bennett, & Ward, 2012). Climate denial often emphasizes the significance of natural cycles as the primary driving force behind climate change (Connor & Higginbotham, 2013). According to Dunlap (2013), the primary cause behind these existing debates is not necessarily the intricacies and reservations within climate science rather this is the outcome of a deliberate and organized "disinformation" campaign that has been put in place, utilizing the intricacies of anthropogenic global warming (AGW) and the inherent uncertainties within scientific research to foster skepticism and denial regarding AGW. This campaign has been deliberately employing strategies to spread uncertainty regarding AGW, as highlighted by Oreskes and Conway (2010), particularly through attacks on climate science and scientists (Powell, 2011).

In response to climate change skepticism, it is imperative to observe the climate change issues arising in the urban centers of the world. Urban cities are at the forefront of the challenge of climate change as more than half of the world's population resides in urban settlements. Increased heat waves around the globe are jeopardizing the health of all age groups without any discrimination.

In addition to droughts, floods have become recurrent and severe, endangering water supplies for coastal cities, increasing sea level rise, and frequent storm surges harming residents and basic infrastructure. These effects of climate change are exerted on urban environments (IPCC, 2007).

According to the UN-Habitat report from 2011, over half of the world's population, or 5 billion people, are expected to live in cities by the year 2030. The least developed nations are expected to see the fastest rates of urbanization. The majority of urbanization is anticipated to occur in smaller urban centers as the large megacities continue to grow quickly. Cities are now recognized as contributing to the issue of climate change as areas of fast expanding population. On the one hand, cities are now considered to be vulnerable to climate owing to the evolution of economic activities (UN-Habitat, 2011).

The 2006 stern review carried out for the UK government finds, for example, that:

Many of the world's major cities (22 of the top 50) are at risk of flooding from coastal surges including Tokyo, Shanghai, Hong Kong, Mumbai, Calcutta, Karachi, Buenos Aires, St Petersburg, New York, Miami, and London (Stern, 2006).

At the urban scale, five major challenges as a result of climate change are the most significant which include (Hunt and Watkiss, 2011):

- Sea level rise in the coastal cities (including frequent storms)
- Extreme events (e.g., wind storms, floods, Heat extremes, and droughts);
- Health;
- energy use
- water availability and quality

A study by McCarthy, Best, and Betts (2010), reports that as cities are growing in terms of population, they are facing climate change challenges in the form of an increase in greenhouse gas emissions and the local effects of urbanization, such as the infamous urban heat island effect (UHI). Scientists have developed a climate model to understand the impact of urbanization on climate, the model reveals that those regions which have relatively high population growth levels are most likely to have urban heat islands and this is evident in the Middle East, Indian Subcontinent, and East Africa.

Another vital observation in this regard is that, as climate change intensifies, disparities between socioeconomic classes are worsening in metropolitan areas (Mehrotra et al., 2009). For instance, the impoverished population in urban cities is more likely to have difficulty leaving during extremely vulnerable situations in riverine and coastal areas that are more likely to experience intense flooding. This would result in a strong impact on the spatial distribution and density of both formal and informal settlements (Rosenzweig et al. 2011).

Urban areas or cities with fragile systems and sizable populations of individuals who are socially or economically underprivileged are those that are most vulnerable to external shocks and pressures (including climate change). Due to their high exposure to risks or limited capacity for adaptation and response, those who are most vulnerable are those who experience these effects the most (due to physical limitations or financial capacity) (Asian Development Bank, 2014).

Florianopolis, a city located on the southeastern coast of Brazil could be considered as an example similar to Karachi. Florianopolis is characterized by the presence of low-income households, businesses, and communities occupying substandard structures and informal settlements located in high-risk areas i.e., steep slopes, and low-lying lands that lack adequate infrastructure and basic amenities. As a consequence, the vulnerable populations residing here are at great risk of climate-related hazards including heavy rainfalls, floods, landslides, subsequent storm surges, and strong winds.

Pakistan is the fifth most climate-vulnerable nation in the world facing extreme climate variations and climate-related disasters (Bhutto, 2020). According to Farhan Anwar (2012), in the context of climate change, Pakistan faces complicated urban development issues, and how development is occurring is more in the type of maladaptation than it is fulfilling the requirements of adaptation. In this regard, it is somewhat alarming that efforts to address the climate change challenge in Pakistan have placed little or no emphasis on urban areas. Karachi City – is the largest urban center of Pakistan offering the most complex set of urban development challenges anywhere to be found in Pakistan (Anwar, 2012). In Karachi, the background capacity for adjusting to potential climate change scenarios is bleak. While Karachi continues to be the commercial hub of Pakistan, environmental degradation and socioeconomic inequalities are on the rise. Human settlements, such as slums and hill communities, are vulnerable to hill torrents, stormwater flooding danger, and river floods in the lack of adequate protection

Qadir (2012) explains the climate profile of Karachi by mentioning the key vulnerabilities surrounding the city for example, the variability in Karachi's weather is influenced by factors such as western disturbances, tropical storms, the Southwest monsoon, and the presence of continental air. These factors, along with external ocean and atmospheric conditions, contribute to the city's climate patterns. While precipitation levels have remained relatively stable, there is a noticeable increase in average temperature over time. Rosenzweig et al., (2011) discuss the case of four prominent megacities, namely New York, Buenos Aires, Lagos, and Delhi, which share similar characteristics to Karachi and are located in different sub-regions across the globe. These cities have been examined in terms of their climate adaptability strategies and risk management approaches. Like Karachi, these metropolitan urban centers make significant contributions to their respective economies in terms of GDP. In the discussion chapter, this study will utilize the literature source by (Rosenzweig et al., 2011) to explore these cases within the context of Karachi, focusing on the examination of their climate adaptability and resilience strategies in order to gain valuable insights that Karachi can potentially acquire from these cases.

1.2 Poverty in Urban Cities

As urban development continues to expand across the developing world, it is giving rise to intricate challenges related to poverty. There is a notable increase in the proportion of impoverished individuals residing in urban regions, and this growth is occurring at a faster pace compared to the overall population. Consequently, prominent global institutions such as the World Bank are actively engaged in comprehensive research endeavors aimed at comprehending the prevalence of urban poverty and its typical manifestations within urban environments (Ravillion, 2007). In light of these circumstances, the prevalence of poverty in urban settings is gaining prominence day by day.

Some of the mainstream constituents of urban poverty mentioned in the literature are insufficient availability of necessities including food and water, inadequate shelter, lack of provision of public infrastructure (e.g., piped water, sanitation, drainage, roads, footpaths), limited access to social security nets, inadequate protection of marginalized groups, powerlessness with the political system and bureaucratic structures (Scatterthwaite, 2001).

Although the phrase "live in poverty" is used frequently but the definitions of poverty rarely take housing conditions into account. When monetary poverty lines are applied to urban populations or

a city's population and are based primarily on the price of food, there may be little urban poverty. In reality, about a billion urban residents "live in poverty" in crowded tenements or inexpensive boarding houses, unofficial settlements, or temporary camps. Since most of such housing is regarded as "illegal," its occupants typically lack access to public infrastructure i.e.: all-weather roads, water that is piped to dwellings, sewer connections, and drainage or services such as health care, emergency services, safety nets, pre-schools, and schools (Mitlin & Satterthwaite, 2013).

Boonyabancha & Kerr (2015), commenting on the role of government in providing facilities to the informal settlements asserts that many are partly a result of residing in unofficial communities where local governments and utilities are prohibited from offering services or opt not to. Lack of policing (often in areas with high rates of violence and other crimes), a lack of financial services (as they frequently call for legal addresses and formal land tenure documents), and the absence of a safety net are some of these privations. Lack of government service provision also results in increased pricing (and frequently subpar quality) for private services, such as those provided by water sellers or shops, latrine-emptying services, educational institutions, or medical care. Those without a legal address may not be able to get state benefits or register to vote (and few informal settlements have legal addresses). The lack of any influence on how poverty is defined, quantified, and addressed is thus possibly the most recent discovery in our understanding of the numerous deprivations that low-income urban people experience (Boonyabancha & Kerr, 2015).

A growing number of in-depth studies in informal settlements have revealed the extremely poor living conditions, high levels of overcrowding, and deprivations (for provision of water, sanitation, solid waste collection, health care, and schools), which have informed our understanding of the health risks associated with urban poverty (Muindi, 2014). According to several research, such living circumstances are linked to poor health outcomes, such as increased newborn and child death rates (Aphrc, 2002). Since the only land sites that the impoverished populations could inhabit were those with a high danger of flooding (in watersheds, along rivers), or on steep slopes (the land that middle- and upper-income groups don't want), there is a significant risk of eviction many informal communities or temporary camps. When there is a high chance of flooding, households frequently hesitate to relocate because they worry about being turned away or having their property plundered. There are also the potential shocks that disasters might cause, as well as the absence of

safeguards against these risks, such as a possession base, credit availability, or safety nets (including cash transfers) (Hardoy & Pandiella, 2009).

There is a lack of consensus over an agreed definition of Slums. The absence of a consensus definition is the root of the problem in measuring slums. So far, standard monitoring tools including national population censuses, demographic and health surveys, and worldwide surveys have not included slum enumeration. Some surveys offer substitutes or similar variables like "percentage of squatters" or "proportion of unlawful housing." Participatory poverty evaluations are typically only able to provide qualitative data on urban poverty in many least-developed countries (LDCs). According to the general definition, a slum is: 'A contiguous settlement where the inhabitants are characterized as having inadequate housing and basic services. A slum is often not recognized and addressed by the public authorities as an integral or equal part of the city' (UN-Habitat, 2002). Usually If the term "slum" is used in developing nations, it typically no longer has the negative and controversial original connotation and instead refers to 'low quality' or 'informal Housing'. Large, obvious squatter or informal dwelling areas have developed a close relationship with views of poverty, a lack of access to essential services, and unease (UN-Habitat, 2003).

Precarious villages consisting of iron sheets and tins are referred to as villa miseria in Argentina, favelas in Brazil, kampungs in Malaysia and Indonesia, and bidonvilles in France and Francophone Africa (bidons) (UN-Habitat, 2003). The number of people living in slums climbed from 23% to 24% of the urban population globally between 2014 and 2018, totaling more than 1 billion people. Eastern and South-Eastern Asia (370 million), sub-Saharan Africa (238 million), and Central and Southern Asia are the three regions with the highest concentrations of slum residents (226 million). A huge portion of the world's population is left behind because the interests and concerns of these people are rarely taken into consideration in traditional urban planning, funding, and politics (United Nations Statistics Division, n.d.).

The interconnection between slums and poverty is intimate and mutually reinforcing, however, it is not always straightforward. The increasing rate of urban slums in developing countries is an indication of the urbanization of poverty or shifting of deprivation from rural to urban contexts (Rice, 2009) Slums and urban poverty are more than merely a result of population growth, demographic shifts, or even the impersonal, overwhelming forces of globalization. Slums must be viewed as the outcome of failed national, urban, and housing policies, regulations, and delivery

systems. The biggest obstacle to success in enhancing low-income people's housing and living conditions in slums and informal settlements is the absence of genuine political commitment to deal with the problem in a fundamentally structured, long-term, and comprehensive way. The political will to implement long-term and structured interventions is without a doubt essential to success, especially when it is combined with local ownership, leadership, and the mobilization of the potential and available resources (UN-Habitat, 2003).

Urban poverty and food insecurity are both primarily caused by the income poor. It is obvious that finding decent and stable employment is the top goal. Social protection programs like Bolsa Familia in Brazil, Progres-Oportunidades in Mexico, and the Hunger Safety Net in Kenya all boost food security by ensuring more steady earnings. These initiatives are crucial for enhancing the ability to adapt to the effects of climate change. However, in about 80% of the world's poorest nations, these safety nets are either nonexistent or insufficient. Moreover, these programs frequently exclude residents in urban informal settlements due to the formal requirements for people to have an address and for enterprises to be registered (Song & Imai, 2019).

Four out of every five urban households, according to recent research in eleven Southern African cities, experience food insecurity. Reducing food quality and quantity, skipping meals, and working longer hours are all frequent coping mechanisms. It is apparent that this will have long-term health effects. Due to the need to combine earning an income with caring for others, frequently without the assistance of males, women work longer hours than men do. In many situations, women forgo eating in order to provide for their children (Frayne et al., 2010). According to Hossain & Naomi (2012), food insecurity, however, is not just a result of income poverty. Numerous urban dwellers in low-income nations stay in packed, crammed dwellings with little space for storage and cooking. Food must be purchased in limited amounts at increased costs. Major contributors to the prevalence of severe diarrhea, malnutrition, and stunted growth in cities in Asia and Africa include the lack of adequate access to clean water sources, severely inadequate sanitation, and the lack of waste disposal. Infant and under-five mortality rates in Nairobi's informal settlements are greater than those in the city's wealthier neighborhoods as well as in rural areas.

In addition to the food security issue, environmental risks are present in low-income and unofficial urban areas, and climate change makes them worse. These communities frequently have little or

no surface water drainage systems and are situated in flood areas. Therefore, one of the most common and harmful effects of shifting rainfall patterns is flooding. Globally, 178 million people were impacted by floods in just 2010. Devastating floods have become a yearly occurrence in many African and Asian towns. Food security is impacted by floods in a number of different ways. As home items like furniture, kitchenware, and clothing are lost, they make it harder for people to go to work and drive-up costs. Food costs go climb when transportation infrastructure is disrupted, and marketplaces are harder to reach. Malnutrition is exacerbated by the rapid rise in water-borne illnesses including cholera, dysentery, and skin infections, particularly in places with poor sanitation. Floods have a fundamental impact on people's capacity to store food and prepare meals at home (Jha et al., 2012).

Urban poverty in Pakistan is a complex issue, and the country's fast urbanization rate has made it much harder to handle from scholar Hashim Zaidi's perspective. In addition to highlighting the role that the Orangi Project has had in enhancing Karachi's slum settlement, Zaidi emphasizes the importance of community-based groups in combating the problem of Katchi Abadi and slums. Zaidi claims that the Orangi Project was established in order to examine the issues facing the town of Orangi and develop answers. However, it has grown and expanded into areas like a research and training center, and health and social development; it has constructed schools, a water and drainage network, and a low-cost sanitation programme (Zaidi, 2011). Karachi City is currently facing challenges such as a lack of clean drinking water and inadequate water supply. Residential areas in Karachi can be divided into both planned and unplanned areas. In Karachi, both the native name 'Katchi Abadi' (non-permanent settlements) and the English phrase "informal subdivisions of state land" are used for slums. In Karachi, approximately more than 40% of the Karachi population resides in informal settlements that lack adequate housing facilities, water supply, and other essential utilities (Yousuf et al., 2014).

1.3 Water Insecurity in Urban Cities

The definitions of water security differ in their source, scope focus, and the way they engage with the concepts of risk and certainty. Cook and Bakker's (2012) discussion underscored 4 major dimensions of water security i.e., i) Water stress and availability ii) vulnerability to hazards iii) Human Development needs, and iv) sustainability. According to UN Water (2013), Water security can be defined as the ability of a population to ensure access to water for livelihoods and

development, mitigate water pollution and water-related disasters, and conserve the ecosystem within a context of peaceful co-existence and political stability. Conversely, Water Insecurity refers to a state where the level of risks is intolerable. Those risks may be related to water supply and sanitation, irrigation, industrial use, and ecosystem services including water-related shocks such as drought, flood, contamination, terrorism events, etc. (Grey & Sadoff, 2007). The impact of water insecurity is particularly severe in Urban slums, due to challenges related to water supply and quality. The inequitable distribution of water within cities leads to heightened urban water insecurity, mostly prevalent in slum areas (Habiba et al., 2013). The disparity in water supply distribution within cities is evident in places like Calcutta, India where the slum residents receive a mere 20 gallons of water per day as compared to the water supply of 60 gallons to the non-slum areas (Kumar and Harada, 2011).

Water insecurity presents a significant risk for both human well-being and for a well-functioning ecosystem. According to the baseline environmental outlook from the Organization for Economic Cooperation and Development (OECD), approximately 4 billion people are projected to reside in basins with severe water stress by 2050 (OECD, 2012).

Urban water insecurity is still a problem for many cities. Approximately one-fourth of major cities worldwide experience water stress as a result of either physical or financial insecurity (McDonald et al., 2014). Cities also experience institutional problems with collecting and providing water, which affects water security yet, large-scale availability evaluations frequently lack a thorough grasp of how urban water is administered (Kiparsky et al., 2013). As the urban population grows the demand for municipal water also increases. The weight of urban population development causes unplanned urban growth by putting more stress on scarce water supplies that cannot keep up with rising demands (Sreoshi Singh et al., 2020).

There are several causes that directly contribute to water insecurity in the urban centers of developing countries. According to the UN water report, the majority of urban residents reside in densely populated, unplanned settlements with poor water and sanitation infrastructure which contributes to water insecurity. The Urban centers are concentrations of deprivation, urban planning is not keeping pace with population growth, unplanned slum areas having little to no water and sanitation services pose a constant threat and unserved urban communities are vulnerable to shocks (UN - Water, n.d.).

Water security, as a Sustainable Development Goal, encompasses three key dimensions: environmental, economic, and social (Giddings et al., 2002). Achieving sustainability and security in relation to water requires addressing each of these dimensions. According to Maiti & Agrawal (2005), while water scarcity has traditionally been more pronounced in rural regions, recent studies indicate a growing challenge regarding the availability and quality of water in urban areas.

According to Mukherjee et al. (2022), the previous literature proves that Urban Water Security is a complex problem, an amalgamation of both the bio-physical and social factors, hence requiring a collective response. Urban centers around the world are experiencing rapid population growth, with an estimated addition of 67 million people each year, equivalent to approximately 1.3 million individuals every week. Projections suggest that by 2030, cities will be home to around 5 billion people, constituting about 60% of the anticipated global population of 8.3 billion. It is important to note that the urban poor face greater vulnerability to environmental and health risks due to their limited access to adequate housing, sanitation, and other essential services (Prinz, 2005).

Prinz et al. (2009), highlighted the current water-related changes in urban areas that are most likely to prevail in the future as well such as dealing with the physical limitations related to water resources, contamination of groundwater, rivers, reservoirs, and lakes due to industrial, agriculture and domestic waste, fighting the environmental effects of water extraction, building strong mechanisms to deal with flooding and lastly overcoming the administrative and financial constraints and operational incapacities.

Pakistan is currently among the world's 8th most water-stressed countries (Mangi et al., 2019). When a wealthy metropolis like Karachi is compared to the national poverty line, it may be inferred that much of Karachi is above the limit and, by that one definition, "not poor." On the other hand, perhaps a more Karachi-specific relative poverty standard needs to be created in order to determine the amount of relative differential in a city that is wealthier than the average, such as Karachi (Zaidi, 1997). According to the Multidimensional poverty index, the poverty rate in Karachi is 4.5% (2016), the city stands at number three among all the districts of the country in terms of having the least poverty (The Express Tribune, 2016). However, the megacity is still facing the challenge of poverty especially in Karachi slums or 'katchi Abadi' which are informal settlements with almost 40% of the city's population ' (AREC 1993). There are now more than 600 slum areas

in Karachi (Project, 2021). The 40% living in Kachi abadis are classified as poor in Karachi lacking social facilities and harboring criminal activities (AREC, 1993).

There are no plans for flood defenses, and drainage routes are choked or blocked aside from the Malir River Embankment. There are no designated flood storage spaces. In the event of a potential drought, the Hub River source would be Karachi's main source of rain-fed water supply, feeding a population of 5 million (S. Akhtar & M.R Dhanani, 2012). Significant human populations in the rural Karachi Goths depend on farming, much of which uses groundwater. Goths are in danger and the ground water is already decreasing as a result of human activities like sand mining. There is no promotion of water conservation, recycling of wastewater, or collecting rainwater in the city.

Karachi is the sixth most water-stressed city in the world (Sayed et al., 2017). Water security has gained unprecedented importance in international relations discourse following the current wave of Climate change around the globe. (Grey & Connors, 2009). Pakistan's water supply was discussed by Nazim Ali of the Global Change Impact Studies Center of Pakistan. In his opinion Infrastructure is lacking and difficult to create in already existing informal settlements in Karachi, which is why some areas of the city were poorly or never planned (informal settlement) (Ali, 2006). Poor water and sanitation services frequently result in water-related riots, and "water mafias" frequently work along with criminal forces in metropolitan areas, particularly in Karachi. In the late 1990s and early 2000s, there were numerous violent riots in the southern Pakistani megalopolis of Karachi, notably in its unofficial colonies (Katchi Abadi's), such as Lyari. Water access, or the lack of it, is the largest issue, according to Lyari residents, which further fuels their discontent with the country's political system (Qutub, 2005).

1.4 Pakistan's SDG Agenda 2030

The UN's goal to raise the number of people with access to appropriate water supply and sanitation, originally outlined in the Millennium Development Goals and later in the Sustainable Development Goals, has been a significant factor in the focus on water supply. The goal-oriented perspective raises the question of who should be responsible for ensuring water security: all urban residents equally, or primarily for the city's wealthier neighborhoods and business districts; and the city's water users, or also the users in the catchments where water is extracted for urban use. Many times, the question of "security for whom" goes unanswered. (Arjen Y Hoekstra et al., 2018).

The United Nations Sustainable Development Goals (SDGs) agenda of 2030, is dedicated to equipping developing countries as they face the challenge of urbanization. The primary focus of the UN SDGs 2030 agenda is to make cities and human settlements inclusive, safe, resilient, and sustainable and this is particularly emphasized in the urban goal, SDG11. Given the close connections between the 17 SDGs and their 169 targets, it is obvious that an integrated strategy is required to achieve both the urban aim and a local-level implementation of the SDGs. This is especially true in light of the fundamental urban issues of a lack of urban basic services, socioeconomic inequality, and environmental degradation. These problems transcend geographical or organizational boundaries, and they cannot be solved by a single sector or player. (Eisenbeiß, 2021).

Pakistan avowed its commitment to the 2030 Agenda for Sustainable Development, by adopting the Sustainable Development Goals (SDGs) as its own national development plan through a unanimous National Assembly Resolution in 2016 (United Nations Pakistan, n.d.). In 2018, the Government designed and approved a National SDGs Framework that envisages a national vision to prioritize and localize SDGs. The SDG Support Units contribute to creating an environment that makes the 2030 Agenda possible to execute. These Units operate as a cooperative venture between the provincial planning and development departments and the Federal Ministry of Planning, Development, and Reform. The project is based on the Mainstreaming, Acceleration, and Policy Support (MAPS) for SDGs tool from the UN Development Group. The project helps the Pakistani government incorporate the 2030 Agenda into its long, medium-, and short-term planning and budgeting processes and offers technical assistance for a tailored strategy for implementing the SDGs in the country. (UNDP Pakistan, n.d)

This research paper considers three main SDG goals in the context of Karachi:

SDG Goal 1: Eradicate Poverty in all its forms:

Given current trends, 575 million people (nearly 7% of the world's population) will still be living in extreme poverty in 2030 compared to 800 million in 2015 (or 10.8%) (United Nations, 2022).

According to recent estimates, approximately 575 million people which make up nearly 7% of the world's population will be poverty-stricken in 2030 in comparison to 800 million in 2015 or 10.8%

(United Nations, 2022). According to United Nations (2010), There are following sub-targets or sub-indicators under SDG Goal 1.

- Goal to eliminate extreme poverty for all people worldwide by the year 2030, which is currently being measured as a person making less than \$1.25 per day.
- Reduce the percentage of men, women, and children of all ages living in poverty in all of its manifestations by at least 50% by the year 2030, as determined by national criteria.
- Implement social protection systems and policies for all, including floors, at the national level, and by 2030, substantially all the poor and vulnerable individuals must be ensured complete financial coverage.
- Ensure that by 2030 all men and women, especially the poor and the vulnerable, have equal access to economic resources, ownership of land and other forms of property, control over inheritance, natural resources, appropriate new technology, and financial services, including microfinance.

SDG Goal 6: Ensure availability and sustainable management of water for all

According to United Nations (2010), There are the following sub-targets or sub-indicators under SDG Goal 6.

- All people will have access to adequate and equitable sanitation and hygiene and open defecation will be eradicated. Women's and girls' need as well as those of those in vulnerable situations will be given special consideration by 2030.
- Reduce pollution, stop dumping, limit the release of dangerous chemicals and materials, cut in half the amount of untreated wastewater, and significantly increase recycling and safe reuse around the world by 2030
- Improving water usage efficiency across all sectors, ensuring sustainable freshwater withdrawals, and significantly lower the number of people affected by water scarcity by 2030.
- Implementing integrated water resources management by 2030, including, when necessary, through transboundary collaboration.
- conserve and restore water-related ecosystems, such as lakes, rivers, aquifers, marshes, mountains, and forested areas by 2030.

- Increasing international collaboration and capacity-building assistance for projects and activities related to water and sanitation in developing countries, including technology for water harvesting, desalination, water efficiency, wastewater treatment, recycling, and reuse.
- Encouraging and bolstering local communities' involvement in improving water and sanitation management.

SDG Goal 13: Take urgent action to combat climate change and its impacts

According to United Nations (2010), There are the following sub-targets or sub-indicators under SDG Goal 13:

- Boost global adaptability and resistance to climate-related dangers and natural disasters
- Include climate change mitigation measures in national planning, strategy, and policies.
- Enhance climate change education, awareness-raising, and institutional and human capacity for impact reduction, early warning, and adaptation
- Implement the pledge made by developed-country parties to the UNFCCC to a target of mobilizing \$100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation, and as soon as possible fully operationalize the Green Climate Fund through its capitalization.
- Encourage measures to improve the ability of least developed nations and small island developing states to effectively plan for and manage climate change, with an emphasis on women, youth, and local and marginalized populations.

Human Security and Sustainable Development as a Conceptual Framework

This research in essence is predicated on the conceptual framework of human security and sustainable development in the context of a megacity i.e., Karachi. A discussion on human security requires a contextual perspective, human security falls under the larger umbrella of Non-traditional security.

According to Maly Caballero Anthony (2016), ‘Non –traditional security is also considered as a broader umbrella that overlaps and covers human security issues and the conceptualization of security in terms of national sovereignty and territorial integrity is insufficient given the urgency

of the global fight against hunger and poverty, environmental degradation and transnational crime'. Anthony (2016) also defined nontraditional security as 'An approach that is human-centric with a primary focus on contemporary issues such as climate change, resource depletion and scarcity, infectious diseases, natural disasters, illegal migration, food shortages, human and drug trafficking, and transnational crimes. The transnational nature of these threats requires comprehensive political, economic, and social reforms. One of the fundamentals of NTS is human security and the essence of human security lies in acknowledging the diverse capabilities, requirements, and situations of individuals, civil society, and governments. It attempts to formulate inclusive approaches that safeguard and enhance the well-being of all individuals through collective efforts and solutions (United Nations Trust Fund for Human Security, n.d.).

Several attempts have been made by security specialists to develop a consensus toward defining human security and its parameters. However, many scholars have criticized the existing definitions of human security by arguing that the concept of human security is way too extensive and overburdens the security agenda hence it must be delimited. Scholars like Suhrke (1999), argue that 'Human security should focus only on 'vulnerability' as its defining feature by mentioning three major categories i.e., victims of internal conflict and war, people living below subsistence levels, and victims of Natural disasters. Lodgaard was another author who called for a precise definition of human security aiming towards 'vulnerability to physical violence during a conflict only' (Lodgaard, 2001). The United Nations Development Programme, in its annual report, highlighted 'Human Security' acknowledging the importance of physical security along with 4 key characteristics of Human security i.e., universal nature, interdependency, early prevention, and people-centric. The report also included 7 major domains of human security threats i.e., Food, economic, health, environmental, personal, community, and political. (UNDP, 1994).

The constructivist school of thought posits that 'the security threats are constructed and not natural'. Given the fluid nature of the concept of human security, constructivists offer a comprehensive view of how 'security ideas are mostly promoted by the global norm entrepreneurs and the shifts within the global ideational structures can hinder or promote the prospects of human security' (Acharya, 2004). A leading constructivist scholar Finnemore (1996), asserts that 'the structure of the international system not only includes the material and power structures but also

the meaning and value structures. National interests are not a given but rather are discovered and constructed through social interaction.

The liberalist perspective offers substantial support for non-traditional security as it looks beyond the military security and hard power narratives of dealing with security challenges. According to a liberal scholar Mahbub-ul-Haq, the pioneer of the concept of 'human security' which was an auxiliary concept to his previous 'Human development' concept which he devised in the 1993 human development report, and later in 1994 human development report with a grandiose impact. Haq emphasized that 'Development must put people at the center of its concerns' (Haq, 2003). His human development paradigm stresses the importance of both building up human capabilities and making the best use of those capabilities to acquire higher national growth and employment. (Haq, 2003). The report conveyed that the essence of development centers itself on expanding the opportunities and choices available to individuals to improve their living standards. These choices encompass various dimensions for instance longevity, knowledge, political freedom, personal security, active community participation, and assurance of fundamental human rights. The development of human capabilities is central to the pursuit of these choices (Churruca Muguruza, 2017).

The conceptual framework of human security has been further elaborated by Commission on Human Security (CHS) 2003 report named 'Human Security Now'. In its effort to bring forth a more dynamic yet precise definition of human security, CHS comprehends human security as a critical aspect of human lives that ensures personal freedom and fulfillment. In addition to that human security encompasses a range of aspects such as i) Protection of human freedom ii) Protection of people from critical and widespread threats which might prove a danger to human life iii). Embracing processes that are more inclusive and built on people's strength iv) Social, environmental, political, military, and cultural systems that are well integrated and nurture adequate conditions for improving sustainable livelihoods, human survival, and dignity (Churruca Muguruza, 2017) (Commission on Human Security, 2003). Countries have been incorporating sustainable development in attaining their human security agenda. Human security serves as both an analytical perspective and a framework for implementation, enhancing, and supplementing the mechanisms meant to attain the Sustainable Development Goals (SDGs). Human security initiatives actively involve individuals in determining their unique needs and vulnerabilities. As a

result, their efforts promote the formation and implementation of policies and measures aligned with their preferences, generating benefits for sustainable development on both the national and international levels.

The advent of a sustainable development agenda emphasizes the interconnectedness of the world's challenges in order to achieve sustainable development. It emphasizes the significance of comprehensive and integrated approaches to support inclusivity, shared prosperity, and resilience. This goal is stated in the "Transforming our world: The 2030 Agenda for Sustainable Development," which aims to create a world free of poverty, hunger, disease, fear, and violence while also guaranteeing access to high-quality social protection, healthcare, education, and energy for all. (UN, 2015). These principles are in line with the human security concept, which provides a useful framework to improve the UN system's assistance in assisting nations to form all-encompassing alliances. With the help of these alliances, it is possible to create societies that are robust to both unexpected and jarring shocks in daily life as well as to persistent threats like starvation, disease, violence, and repression (United Nations Trust Fund for Human Security, 2016).

The human security strategy provides a practical way for the United Nations to collaborate successfully and utilize resources in an integrated manner when applied to Agenda 2030's SDGs. Lessons gathered from the implementation of human security show its benefit in reducing poverty and advancing sustainable development. Local context-specific analysis, a crucial component of human security, offers significant insights to further boost economic growth inside and between nations. The human security strategy promotes inclusive and multifaceted responses by addressing underlying causes and inequities, leading to substantial advancements in development on a global scale. Based on its fundamental goal of achieving freedom from fear, want, and indignity, the human security approach can assist in addressing issues caused by and contributing to enduring conflicts, marginalization, and extreme poverty. Human security can draw attention to the interdependence of these factors and ensure that strategies for reducing poverty pay attention to the underlying causes and corrective measures required to stop the persistence of violence and other forms of instability and stop their negative effects on the pursuit of inclusive and sustainable development. Therefore, the use of human security enhances and complements the procedures that will be required to achieve the SDGs. The human security approach can devise future responses,

policies, and plans in a more integrated and methodical way by conceptualizing the relationship between the many SDGs' components. It can help make clear how many concerns interact and necessitate mutually beneficial solutions to achieve more equitable and sustainable growth. It can help the United Nations system identify appropriate answers in this new direction and progress the crucial extension of the SDGs towards greater respect for human dignity and planetary sustainability for everyone based on its integrated guiding principles. (United Nations Trust Fund for Human Security, 2016).

CHAPTER 2

A Glimpse into Karachi's Climate, Water, and Poverty Profile

The current population in Karachi for the year 2023 is now estimated at 17,236,230. There were 1,055,380 people living in Karachi in 1950. In the past year, Karachi has grown by 396,280, or 2.35% annually. The former capital city of Pakistan, Karachi is also known to be the country's largest city and the capital of Sindh province. Over the past few years, Karachi has faced substantial growth, resulting in a metropolitan area that now houses over 23 million people. With a population density exceeding 24,000 individuals per square kilometer (63,000 per square mile), Karachi outstrips all other "megacities" with urban populations exceeding 10 million, except for Dhaka, Bangladesh, and Mumbai. This makes Karachi the largest city in Pakistan in terms of both population size and density. The city is growing at a ratio of around 5% per year, primarily because of rural-to-urban migration in the area and the 45000 migrant workers who come to Karachi in pursuit of better opportunities from all across Pakistan (World Population Review, 2023).

2.1 Climate Profile of Karachi

Anwar (2012) provides valuable insights into the precise geographical standing, topographical characteristics, and climatic features of Karachi city, which will serve as a crucial reference for this study.

Location

Karachi holds the distinction of being the largest city in Pakistan, spanning an expansive area of 3,527 km². Geographically, it is positioned between 24°45" to 25°15" north latitude and 66°37" to 67°37" east longitude. The city is surrounded by Dadu District in the northeast, Thatta District in the southeast, the Arabian Sea to the south, and the Lasbela District of Baluchistan Province to the west.

Topographical features

Karachi demonstrates a distinct geographical division, primarily recognized by its hilly regions in the north and west, contrasting with an undulating plain and coastal area in the southeast. The hills found in Karachi are extensions of the Kirthar Range, with the highest point reaching

approximately 528m in the extreme northern part. These hills, largely devoid of vegetation, are accompanied by expansive plains, dry river beds, and water channels. Positioned in the southern part of the city, Karachi boasts an extensive coastline, featuring renowned sea beaches such as Hawks Bay, Paradise Point, Sands Pit, and Clifton. Additionally, China Creek and Korangi Creek offer tranquil water channels ideal for activities like rowing. Further inland, one can discover small islands including Shams Pir, Baba, and Bhit.

Climate profile

Karachi has a generally temperate climate with a high degree of relative humidity. The driest month, December, has a humidity of 58 percent, while the wettest month, August, has a humidity of 85 percent. The people are greatly comforted by the evening breeze's presence. Winds blow from the southwest to the west for more than half of the year, including the monsoon season. The wind turns to the east and northeast throughout the winter, keeping the temperature at about 21 °C on average.

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Karachi City – The Context for Climate Change			
Flooding	Drought	Extreme Heat Events	Sea Level Rise
Significant human settlements (e.g. slums) exposed to fluvial, storm water flooding risk and hill torrents	The Hub River source, a rain fed source is a major water supply source for Karachi (5 million population served)	Inadequate health and emergency response infrastructure and services to cope with large scale spread of infectious diseases	Sensitive national installations and significant human settlements (fishing communities) exposed to tidal flooding
Sensitive national installations and significant human settlements (fishing communities) exposed to tidal flooding	Livelihoods of significant human settlements based in rural Karachi (Goths) dependent on farming mostly using ground water	Shortage in energy and substantial energy loss Energy consumption increasing and no efforts to promote energy conservation	Biodiversity impacts/wetlands and tidal zones and loss/alteration of flora/fauna – possible salt water intrusion
Other than the 'Malir River Embankment' no provision for flood defences and drainage channels choked or blocked	Ground water table is lowering and aquifers are threatened due to human activities such as sand extraction	Due to rising population density in 'inner city' and increased traffic /congestion the likelihoods of the 'Heat Island Effect' increasing even further	
No provision of flood storage areas	No water conservation, waste water recycling or rain water harvesting practices being promoted in the city		

Figure 1 Anwar, F. (2012). Karachi city climate change adaptation strategy

2.2 Informal Settlements in Karachi

There is a swift and uncontrolled informal settlement growth in Karachi, reflecting the increasing demand for housing among the low-income community in the city. Due to the limited availability of public sector housing facilities, new units are being added to existing Katchi Abadi's through land acquisitions and vertical growth to settle the increasing population. Additionally, plot sizes typically ranging from 80 to 120 square yards are used in informal subdivisions of public land and rural areas to create dwellings, frequent duplication of the designs of projects in the formal sector has also been observed. Informal settlements are also expanding within the planned residential and commercial districts, particularly in inner ring towns and labor colonies encircling industrial zones. These informal settlements have higher population densities compared to regular housing areas. However, the quality and coverage of basic amenities remain insufficient, and the houses are

mostly constructed as temporary (katcha) structures. Orangi, Baldia, SITE, Korangi, Landhi, Lyari, and Keamari are known to be the hotspots for these informal settlements. Despite the large-scale residential areas aimed at accommodating individuals from all across Karachi and from various income groups in areas like Taisar Town, New Malir, DHA Phase 8 and 9, Shah Latif Town, Scheme 33, Hawk's Bay, and Halkani, these areas are sparsely populated. Hence leading to a reasonable concern arising from the fact that even though hefty investments have been made in developing these plots, they are not being fully utilized or populated as they should be (Karachi Strategic Development Plan, 2020).

2.3 Karachi's Drainage and Sewerage Networks

Syed Sohail Akhtar and Dahnani (2012), discuss Karachi's drainage patterns in detail, which would serve as a crucial source for the study to comprehend the water-related challenges in the city. Karachi's drainage pattern can be identified as dendritic. The surface drainage of Karachi City is divided into 4 parts based on surface runoff and stream flow:

- a) Malir River Basin
- b) Lyari River Basin
- c) Budnai Basin
- d) Coastal Basin

The Malir River basin and the Layari River basins are the two most important basins that account for approximately 80 percent of the surface runoff. On the other hand, the Budnai Basin and the coastal basin are considered minor basins. In addition to that, there are several small and large channels within each basin that drains into the sea after collecting the surface runoff. *Figure 2*, illustrates the characteristics of each water basin.

Water Basins	
<ul style="list-style-type: none"> • The Malir River basin is the largest basin and source of surface runoff and sediments load. The Malir River forms as a result of the confluence of two main rivers the Mol River and the Khadeji River. The catchment area of the Mol River is about 620 square km and Khadeji River is 580 square km 	<ul style="list-style-type: none"> • The Budnai basin is drained by Budnai Nadi and number of small but powerful streams originating from the ridges of Orangi hills and Jhill hills in Mochko and around Sona pass. The total length of Budnai stream is about 46 km and its catchment area is about 95 square km
<ul style="list-style-type: none"> • The Lyari River originates from the hilly ranges of Manghopir anticlines from the north of the city and south of the Hub dam where its height is about 190 meters. Its catchment area is smaller than the Malir River because of its shorter length and smaller number of tributaries. Its total length is about 180 km while its catchment area is about 578 square km 	<ul style="list-style-type: none"> • The coastal areas of Bin Qasim, Korangi and Jhill hills are drained by many hill torrents and small streams which are very active during rainy days

Source: Surface Water Drainage and Flooding in Karachi City, S. Akhtar and M.R Dhanani, 2012, Department of Geography, University of Karachi, Karachi, Pakistan

Figure 2 Water basins (Anwar, F. (2012). Karachi city climate change adaptation strategy.

Besides the primary rivers i.e., Malir and Layari, the tributaries and lined drains also identified as *nullahs*, have a critical role in the city's drainage infrastructure. However, these drainage channels are experiencing serious strain. These drainage *nullahs* were not originally designed with a probability to accommodate the heavy rainfall events that Karachi is now experiencing. Secondly, the blockages and encroachments upon these drainage points have led to their inefficiency. Furthermore, Natural drainage areas, *nullahs*, and low-lying areas have all been altered into developed lands in the past to cater to population needs, as a result of improper land use practices, often without adequate arrangements for alternative or artificial disposal channels, normal flow conditions have been disrupted. Especially during heavy rain or storm events, leading to an unregulated storm drainage pattern. Additionally, a sizable amount of solid waste, particularly from surrounding neighborhoods, is routinely dumped into the open storm drainage channels. When storms strike, this negligent method of garbage disposal causes a complete blockage or partial obstruction of flow inside the drainage system. (Anwar, 2012). Karachi's Strategic Master Development Plan 2020 (2020), declared the aforementioned cause which led to the catastrophic floods that struck the city in 2006. Figure 3, illustrates the natural drainage basins in Karachi.

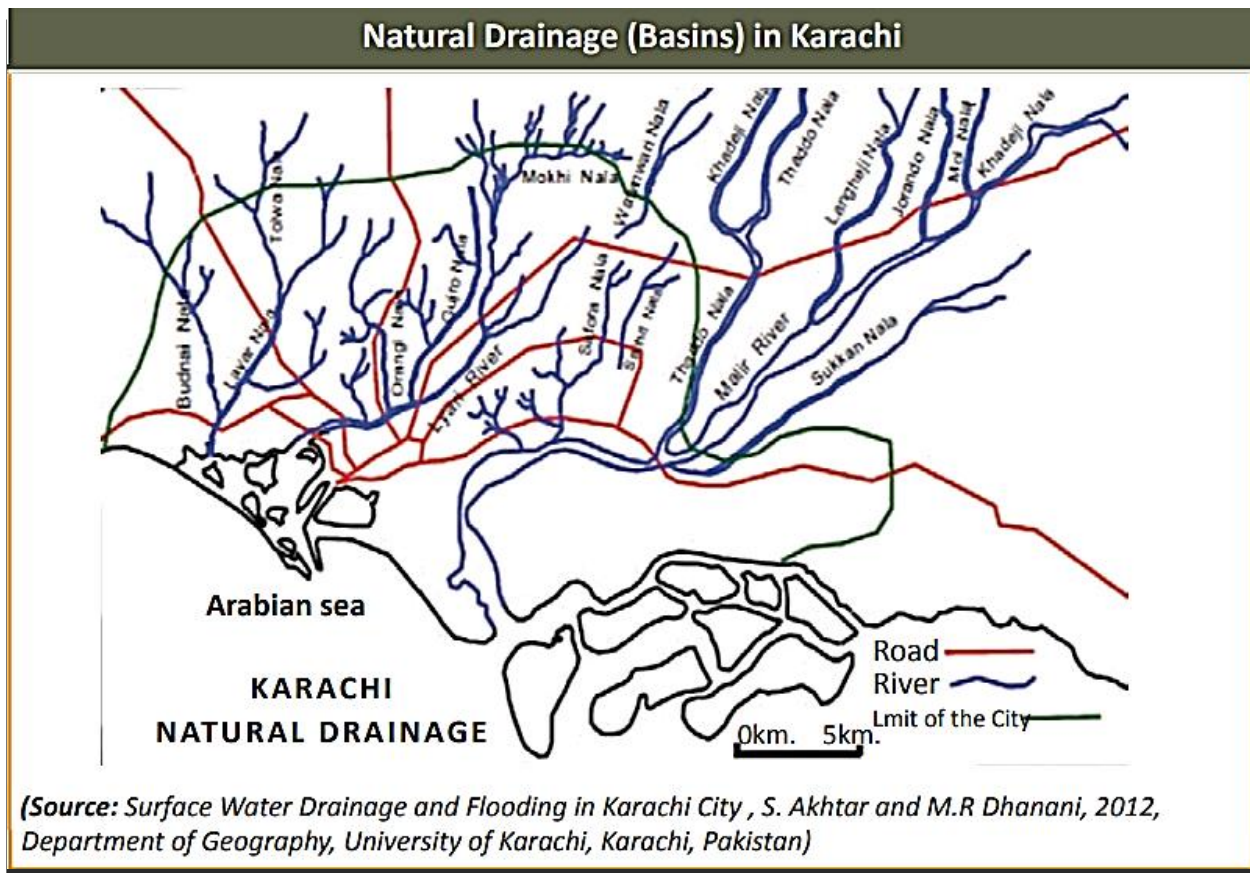


Figure 3 Natural Drainage Basins

Source: (Anwar, F. (2012). Karachi city climate change adaptation strategy.

In central and southern Karachi, three sewerage areas are linked to the existing treatment plants at SITE, Mehmoodabad, and Maripur through interceptors. However, in other areas, sewerage systems exist but directly discharge into *nallahs*, rivers, or the sea without undergoing any treatment. The main challenges within the system include inadequate coverage of the collection network, a lack of essential interceptors, insufficient capacity for wastewater treatment, and low operational efficiency of the existing treatment plants.

About 37% of Karachi's population was a part of the city's piped sewage system as of 1990. Sadly, there is a dearth of more recent information on this subject. It is significant to note that certain city neighborhoods have sewerage systems in place and are connected to interceptors, whilst other neighborhoods have sewerage systems that discharge directly into the environment. Because there is no infrastructure for piped sewerage collection in informal communities like Katchi Abadi's, waste flows through open drains and is dumped untreated into *nallahs* (drainage channels) and

ivers. On the other hand, industrial waste frequently pours into open sewers and goes straight into rivers or the sea without being treated.

When Karachi's sewer system was first constructed, between 25 and 35 years ago, it was situated near the road's surface. Making maintenance and repair work more difficult, it has now moved over time to a depth of five to seven feet below the road-wearing course. Larger pipes lack vent shafts, and this, together with the "crown effect," has caused pipes to sink along main arterial roads and in locations with a lot of commercial and industrial activity. Manholes that are both insufficient and badly maintained make the problems worse. A considerable amount of groundwater infiltration into the sewage network is caused by the existence of broken manholes and improperly sealed junctions. This infiltration puts a strain on treatment systems in addition to increasing the volume of wastewater. The majority of sewage builds up in *nallahs* (drainage channels) and the Malir and Lyari Rivers in the lack of sewer interceptors, effectively converting them into open sewers as they pass through Karachi's heavily populated regions. Residents of the area face considerable health risks as a result of these unhygienic circumstances, and the odors they produce are offensive to neighbors. Figure 4, Illustrates the major sewerage treatment lines and plants in Karachi.



Figure 4 Sewerage treatment plants
 Source: Karachi Strategic Development Plan 2020. (2020, July 19). Urban Resource Centre

CHAPTER 3

Research Findings

3.1 Drivers of Increased climate vulnerability, Water Insecurity, and Poverty in Karachi

Climate Vulnerability

As elucidated in the previous literature that climate change is now a reality and its effects are evident from its various impacts in different parts of the world (IPCC, 2007) the dominant effects of climate change on urban areas include (a) a rise in sea levels and storm surges, (b) extreme weather events and flooding, (c) heat waves and higher temperatures, (d) air pollution and reduced air quality, (e) water shortage and water pollution (Balaban, 2012). As for the impact of climate change on coastal cities, it is projected by the Intergovernmental Panel on climate change, that the sea levels are expected to rise by approximately 18 cm by 2040 and up to 48 cm by 2100 in the most extreme scenario (Prasad et al., 2009). In addition to that coastal urban areas situated in deltas, low-lying coastal plains, and islands are the most vulnerable to the threat of rising sea levels (Hunt and Watkiss, 2007). Urban Population areas with higher density also tend to experience the urban heat island effect, which results in temperatures in urban areas that are 5°C to 6°C higher as compared to the local urban areas (Wilby, 2007; Satterthwaite et al., 2007). Furthermore, it is widely recognized that urban cities will face more frequent and intense heatwave episodes, higher temperatures, and increased drought conditions (Hunt and Watkiss, 2007; Satterthwaite et al., 2007; Wilby, 2007).

Karachi is now progressing as a tangible demonstration of the challenges posed by climate change. Experts have warned that Karachi could be completely submerged by the year 2060 if the sea level rise continues at the current speed (Zaafir, 2021). Karachi city is situated on a coastal plain characterized by rocky outcroppings, coastal marshlands, and hills. Coastal mangrove forests are also located in the brackish waters surrounding Karachi Harbor and extend southeastward towards the vast Indus River Delta (European Space Agency, n.d.). It has been previously demonstrated that due to the current levels of rising population density in Karachi, the city is most likely to experience the urban heat island effect and due to rising sea levels the wetlands and tidal zones are at risk of possible loss of flora and fauna along with the continued loss of mangroves that serve as

a buffer against the risk of tidal flooding (Anwar, 2012). Karachi experienced some intense heatwave episodes in 2015 which resulted in around 1500 deaths and 50,000 people sick, in 2018, 65 people lost their lives in three days due to the heatwave, recently in 2022, Pakistan faced a record-breaking heatwave with the country experiencing highest temperature in march (Irfan, 2023).

An urban planning consultant, Farhan Anwar embarked on the climate-related challenges that Karachi is facing. In his interview, he argued that Karachi is susceptible to multiple climate change scenarios, encompassing flooding, extreme weather events, droughts, and rising sea levels. Karachi has experienced noticeable changes in climate patterns, including increased precipitation and more frequent occurrences of heat waves and extreme heat events. While conclusive research linking these changes directly to climate change is currently unavailable, the observed spike in exposure and vulnerability within the local communities is a significant concern. This is particularly notable due to the fact that half of Karachi's population resides in informal settlements, which are inherently more susceptible to climate-related risks. These settlements are often located in environmentally sensitive areas, such as floodplains, river beds, and hillsides prone to landslides, further amplifying the risks faced by the residents.¹

The insights gathered from expert interviews regarding the current impact of climate change on Karachi consistently underscore the city's growing vulnerability to its effects. While the interviews suggest that climate change is not the sole cause of the water and poverty-related challenges in Karachi, it serves as an aggravating factor, worsening the existing problems in the city.

Discussing the city's vulnerabilities to climate-related challenges in his interview, Muhammad Haseeb, an ecologist elucidated that Karachi's coastal geography offers certain benefits in terms of climate moderation. Being situated along the Arabian Sea, the city experiences a more temperate climate and fewer instances of extreme weather events like heavy rainfall or severe heat waves compared to inland cities. Additionally, the sea breeze plays a role in reducing smog formation, thereby improving the overall environmental conditions in Karachi. However, despite these advantages, Karachi is not immune to the consequences of regional climate change. In recent

¹ Interview with Farhan Anwar, Urban Planning Consultant, 02.05.2023.

times, the city has witnessed an increase in extreme climate events, particularly heatwaves. The rapid growth of the population and high population density have contributed to the escalation of heatwave occurrences in Karachi. Adding to the existing climate deficiencies, Haseeb asserted that a climate change policy has been formulated at the provincial level, but there is a notable absence of comprehensive planning to address the specific challenges faced by cities like Karachi. (Interview with Muhammad Haseeb, Ecologist, 12.05.2023)². Another expert respondent, Moonis Ahmer, also warned for a tsunami-like situation in Karachi could result bring massive devastation to the city, given the existing sea level rise.

Existing studies highlight the significance of building climate adaptability and resilience strategies and the necessity to understand the urban microclimate to cope with the complex challenges climate change may bring within an urban setting (Borrego et al., 2018). Elaborating on the impact of climate change on issues such as water insecurity and poverty in the city the research findings revealed that Karachi's challenges primarily stem from governance issues rather than climate-related factors. While climate change does pose a non-traditional security threat to Pakistan, particularly in terms of environmental security, water security food, and security the factors affecting Karachi such as ethnicity, municipal issues, and inadequate provision of civic services like waste management, water, and sanitation are unrelated to climate change. Instead, these challenges are directly linked to governance and administrative shortcomings.

The interviews emphasized the dearth of climate adaptation measures in Karachi, exposing its vulnerability and inadequate preparedness to cope with potential major environmental catastrophes. The severity of challenges associated with urban development, water insecurity, and poverty faced by the city further compounds its inability to effectively combat these risks. As a result, Karachi finds itself ill-equipped to address the pressing climate-related concerns it currently confronts.

Water Insecurity in Karachi

Research findings on water insecurity issues in Karachi demonstrate that the city has been grappling with water-related challenges, particularly urban flooding, water supply and distribution

² Interview with Muhammad Haseeb, Ecologist, 12.05.2023

issues along with the poor quality of water, which will be discussed further by sharing the expert views that were gathered during the data collection phase.

Urban Flooding

Rampant urban population growth and ineffective city administration have resulted in urban sprawl in Karachi. The unbridled expansion of infrastructure and buildings has led to a reduction in the absorption capacity of soil to absorb water leading to increased surface runoff. In addition to that the city's stormwater drains and sewerage systems often share the same outlets causing the discharge of domestic sewerage and polluted industrial water into the natural water channels. This situation is further aggravated due to the poor implementation of land use plans and building control bylaws as there are many natural drainage channels and low-lying areas which have been into settlements and slums. (Anwar, 2012)

Shahid Lutfi, an Environmental Engineer, identified unplanned urbanization as the primary cause of water-related shocks in Karachi, particularly urban flooding. In his interview, he reaffirmed that water issues in Karachi are intimately linked with urban practices. He further discussed that Karachi has witnessed extensive concretization, with minimal green spaces and an inadequate drainage system. In the respondent's comments:

The Lyari River has multiple tributaries that historically aided in channeling rainwater out of the city. However, due to ongoing development projects, these tributaries and their natural drainages have been blocked. The city's planning, which initially incorporated approaches and drainages for these rivers in the 1940s, 50s, and 60s, gradually diminished over time and almost disappeared by the 1990s. The flow of water requires a certain cross-sectional area. When the width of a drainage channel decreases, the water level rises, impeding proper drainage. Unfortunately, houses in Karachi have been constructed in catchment areas where water flow was expected, and the streets are extremely narrow. As a result, the city experiences urban flooding after rainfalls, and it takes hours for the water to recede. In addition to that, drainage sections, such as canals (*nalas*), have been reduced in size due to encroachment. For example, if a *nalla* was originally 5-7 kilometers in length, its capacity to

retain water is significantly diminished when it is encroached upon or its size is reduced. This exacerbates the problem and adds to the severity of the issue.³

The risk of flooding in Karachi has significantly increased due to encroachments and obstructions in and around the drainage basins. Illegal settlements and encroached river banks on the Malir River resulted in a high flood in 1977. Several densely populated settlements including Azam Basti, Kashmir Colony, Rehman Colony, Liaqat Ashraf Colony, a portion of Mahmoudabad, and a few parts of DHA have emerged, consequently, the river's width has been reduced. An example could be Qayyumabad where the original 5000 ft. floodplain has now been reduced to only 550ft (Akhtar and Dhanani 2012). The same situation was witnessed in the case of Layari River, Gujjar Nala, Orangi Nala, Safora Nala, Sukkun Nala, etc. (Akhtar and Dhanani 2012).

Urban flooding also became a significant concern, with encroachments on drainage channels impeding water flow. To study the problem of encroachments on drainage channels Parveen Rehman mapped the affected areas and highlighted the role of land grabbers, including the government and wealthy individuals, in obstructing the drainage system, as highlighted by interviewee Aquila Ismail.⁴

Elaborating on the flood issue in Karachi, Aquila professed that Karachi is equipped with more than 56 natural drainage channels that effectively facilitate the flow of water into the sea. However, the issue arises when these drainage channels face obstruction due to illegal encroachments by various entities, including the government and affluent individuals. Examples of buildings, houses, parking lots, and garages constructed over these channels were cited, with even renowned institutions such as Agha Khan Hospital found guilty of building their parking lot over a *nulla* (drainage channel). It is crucial to note that these encroachment practices are primarily carried out by the wealthy class, not the poor. The issue of flooding in old Karachi was specifically attributed to the encroachment of the Soldier Bazaar Nalla. Extensive research has been conducted, and the findings have been made public, highlighting the urgent need for the removal of these encroachments to mitigate the recurring issue of flooding. The maps designed by Parveen Rehman,

³ Interview with Shahid Lutfi, Environmental Engineer, 5.04.2023.

⁴ Interview with Aquila Ismail, Chairperson Orangi Pilot Project Research and Training Institute, 30.05.2023.

which identify various impediments and encroachments, resurface each time Karachi faces flooding.

Overall, the interviewees emphasized the removal of encroachments as a potential solution to address urban flooding in Karachi. However, an article by Hassan (2020) presents a more nuanced perspective, suggesting that the situation is considerably more complex than solely focusing on the elimination of encroachments. Hassan (2020), highlights the multiple factors that are potential contributors to urban flooding in Karachi. From the author's perspective firstly the encroachments, particularly by the residents of informal settlements, along with the accumulation of solid waste in nullahs (drainage channels) are believed to contribute to the flooding problem. Even, the local government built a number of bazaars over the nullahs, including the Urdu Bazaar and the Tyre Market, as a result of the lack of progress on Karachi's development plans and the demand for more space for commercial activity. In the meantime, the Government of Sindh has built buildings on the nullahs for its own purpose, including offices, an MPA hostel, parking lots, and even the Supreme Court of Pakistan's registry. Additionally, a portion of the Women's College on Burnes Road and a bank are also built on nullahs. It is known that Karachi's stormwater drains into the Layari and Malir rivers, which are supported by a network of drainage channels/nullahs. However, due to unrestrained urban expansion and the absence of alternative sewage systems, the nullahs have become a primary means of sewage disposal, leading to the accumulation of sludge and waste. In addition to that land reclamation, both for low-income and elite residential purposes, using solid waste has been observed. This practice, though illegal has resulted in the reclaimed land being utilized for housing which further stresses the drainage system and leads to severe flooding. The outlets to the sea have also been blocked or reduced in size, hindering the disposal of stormwater. This situation is observed in various areas, such as Gizri Creek estuary, China Creek backwaters, and Pitcher nullah. Lastly poor drainage designs, such as roads that act as barriers to stormwater flow or inadequate conduits lead to water accumulation and flooding. Additionally, stormwater from buildings and real estate projects often drains onto roads, swarming the existing sewage system and exacerbating health hazards.

Water Supply and Distribution

In terms of water supply, Karachi confronts significant challenges both in quality and quantity. The existing surface water resources are not sufficient to meet the current demand of the

population, let alone the anticipated growth of the city in the next 15 years. The quality of drinking water is subpar, having notable deficiencies due to inadequate filtration and treatment processes. The Indus River supplies 646 million gallons per day (MDG), and the Hub River dam, contributing 60 MDG, serves as the primary water source to meet Karachi's population, institutions, and business water needs. Nevertheless, even these water sources collective is insufficient to meet the existing demand, consequently, water being rationed for only a few hours per day. (Karachi Strategic Development Plan 2020, 2020)

Niloufer Siddiqui, a distinguished faculty member at the University at Albany-State University of New York, shared her valuable insights during an interview regarding the water supply and distribution challenges in Karachi. Her views on the subject revealed that the problem of water scarcity is a pervasive issue faced by everyone in Karachi, although its impact is more pronounced among those unable to afford private water tankers. Access to water does not solely depend on income. Even affluent areas often need supplemental water sources. However, low-income households face the greatest challenges due to their limited financial means. In her remarks:

The Karachi Water and Sewerage Board (KWSP) is responsible for providing water through the pipeline network. However, not all parts of Karachi have full access to these pipelines, and even where access exists, the water supply is intermittent. High-income areas like Defense Housing Authority have their own public benefit corporations to ensure water provision. Additionally, the Karachi Water and Sewerage Board supplies tankers on demand when water runs out, and in the past, the Rangers (a paramilitary force) have also provided tankers. Private water companies and the water tanker mafia further contribute to the complex water supply landscape. When Karachi was initially developed, the infrastructure included pipelines for state-supplied water to reach various areas. However, as the city expanded, newer areas, including both slums and places like DHA (Defense Housing Authority), lacked the same infrastructure as older areas like Nazimabad. Interestingly, the issue of access to water does not directly correlate with income. Even affluent areas often rely on supplemented water, while low-income individuals bear the

brunt of the problem due to their inability to afford such supplements. They must use water judiciously. The problem with the private water system and the water mafia is twofold. Not only do they sell contaminated water, but they also charge exorbitant prices. Consequently, people receive a small quantity of water at extremely high costs. In informal settlements, such as slums, dependency on non-state water sources is almost absolute. Water tankers play a vital role in these areas, but the water is often purchased at rates up to 30 times higher than what the government charges, putting a significant financial burden on residents.⁵

Water Mafia in Karachi

Research findings further unfold the role of the Tanker mafia in Karachi, which further contributes to the inadequacies in water distribution and supply.

As per the Karachi Master Plan 2020 (2020) highlights, the Hub River's decreased water flow as a result of lower precipitation levels has impacted its capacity to supply the city's water needs, which is another climate change effect contributing to flooding. Only 60% of the bulk water supply is filtered, and the remaining 40% is only chlorinated to disinfect it. As a result, consumers frequently experience poor water quality. Karachi's water distribution system which is around 40 years old, is in a dilapidated state and in urgent need of repair. In addition to concealed valve chambers and air relief valves, rusty pipelines decrease the system's ability to transfer water properly.

The distribution system experiences limited periods of pressurization, causing abrasion on the pipes and hence ideal conditions for contamination when the pressure is low, posing risks to public health. Technical losses due to the deterioration of the distribution system account for an estimated 25% of water production, resulting in a reduced net water supply. Over the years, both legal and illegal direct connections have been made to main transmission channels, compromising their performance. Inadequate storage tanks at the metropolitan and town levels, particularly in low-income settlements like Katchi Abadi's, pose a risk of extended periods without water service for local residents.

⁵ Interview with Niloufer Siddiqui, Professor at University at Albany-State University of New York, 23.05.2023.



Figure 5 Existing Water Supply Network (Karachi Development Plan 2020)

In an article, Hashim (2017) avows that approximately, 550 million gallons of water a day (MGD), finds its way to Karachi’s main pumping station Dhabeji, following a complex network of canals and conduits. However, this supply fails to reach its intended recipients, as a whopping 42 percent, equivalent to 235 MGD, is lost or pilfered before it reaches the consumers as reported by Karachi’s Water and Sewerage Board. As per the United Nations standards for water consumption in a megacity of over 20 million residents, Karachi’s daily water demand should ideally stand at approximately 1100 MGD. However, if we were to be conservative in our estimation, the existing water supply in Karachi should be sufficient to cater to the population’s needs only if it actually reaches the targeted population. asserts Ovais Malik, KWSB's chief engineer, who brings over 12 years of experience to his role at the utility.

Dr. Moonis Ahmer, an assistant professor at the University of Karachi, signaled towards the K4 project which has been quoted as the ultimate remedy for Karachi's water distribution and supply challenges, often referred to as the city's Achilles heel. In his assertion, in order to address the significant disparity between water supply and demand in Karachi, where a staggering daily demand of 1.1 billion gallons clashes with the city's current allocation of 650 million gallons, a

project known as K4 (Karachi-4) was initiated during the regime of General Musharraf in 2005-06. The objective was to tap into the abundant resources of Keenjhar Lake and provide a substantial daily water supply of approximately 200 to 250 million gallons. Regrettably, this ambitious project, launched in 2016, has encountered substantial setbacks, primarily reflected in its soaring costs. Initially estimated at 25 billion rupees, the project's expenses have ballooned to a staggering 250 billion rupees.⁶

In an interview, Aquila Ismail, a prominent civil society activist and chairperson of the Orangi Pilot Project Research and Training Institute (OPPRTI) highlighted the efforts of the Orangi Pilot project in its battle against the water mafia in Karachi. She proclaimed that in the 2000s, the water situation in Karachi deteriorated as water theft became rampant, diverting water meant for the poor to profit-seeking individuals and corrupt officials. She commented:

We exposed this issue through covert data collection, engaged our teams on the ground, and conducted action research. After considerable research we exposed this mafia's 5 billion enterprises involved in water theft and published reports afterwards, leading to public awareness and media attention on the issue. Despite the potential dangers faced by Parveen Rehman and her team, the government was compelled to take action under mounting pressure following the revelations of the report, resulting in the closure of illegal hydrants and improved water distribution, with residents receiving water every 15 days. However, the situation gradually reverted to its previous state. The relocation of hydrants, which was supposed to be monitored by authorities such as the police or water board, fell back into the hands of those who were involved in supporting such practices. The water crisis reemerged and worsened as the water mafia regrouped and began operating in a more organized manner, deepening the challenges faced by the residents.⁷

According to Noman Ahmed head of the architecture and urban planning department at Karachi's NED University, the water tanker industry in Karachi is known to be the most lucrative than any

⁶ Interview with Moonis Ahmer, Former Dean Faculty of Social Sciences, University of Karachi, 11.05.2023

⁷ Ibid.

other industry with over 10,000 water tankers traversing the city and taking almost 50,000 trips on a daily basis. Although they are intended to reach the water hydrants operated under KWSB, due to the presence of more than 100 illegal hydrants across the city, they end up tapping into the city's main lines to steal the water. Anwar Rashid, another director at the Orangi Pilot Project (OPP) asserted that the 100 illegal hydrants are the only ones that have been identified so far, the illegal hydrant network is continuously expanding, with new ones resurfacing on a regular basis, evading detection and intensifying the water theft crisis (Hashim,2017).

Poverty in Karachi

In a metropolitan setting, poverty is not evenly distributed and Karachi is one living example. However, if we are to identify poverty in an urban setting we can distinguish between affluent and non-affluent classes in the city (Altaf et al., 1993). As we mentioned earlier in chapter two, while understanding the poverty issues in a prosperous city like Karachi with respect to the national poverty line, it may appear that Karachi is above that poverty line, suggesting that the city is not poor as compared to the national average. Hence it may be necessary to develop a Karachi-specific relative poverty line to accurately assess the extent of relative differentiation in the city. secondly to that only focusing on income to understand poverty in an urban area might be inadequate and special focus must be positioned on basic services, quality of living conditions, social disparities, etc. (Zaidi, 1997). The consensus among the interviewees was that poverty in Karachi is concomitant with the presence of slums and informal settlements.

Giving us a glimpse of poverty in Karachi, Interviewee, Muhammad Haseeb, an ecologist, professed that Poverty is a glaring issue in Karachi, as evidenced by the high poverty rate where around 70% of the population earns less than 1.25 dollars per day. From his perspective, poverty is particularly prevalent in the slums of Karachi. A significant contributing factor to poverty in the city is the massive influx of migrants from various regions of Pakistan, who arrive in search of employment opportunities. The large-scale migration has further exacerbated the growth of slums within the city. The issue of poverty in Karachi is solely related to unplanned and rigorous urbanization.⁸

⁸ Ibid.

It is evident in the literature that the rapid urbanization of Karachi has placed immense pressure on the city's capacity to adequately provide urban services to its residents. In response to the challenges posed by this rapid growth, five master plans have been devised since 1923. However, none of these plans have been supported by legal backing, leading to uncontrolled urban expansion, the proliferation of Katchi Abadis (informal settlements/slums), and significant deficiencies in essential infrastructure and utilities. These constraints have limited the potential and opportunities for the City District Government Karachi (CDGK) to effectively address the needs of Karachi's residents (Qureshi, 2010).

Environmental expert, Shahid Lutfi, highlighted another compelling perspective on poverty by identifying the mismanagement of land resources. In his assertion, Karachi exhibits lower poverty rates due to its continuous growth and prosperous sectors. The city experiences a high population growth rate and attracts migrants from various regions seeking better employment opportunities. Karachi's affordability in terms of food contributes to its lower poverty levels. However, it is important to acknowledge that Karachi is not a typical metropolis, but rather a conglomerate of large slums. These areas face numerous development restrictions, resulting in inadequate sanitation and insufficient water distribution. A factor that is concomitant to existing poverty in Karachi is the absence of governmental departments actively working to restrict the conversion of agricultural land into real estate. In his remarks,

This practice of agricultural land into real estate land not only exacerbates the effects of climate change but also leads to increased unemployment and rural-urban migration. As agricultural land continues to be converted, the production of essential crops such as cereals and grains declines. With a growing population, this creates a significant gap between food supply and demand, leading to heightened food insecurity and deepening poverty. To address the needs of the expanding population and bridge the supply-demand gap, it is crucial to prioritize the expansion of the agricultural sector. The decline in agricultural land and cereal production is closely intertwined with the adverse impacts of climate change. The reduction in

agricultural resources further contributes to poverty and food insecurity within the city.⁹

As per Karachi development plan 2020 (2020), Karachi City is driven by a robust real estate market, and Karachi has registered an unequivocal growth in residential neighborhoods. This transformation can particularly be seen along main arterials, various intersections, and land with high monetary value from a commercial standpoint. Offices and retail spaces are replacing ground-level residencies, and some homes are being demolished to make way for multi-story structures with commercial space on the ground floor and apartments above. The G+1 height limit is being disregarded and developers are building additional floors within the existing house.

This pattern is especially evident in areas that are fast-growing, such as North Nazimabad, New Karachi, and Gulberg, where the commercial and cottage industrial sectors are expanding significantly. However, without a proportional investment to increase their capacity, this vertical expansion strains already-existing infrastructure networks, adding to the stress on the infrastructure.

In an interview with Aquila Ismail, she discussed the significant programs initiated in the 1980s, particularly the low-cost sanitation model, and the urgent need for improved water and sanitation services due to the prevalence of diseases and inadequate disposal systems. The approach taken by the OPP (Orangi Pilot Project) aimed to empower the local communities by involving them in self-built initiatives, challenging the traditional concept of development. Aquila Ismail emphasized the importance of learning from the everyday efforts of the poor in their quest for better lives. The OPP, led by Aquila's sister Parveen Rehman, sought to establish strong connections with the community through extensive dialogue and interaction, forming what they referred to as a "Rishta" or relationship with the community members. The primary focus was on environmental cleanliness and waste disposal, as it was recognized that a clean environment was essential for economic progress, education, and the rights of individuals, especially women.

The OPP model involved a collaborative approach where the community contributed their efforts, which enabled them to advocate for the government's support. The project was divided into internal and external components. The internal component involved the community working together at

⁹ ibid

the lane level, taking responsibility for sanitation improvements and waste disposal within their own lanes. The OPP provided designs, training, and monitoring support, while the community financed and implemented the work themselves. By investing in these initiatives, the community gained ownership and leverage to demand further action from the government. This included the development of secondary and main sanitation infrastructure, such as sewage lines and treatment plants. The OPP also facilitated connections between the community and the government, urging them to fulfill their part of the responsibility and assist in making the initiatives cost-effective. This approach fostered a partnership between the people and the government, where the community played an active role, and the government recognized and supported their efforts. Aquila Ismail acknowledged that it may seem unconventional for a large government to partner with an organization like the World Bank to obtain a gutter line, but this collaboration demonstrated the effectiveness and ongoing impact of the approach. The success of the OPP's efforts in sanitation was evident as the community transformed their lanes, improving their living conditions significantly. They extended their efforts to laying water lines, although this posed more challenges due to the government's control over the water supply. Nonetheless, the concept of community empowerment and self-service gained traction in Orangi and other Katchi Abadi's (informal settlements) across the country. Stating the power of community work and self-servicing Aquila referred to the unprecedented cloud burst episode in Karachi during 2020, while areas like DHA (Defense Housing Authority) experienced knee-deep water, Orangi Town remained relatively unaffected. This was attributed to the efforts of the Orangi Pilot Project (OPP) in raising awareness among the local community to clean and maintain their nearby drainage channels, allowing water to drain quickly.¹⁰

Overall, Aquila's interview shed light on the OPP's approach, which emphasized community involvement, government partnerships, and self-sufficiency. Through the OPP model, communities were able to acquire technical knowledge and the capacity to undertake their own development initiatives, leading to a sense of empowerment and sustainable change.

The literature provides numerous examples of collaborations between international organizations, non-profit organizations, and local communities to address community issues. These cases highlight partnerships where external entities join forces with local communities to provide

¹⁰ Ibid.

assistance and support in tackling various challenges. For example, in 2015, a joint effort was initiated by UN-Habitat, with the Nairobi City County Government, the Dandora Transformation League, and the Making Cities Together Coalition. Their aim was to upgrade a particular street in Dandora and demonstrate the process of co-creating public spaces. Together with the residents, various initiatives were undertaken, including the remodeling of open spaces, clearing of storm drainages, and establishment of resident-led security management. The project also involved planting trees, paving roadways, installing waste bins, and constructing gateways. The transformation of this street served as a model project, showcasing the potential for positive socio-spatial change and inspiring replication in other areas (UN-HABITAT, n.d).

Impact on Sustainable Development Agenda 2030

Another major research question for this study was related to investigating the impact of Karachi's urban challenges and if it will negatively impact the prospects of Pakistan joining the League of upper-middle-class Nations by 2030. The primary objective of this study was to investigate the broader implications of these challenges in Karachi on Pakistan's progress toward the SDG agenda and its aspiration to become an upper-middle-class nation by 2030 and particularly the SDG goals 1, 6, and 13. To gain insights into these issues, we conducted interviews with various experts. The findings from these interviews highlighted a prevailing skepticism among the interviewees regarding Pakistan's ability to fulfill its SDG agenda. They expressed doubts that the country is far from achieving its goals. Furthermore, the interviewees unanimously emphasized the significant role Karachi plays in Pakistan's sustainable development agenda. They acknowledged that the challenges faced by Karachi would undoubtedly impact the country's overall progress toward the SDGs. The complex nature of these challenges in Karachi, being the largest city and economic powerhouse of the country, poses considerable obstacles to achieving sustainable development targets.

Shahid Farooq, an expert in sustainable development and adapting social protection, was interviewed to gain his valuable perspective on the issue. During the interview, he highlighted the critical governance issues that pose significant obstacles to Pakistan's prospects of achieving its SDG agenda for 2030. His insights shed light on the inconsistencies and challenges faced by the country, providing a comprehensive understanding of the barriers that hinder progress toward sustainable development goals. In his argument, Karachi, being a significant city in Pakistan, holds

the potential to contribute to the achievement of sustainable development goals (SDGs). However, focusing solely on achieving these goals within the indicators of one city may not effectively reflect the overall SDG performance at the national level. From the interviewee's perspective it is important to consider that after the completion of the SDG phase in 2030, there will be a comprehensive analysis of how cities have contributed to the goals, as urban development itself is one of the goals. In addition to Farooq's argument when working on sustainable urban planning, various aspects such as health, education, water supply, governance, and human rights need to be taken into account. Strengthening these areas at the level of Karachi, which represents a significant portion of Pakistan's population (around 15 to 20%), can contribute towards sustainable development goal progress. However, it is crucial to acknowledge that the impact at the national level requires a broader commitment and concerted efforts from across the country. The respondent stated with regret that, unfortunately, Pakistan's National Volunteer review of SDGs conducted last year revealed limited progress. While there were programs labeled as SDG initiatives, many of them seemed to be designed primarily for political support rather than genuine progress. For instance, substantial funds were allocated for strengthening SDGs, but the focus was often skewed towards specific areas such as water, sanitation, and energy projects, neglecting critical aspects like health and education. Political motivations and World Bank requirements seemed to take precedence over comprehensive SDG implementation. Currently, there is a lack of understanding and willingness at the government level to overcome these challenges and steer the country toward achieving the SDGs by 2030. The Millennium Development Goals provide a relevant example. Despite a comprehensive 1600-page report on Pakistan's progress, attributing failures solely to terrorism was a simplistic approach that failed to address the underlying issues hindering goal attainment. Closing the argument, he stressed that while the contribution of productive citizens in Karachi towards the SDGs is important, it is essential to recognize that overall national progress on the SDGs requires a comprehensive approach that encompasses the entire country. Merely focusing on a specific chunk of the population, without a broader commitment and understanding at the national level, will not significantly impact the overall SDG performance. Therefore, it is crucial for the government to foster a comprehensive understanding and commitment to achieving the SDGs by 2030.¹¹

¹¹ Interview with Shahid Farooq, Sustainable Development Expert, 17.05.2023

In the same vein, interview respondent Dr. Irfan,¹² a senior environmental consultant, anchored his arguments on the premise of poor governance, forming the basis for his discussion. As per his rationale, despite being halfway towards the 2030 deadline for the Sustainable Development Goals (SDGs), progress in achieving these targets has been limited. Technical capacity limitations, inadequate policy implementation, and institutional weaknesses have hindered our advancement. The promised support from developed nations, as outlined in the Paris Agreement, has not been fulfilled adequately, making it challenging for our institutions to access the assistance available. This is evident in our inability to secure projects like GLOF-2, which focused on addressing glacial lake outburst floods. Pakistan, including Karachi, faces heightened vulnerability to climate change impacts, further exacerbating these challenges. Insufficient capacity and coordination among institutions contribute to the problems faced by Karachi, which has expanded to the extent that it resembles a country in terms of its complexity. Issues related to water, sanitation, municipal services, and local governance often take precedence, while disputes over census data complicate resource management. He remarked,

Based on my extensive experience as an international consultant, I have concluded that Pakistan's paramount hurdle lies in its governance deficiencies. To triumph this obstacle, it is imperative to enhance governance systems and accord higher precedence to administrative affairs over political conflicts. This entails fortifying democratic institutions, particularly at the local government level, and endowing them with greater responsibilities and authoritative power. By adopting such measures, we can effectively confront the multifaceted challenges encountered by the populace, particularly those residing in Karachi, and forge ahead in the pursuit of attaining sustainable development goals.

¹² Interview with Dr. Muhammad Irfan, Senior Environmental Consultant 12.04.2023

CHAPTER 4

Route To Climate Resilience, Water Security and Eliminating Poverty: Policy Strategies for Karachi

As the study has examined the underlying factors contributing to climate vulnerability, poverty, and water insecurity in Karachi through extensive research and analysis, it will now explore potential policy options for the city. To develop effective strategies, it draws insights from other metropolises around the world that face similar challenges as Karachi. By examining the policy measures implemented in these cities, we can gain valuable insights into how they are addressing and mitigating these challenges in each domain. Throughout the data collection phase, experts that were interviewed conveyed a notable level of uncertainty and skepticism regarding Karachi's ability to adapt to climate change. As a result, they emphasized the urgent need for prompt action to address this issue.

Megacity Challenges: Climate, Water, and Poverty

Megacity Challenges: Climate, Water, and Poverty	
City	Major Challenges
Cape Town	Water scarcity and potential distribution conflicts, increased energy consumption, heat-related health risks, increased water use, flooding (beaches, shorelines, coastal areas, infrastructure), and stresses (fire) on indigenous vegetation.
Delhi	Delhi Water shortages, heat waves, higher energy demands, flooding, rise in disease vectors, urbanization in vulnerable areas, rising migration, and increasing poverty levels.
Lagos	Extreme temperatures, extreme precipitation events, coastal storm surges, sea level rise leading to coastal flooding and erosion, poor water quality, dense informal settlements, and informal water supply issues.

City governments have started to place a greater emphasis on making their cities adaptable to the inevitable effects of climate change. In its 2007 Fourth Assessment Report (AR4), the Intergovernmental Panel on Climate Change (IPCC, 2007) concluded that there is a greater than 90 percent chance that the average global temperature increase over the last century was primarily

caused by human activity. However, in the existing literature, the climate-induced challenges within the context of cities have not received much attention (Rosenzweig et al. 2011). In order to advance, Karachi's urban resilience, infrastructure, and services demands comprehensive master planning, advanced disaster management capabilities, and shared responsibility among stakeholders. It is imperative to reconsider the city's governance structure in order to address the pressing urban challenges faced by its residents and foster the development of sustainable cities for the years ahead. (The News, 2022).

Seven master plans have been proposed for Karachi throughout its history, with two of them being introduced even before Pakistan's independence in 1947. Despite these efforts, there have been significant obstacles in the way of actual implementation of these master plans. Among the seven plans, only the first one, put forward by A.E. Miram in 1922, received complete approval and was successfully executed. The subsequent plan, presented by Colonel Swain Thomas in 1946, along with the five following plans, encountered various difficulties such as delayed publication, inadequacy in aligning proposals with the prevailing circumstances, legal and technical deficiencies, and limited execution (Toheed, 2023).

Toheed (2023), offers a historical reflection of the master plans proposed for Karachi since the independence and the factors behind their potential failure. In his perspective, the failure of master plans in Karachi can be attributed to various factors, including the absence of concrete data, inadequate community participation, poor governance and lack of coordination among government institutes political intervention, and poor execution. Due to the lack of comprehensive and accurate data informed decision-making regarding the city's development has suffered detrimental consequences. In addition to that the absence of community engagement has resulted in a disconnect between the planning process and the needs and aspirations of the residents.

Diverging interests and weak coordination among government departments have led to inconsistent plans for Karachi. Political considerations and corruption have at times influenced the planning process, resulting in poor decision-making on behalf of the community. Insufficient coordination between government agencies, a lack of political commitment, and a lack of resources can all be blamed for the plans' ineffective implementation. Addressing these issues and prioritizing the availability of thorough data, meaningful community input, and efficient

implementation throughout the planning process is essential if future master plans are to be successful.

Policy lessons from megacities worldwide

This section aims to explore various case studies of megacities worldwide, focusing on their adaptation plans. The intention is not to draw direct comparisons but rather to extract policy lessons that can be applied to Karachi. By delving into the unique aspects of each city, including their status as megacities, we will examine how they have tackled similar challenges such as climate vulnerabilities, water security issues, and poverty-related concerns. The insights gained from these cities will provide valuable information and open avenues for future researchers and policymakers in Karachi, fostering a deeper understanding of the issues at hand and potentially facilitating policy comparisons.

The incentive for adaptation action in the discussed cities is driven by local stakeholders' clear awareness of climate change vulnerability and perceived risks. Prioritizing community safety and minimizing disaster impacts are key objectives in many adaptation plans, as evident in the case of Cape Town. These plans are intended to support and upgrade existing strategies, incorporating mainstreaming of adaptation actions with local development goals. This approach guarantees to promote consistency rather than a radical change in local priorities. However, the specific focus of adaptation strategies varies among cities, in the case of Cape Town the city's primary adaptation plans are connected to existing environmental programs. However, it is important to note that strong local leadership is essential for successful adaptation action. Local politicians and personalities play a substantial role in driving city-level adaptation efforts. Their motivation stems from the desire to gain recognition as innovative and future-oriented, both on regional and international platforms, as demonstrated in the case of Delhi. Additionally, local leaders aim to showcase good governance to residents and stimulate innovation in local administration. Cape Town's slogan "The city is working for you" serves as an example. Cape Town has implemented an all-inclusive and coordinated framework for climate change adaptation, incorporating both the direct impacts on natural resources and monitoring the subsequent socioeconomic consequences for local communities. This approach acknowledges the specific challenges posed by climate change and proposes targeted strategies to address these challenges effectively. By considering the interplay between environmental and socioeconomic factors, Cape Town's adaptation framework

strives to create a holistic response that ensures the resilience and well-being of the city and its inhabitants (Mukheibir and Ziervogel 2007).

Cape Town has adopted a proactive approach by developing a dedicated "framework for adaptation to climate change." This framework explicitly addresses the challenges posed by climate change and outlines specific strategies to mitigate its impacts. Furthermore, Cape Town's adaptation measures prioritize defensive actions and measures, particularly in response to coastal risks such as sea-level rise and extreme events. The city's framework emphasizes the need to safeguard natural resources and socioeconomic conditions while considering both the direct and secondary impacts of climate change. In Cape Town, the institution responsible for environmental resource management within the Department of Environmental Affairs, Development, and Planning takes the lead in climate adaptation efforts. This indicates the city's strong focus on environmentally sustainable development and reflects the presence of a dedicated agenda in this area. Furthermore, each city adopts distinctive approaches to engage the stakeholders such as civil society, private sector entities, and local communities. In Cape Town, the 'Water Conservation and Water Demand Management (WCRSS) initiative employs various productive techniques such as newspaper advertisements, capacity-building exercises, public meetings, newsletters, and workshops engaging the stakeholders. As a consequence, these efforts aimed to promote behavioral change and encourage sustainable water consumption practices among citizens (Hoorweg et al., 2011).

The government of Delhi has dedicated significant efforts to address climate change through mitigation measures, with a particular focus on areas such as energy, water, transportation, public health, and socio-economic development (Department of Environment, 2008). Some of the mitigation measures that Delhi has put in place could also help with adaptation. One significant instance is the use of green building techniques, which the Public Works Department and the Airport Authority are required to implement. This technology has advantages for adaptation while being primarily focused on lowering greenhouse gas emissions and decreasing climate change. It is anticipated to lead to considerable reductions in energy use of up to 100% for water heating and a reduction of 35 to 50% for overall energy consumption. In order to further support efforts for both mitigation and adaptation, the New Delhi Municipal Council has also established time-bound efficiency targets to lower energy demand in other sectors (Rosenzweig et al. 2011). According to the India State of Forest Report 2021, Delhi has observed a remarkable increase in its green cover

over the past two years. The report indicates that the city's green cover has witnessed a considerable surge from 21.88 percent to 23.06 percent of its geographical area. In terms of actual figures, the total green cover in 2019 measured 324.44 square kilometers, which has now grown to 342 square kilometers in 2021. This notable increase can be attributed to the concerted efforts of the Delhi government in conducting extensive tree plantation drives. As a result, the tree cover alone has witnessed a significant growth of 18 square kilometers, contributing to the overall enhancement of the city's green environment (Shrangi, 2022). Delhi has also implemented a policy of planting ten trees for every tree that is cut down in collaboration with various stakeholders, including school children, homemakers, and neighborhood associations. Additionally, the Delhi government has developed another awareness initiative about carbon credits and clean development mechanisms among different departments, aiming to reduce greenhouse gas emissions and support projects that can earn carbon credits. These mitigation projects, such as green roofs, walls, and energy-efficiency measures, not only contribute to reducing emissions but also enhance adaptive capacity by cooling the urban environment and mitigating heat island effects.

Lagos City has crafted various initiatives and plans to mitigate the climate vulnerability risks that it confronts. To address the issue of urban flooding, Lagos has undertaken the construction and improvement of primary and secondary drainage channels across the city. These measures aim to alleviate flooding in the coastal areas and defend against the risk of coastal flooding, erosion, and manage heavy rainfall effectively. Furthermore, The Lagos State Ministry of Environment Task Force has launched the "Drain Ducks" initiative, which focuses on the cleaning of open drains and gutters. By ensuring unobstructed water flow, this initiative helps to minimize the risk of flooding and improve overall drainage efficiency in the city. In an effort to improve living conditions in informal settlements, the Lagos Metropolitan Development and Governance Project (LMDGP) has initiated slum upgrade projects. These projects aim to foster resilience, provide better infrastructure, and create healthier and more sustainable living environments for residents. Lagos has also placed a strong emphasis on awareness and education regarding climate change. The city has established Climate Clubs in primary and secondary schools, providing platforms for students to learn about climate-related issues and engage in environmental activities. Additionally, training sessions and workshops are organized to educate community members about the impacts of climate change and ways to adapt and mitigate its effects. Through these initiatives, Lagos is demonstrating its strong commitment to climate resilience, sustainable development, and

community engagement. By instigating these strategies, the city aims to enhance its ability to cope with climate challenges and create a more sustainable and resilient future for its residents (Rosenzweig et al. 2011).

CHAPTER 5

Summary of Research Findings

In Chapter 3 we delved into the critical challenges facing Karachi, focusing on three primary themes: poverty, water insecurity, and climate vulnerability, and their potential implications on Pakistan's broader SDG agenda for 2030. The study drew on both primary data, gathered from expert interviews, and secondary data, comprising scholarly articles and reports, to comprehensively examine the nature and causes of these pressing issues in the mega city. Remarkably, the research findings shed light on an intricate interconnection between these three core themes, revealing a symbiotic relationship among them. It becomes evident that each factor profoundly impacts the others, forming a complex web of dependencies. For instance, while climate change adaptation certainly plays a role in the challenges faced by Karachi, its absence is not the sole cause; rather, it exacerbates existing problems, such as water insecurity and pockets of poverty in the city. Similarly, a noteworthy association surfaced between water insecurity and poverty, as water-related challenges aggravate the plight of impoverished communities in Karachi.

The research findings also highlighted the potential repercussions of these intertwined issues on Pakistan's broader SDG agenda and particularly SGD goals 1, 6, and 13. Given Karachi's economic significance for the country, the adverse effects on poverty, water security, and climate vulnerability could reverberate on a national scale, hindering progress toward achieving the Sustainable Development Goals by 2030. Upon thorough analysis of the nature and underlying causes of these major challenges, the research findings convincingly concluded that a common root cause lies at the heart of all three issues: poor governance in the city. It becomes evident that effective and responsible governance is fundamental to address these challenges effectively and to set Karachi on a path of sustainable development and prosperity. As such, addressing this underlying governance deficit emerges as a crucial step in tackling the multifaceted problems facing Karachi and achieving Pakistan's broader sustainable development objectives. This may serve as an opportunity for forthcoming researchers to explore the connection between inadequate governance and the themes under discussion. Subsequent research endeavors could also focus on analyzing policy choices in this context.

Historical developmental mistakes, faulty policy decisions, and poor governance has been declared as the root cause of all other prevailing issues in Karachi. In 1991, the Karachi Development Authority developed 58 analyses zones (KDA, 1991) in Karachi which were even utilized in various planning and environmental cities and more than 25 planning agencies were developed to enhance the efficacy of service provision to the citizens of Karachi however the lack of coordination between the developmental agencies could not yield effective outcomes for the population (Qureshi, 2010). The urban governance system in Karachi exhibits serious policy deficiencies that have significantly impacted the city's economic capacity and exacerbated human security challenges. One notable policy oversight is the disproportionate focus on urban flooding in the discourse on disaster management while neglecting the critical issue of heat waves. Even in the Multi-Hazard Contingency Plan (PDMA, 2013), there was no acknowledgment of heat as a threat in the Sindh context. However, the devastating heatwave of 2015 led to a change in perspective, prompting discussions on rising temperatures as a disaster and the state's role in managing it.

Subsequently, the Karachi Heatwave Management Plan (KHMP) (Commissioner Karachi, 2017) was developed in collaboration with the Karachi Commissioner Office, the Government of Sindh, and Leadership for Environment and Development (LEAD) Pakistan, through its Climate & Development Knowledge Network (CDKN) Program. The KHMP's framework was revised from a plan initially designed for the Indian city of Ahmedabad, which faces similar high-temperature challenges (AMC, 2016). While the KHMP outlined general strategies for dealing with a heatwave, it considerably lacked specific definitions of a heatwave or contextually relevant coping mechanisms tailored to Karachi's diverse microclimates (Anwar et al., 2022). In addition to that, In the Sindh provincial budget for 2021-22, the Provincial Disaster Management Authority (PDMA) was allocated PKR 1150 million for "rehabilitation" activities (GOS, 2021). According to Anwar et al. (2022), out of this allocation, PKR 1000 million was designated for relief work. However, upon reviewing the PDMA's relief efforts, it becomes obvious that the focus has primarily been on addressing issues related to urban floods, COVID lockdowns, and droughts in Sindh. Surprisingly, there is no mention of any funds or activities to mitigate the risks related to extreme heat.

Currently, the Government of Sindh is working on a new master plan for Karachi, aimed for the year 2047, coinciding with Pakistan's 100th year of independence celebration. This plan, titled "Karachi Master Plan 2047" or "Greater Karachi Regional Plan 2047," receives technical assistance from the United Nations Development Programme (UNDP). Led by the urban policy and strategic planning unit of the Sindh government, the effort is supported by entities like the Karachi Development Authority (KDA), Sindh Building Control Authority (SBCA), and the World Bank-funded Project Implementation Unit of the Karachi Neighborhood Improvement Project (KNIP). The plan aims to create "Vision Karachi 2050," focusing on enhancing urban livability and sustainability in the city, in response to the Supreme Court's directives and the Sindh Urban and Regional Master Plan Authority Act 2020 (Toheed, 2023).

In essence, any Master Plan for Karachi would be ineffective unless it embraces inclusivity and adopts a micro-level approach to tackle the city's issues. It is crucial for policymakers to learn from past mistakes and devise strategies that address Karachi's challenges at the grassroots level. Merely implementing rigorous urban planning without acknowledging the city's unique and sensitive urban challenges would be insufficient. Understanding the root causes and developing targeted solutions are essential to ensure the plan's success and bring about meaningful change in the city's development.

References

- IPCC (2007). *Climate Change 2007: Impact, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden and C. E. Hanson, Eds., Cambridge, UK: Cambridge University Press
- Mehrotra, S., C. E. Natenzon, A. Omojola, et al. (2009). *Framework for City Climate Risk Assessment*. Commissioned research, World Bank Fifth Urban Research Symposium, Marseille, France
- Rosenzweig, C., Solecki, W. D., Hammer, S. A., & Mehrotra, S. (2011). *Climate change and cities: First assessment report of the urban climate change research network*. Cambridge University Press.
- United Nations Statistics Division. (n.d.). — *SDG indicators*. <https://unstats.un.org/sdgs/report/2021/goal-11/>
- UN-Habitat (2002c) ‘Expert group meeting on slum indicators, October’, Revised Draft Report. UN-Habitat, Nairobi UN-Habitat (2002d) ‘Defining slums: Towards an operational definition for measuring slums’, Background Paper 2, Expert Group Meeting on Slum Indicators, October. UN Habitat, Nairobi
- Sayed Hashim Zaidi. (2011, August 5). *Urban poverty in Pakistan*. Repository Home. <https://repositories.lib.utexas.edu/handle/2152/ETD-UT-2011-05-3355>
- Akbar Zaidi, S. (1997). *Politics, Institutions, Poverty: The Case of Karachi*. JSTOR. https://www.jstor.org/stable/4406207#metadata_info_tab_contents
- Ali, N. (2006). *Climate Change and Water Supply Security in Karachi, Pakistan*. Research Gate. https://www.researchgate.net/publication/260539799_Climate_Change_and_Water_Supply_Security_in_Karachi_Pakistan
- Bhutto, F. (2020, September 27). *Opinion | Pakistan’s Most Terrifying Adversary Is Climate Change*. The New York Times. <https://www.nytimes.com/2020/09/27/opinion/pakistan-climate-change.html>
- Grey, D., & Connors, G. (2009). “The Water Security Imperative: We Must and Can Do More,” 5th World Water Forum, Istanbul (2009). <https://thesvi.org/wp-content/uploads/2020/09/JSSA-Vol-VI-no-1-66-95.pdf>
- Hashim, A. (2017). *Parched for a price: Karachi’s water crisis*. Al Jazeera English. <https://interactive.aljazeera.com/aje/2017/parched-for-price/index.html#:~:text=Karachi%27s%20roughly%2020%20million%20residents,failing%20distribution%20and%20supply%20system.>
- Project, B. (2021, December 10). *10 Facts About Poverty in Karachi*. The Borgen Project. <https://borgenproject.org/10-facts-about-poverty-in-karachi/#:~:text=There%20are%20now%20more%20than,as%20well%20as%20hiding%20criminals.>
- Qutub, S. A. (2005). *Karachi — a case of asymmetric inclusion in the current globalization?* SpringerLink. https://link.springer.com/chapter/10.1007/3-540-28351-X_17?error=cookies_not_supported&code=7bcdcea-4370-4dfb-9e68-64d0d695ac24

Sayed, A. H., Spangler, C., & Usman, M. F. (2017). The Perils of Denial: Challenges for a Water-Secure Pakistan. *New Security Beat*. <https://www.newsecuritybeat.org/2017/08/perils-denial-challenges-water-secure-pakistan/>

The Express Tribune. (2016). Measure of impoverishment: Karachi third least poor district. <https://tribune.com.pk/Story/1144434/Measure-Impoverishment-Karachi-Third-Least-Poor-District>. <https://tribune.com.pk/404>

UNDP Pakistan. (n.d.). Policy support for mainstreaming the Sustainable Development Goals in Pakistan | United Nations Development Programme. UNDP. <https://www.undp.org/pakistan/projects/policy-support-mainstreaming-sustainable-development-goals-pakistan>

United Nations Pakistan. (n.d.). Our Work on the Sustainable Development Goals in Pakistan. <https://pakistan.un.org/en/sdgs>

World Population Review. (2022). Karachi Population 2022 (Demographics, Maps, Graphs). <https://Worldpopulationreview.Com/World-Cities/Karachi-Population>. <https://worldpopulationreview.com/world-cities/karachi-population>

Surface Water Drainage and Flooding in Karachi City , S. Akhtar and M.R Dhanani, 2012, Department of Geography, University of Karachi, Karachi, Pakistan

Climate Profile of Karachi, KW&SB Climate Change Adaptation Strategy,2012, Ujala Qadir, WSP

McDonald R. I. Weber K. Padowski J. Flörke M. Schneider C. Green P. A. Gleeson T. Eckman S. Lehner B. Balk D. Boucher T. Grill G. Montgomery M. (2014). Water on an urban planet: urbanization and the reach of urban water infrastructure. *Global Environmental Change* 27, 96–105. <http://dx.doi.org/10.1016/j.gloenvcha.2014.04.022>.

Sreoshi Singh, Tanvir Hassan, Masooma Hassan, & Neha Bharti. (2020). *Urbanisation and water insecurity in the Hindu Kush Himalaya: Insights from Bangladesh, India, Nepal and Pakistan | Water policy | IWA publishing*. <https://iwaponline.com/wp/article/22/S1/9/65845/Urbanisation-and-water-insecurity-in-the-Hindu>

UN - Water. (n.d.). *Water and urbanization*. UN-Water. <https://www.unwater.org/water-facts/water-and-urbanization>

Arjen Y Hoekstra, Joost Burman, & Kees C H van Ginkel. (2018). *Urban water security: A review*. <https://iopscience.iop.org/article/10.1088/1748-9326/aaba52/pdf>

Eisenbeiß, K. (2021, July 23). *Achieving the sustainable development goals in cities*. Urbanet. <https://www.urbanet.info/sdgs-integrated-urban-development/>

Rice, J. (2009). The concentration of disadvantage and the rise of an urban penalty: Urban slum prevalence and the social production of health inequalities in the developing countries. *International Journal of Health Services*, 39(4), 749-770. <https://doi.org/10.2190/hs.39.4.i>

McCarthy, M. P., Best, M. J., & Betts, R. A. (2010). Climate change in cities due to global warming and urban effects. *Geophysical Research Letters*, 37, L09705. <https://doi.org/10.1029/2010GL042845>

- Gifford, R. (2011). The dragons of inaction: Psychological barriers that limit climate change mitigation and adaptation. *American Psychologist*, 66, 290-302.
https://www.researchgate.net/publication/254734365_The_Dragons_of_Inaction_Psychological_Barriers_That_Limit_Climate_Change_Mitigation_and_Adaptation/link/0c96052047aaad383e000000/download
- Lazarus, R. J. (2009). Super wicked problems and climate change. *Cornell Law Review*, 94, 1153-1234.
- Weber, E. U., & Stern, P. C. (2011). Public understanding of climate change in the United States. *American Psychologist*, 66, 315-328.
- Pooley, E. (2010). *The climate war: True believers, power brokers, and the fight to save the earth*. New York, NY: Hyperion.
- Rahmstorf, S., Foster, G., & Cahill, N. (2017). Global temperature evolution: recent trends and some pitfalls. *Environmental Research Letters*, 12(5), 054001
- Akter, Sonia, Jeff Bennett, & Michael B. Ward. (2012). “Climate Change Scepticism and Public Support for Mitigation: Evidence from an Australian Choice Experiment.” *Global Environmental Change*, 22(3), 736 - 745.
- Connor, L. H., & Higginbotham, N. (2013). “Natural cycles” in lay understandings of climate change. *Global Environmental Change*, 23(6), 1852-1861.
- Oreskes, N., & Conway, E. M. (2010). *Merchants of doubt*. New York, NY: Bloomsbury.
- Pearce, F. (2010). *The climate files*. London, UK: Guardian Books
- Powell, J. L. (2011). *The inquisition of climate science*. New York, NY: Columbia University Press
- Giddings, B., Hopwood, B., and O’Brien, G. (2002). Environment, economy and society: fitting them together into sustainable development. *Sust. Dev.* 10, 187–196. doi: 10.1002/sd.199
- Maiti, S., and Agrawal, P. K. (2005). Environmental degradation in the context of growing urbanization: a focus on the metropolitan cities of India. *J. Hum. Ecol.* 17, 277–287. doi: 10.1080/09709274.2005.11905793
- Mukherjee, S., Sundberg, T., Sikdar, P. K., & Schütt, B. (2022). An Integrated Quantitative Assessment of Urban Water Security of a Megacity in the Global South. *Frontiers in Water*. <https://doi.org/10.3389/frwa.2022.834239>
- Prinz, D., Juliani, A., & Brontowiyono, W. (2009). FUTURE WATER MANAGEMENT PROBLEMS IN ASIAN MEGACITIES . *Jurnal Sains Dan Teknologi Lingkungan*, 1(2085-1227).
- OECD. (2012). *OECD ENVIRONMENTAL OUTLOOK TO 2050: The Consequences of Inaction*. <https://www.oecd.org/env/indicators-modelling-outlooks/49846090.pdf>

- Yousuf, A.F., Siddiqui, R & Khan, A.N. (2014). Survey of gram negative and gram positive bacteria in drinking water supplies in Karachi, Pakistan. *British Microbiology journal*. 4(6): 592-597.
- Romero-Lankao P and Qin H. 2011. Conceptualizing urban vulnerability to global climate and environmental change. *Current opinion in Environmental Sustainability* 3, pp. 142–149. (DOI: <http://dx.doi.org/10.1016/j.cosust.2010.12.016>).
- O'Brien K, Hayward B, Berkes F. 2009. Rethinking social contracts: building resilience in a changing climate. *Ecol. Soc.* 14, Art 12. URL: <http://www.ecologyandsociety.org/vol14/iss2/art12/>.
- Rafael, S. (2015). Urban vulnerability and resilience to climate change. *WIT Transactions on Ecology and the Environment*. <https://doi.org/10.2495/air150331>
- Twigg, J. (2007). *Characteristics of a Disaster-resilient Community A Guidance Note*. https://www.preventionweb.net/files/2310_Characteristicsdisasterhighres.pdf
- Churruca Muguruza, C. (2017). Human Security as a policy framework: Critics and Challenges. *Deusto Journal of Human Rights*, 4, 15. <https://doi.org/10.18543/aaahdh-4-2007pp15-35>
- Commission on Human Security. (2003). Human security now : In *digitallibrary.un.org*. The Commission., <https://digitallibrary.un.org/record/503749?ln=en>
- UNITED NATIONS. (2010). *#Envision2030 Goal 1: No Poverty | United Nations Enable*. Un.org. <https://www.un.org/development/desa/disabilities/envision2030-goal1.html>
- World Population Review. (2023). *Karachi Population 2020 (Demographics, Maps, Graphs)*. Worldpopulationreview.com. <https://worldpopulationreview.com/world-cities/karachi-population>
- PRASAD, N., RANGHIERI, F., SHAH, F., TROHANIS, Z., KESSLER, E., SINHA, R. (2009) *Climate Resilient Cities: A Primer on Reducing Vulnerabilities to Disasters*, World Bank, Washington DC
- HUNT, A., WATKISS, P. (2007) *Literature Review on Climate Change Impacts on Urban City Centres: Initial Findings*, Working Party on Global and Structural Policies, ENV/EPOC/GSP(2007) 10/FINAL, OECD, France
- SATTERTHWAITE, D., HUQ, S., REID, H., PELLING, M., ROMERO LANKAO, P. (2007) *Adapting to Climate Change in Urban Areas: The Possibilities and Constraints in Low- and MiddleIncome Nations*, Human Settlements Discussion Paper Series: Climate Change and Cities 1, International Institute for Environment and Development (IIED), London.
- Zaafir, M. S. (2021). Karachi could be completely submerged by 2060, warn experts. [Www.thenews.com.pk.https://www.thenews.com.pk/print/904708-karachi-could-be-completely-submerged-by-2060-warn-experts](https://www.thenews.com.pk/print/904708-karachi-could-be-completely-submerged-by-2060-warn-experts)
- European Space Agency. (n.d.). Karachi, Pakistan - Historical Views - Earth Watching. Earth.esa.int. Retrieved June 29, 2023, from <https://earth.esa.int/web/earth-watching/historical-views/content/-/article/karachi-pakistan/#:~:text=Karachi%20is%20built%20on%20a>
- Anwar, F. (2012). Karachi city climate change adaptation strategy. https://www.preventionweb.net/files/27915_100286295karachicityclimatechangead.pdf
- Irfan, W. (2023, June 13). As Karachi suffers from merciless heat, some suffer more than others. DAWN.COM. <https://www.dawn.com/news/1758265>
- Borrego, C., Rafael, S., Rodrigues, V., Monteiro, A., Sorte, S., Coelho, S., & Lopes, M. (2018). Air quality, urban fluxes and cities resilience under climate change – A brief overview. *International Journal of*

- Environmental Impacts: Management, Mitigation and Recovery, 1(1), 14–27. <https://doi.org/10.2495/ei-v1-n1-14-27>
- Cook, C., & Bakker, K. (2012). Water security: Debating an emerging paradigm. *Global Environmental Change*, 22(1), 94–102. <https://doi.org/10.1016/j.gloenvcha.2011.10.011>
- UN Water. (2013). *Water Security and the Global Water Agenda*. UN-Water. <https://www.unwater.org/publications/water-security-and-global-water-agenda>
- Habiba, Umma & Abedin, Md & Shaw, Rajib. (2013). Defining Water Insecurity. 10.1108/S2040-7262(2013)0000013007.
- Kumar, K. S., & Harada, H. (2011). Field survey on water supply, sanitation and associated health impacts in urban poor communities! A case from Mumbai City, India. Department of Environmental Systems Engineering, Nagaoka University of Technology (Vol. 46, Issue 1).
- Akhtar S, Dhanani M (2012) Surface water drainage and flooding in Karachi city. *Sindh Univ Res J-SURJ (Science Series)* 44(1):59–70
- Karachi Strategic Development Plan 2020*. (2020, July 19). Urban Resource Centre. <https://urckarachi.org/2020/07/19/karachi-strategic-development-plan-2020/>
- Lee, K., & Yang, S. (2023). A Comparison of Urban Planning in Eastern Asian Capitals during Japanese Colonial Rule: Tokyo, Taipei (1895), Seoul (1910), and Beijing (1936). *Sustainability*, 15(5), 4502. <https://doi.org/10.3390/su15054502>
- Lewallyn, T. (2022, January 22). *Poverty in Delhi: Rich Delhi, Poor Delhi*. The Borgen Project. <https://borgenproject.org/poverty-in-delhi/>
- Shinde, A. (2021). *Challenges and Opportunities of Sustainable Urbanisation Case study of Delhi and Rajkot*. <https://www.researchsquare.com/article/rs-815019/v1.pdf>
- Saxena, R., Rath, R., Gupta, S., & Sood, N. (2021). A review on ecological degradation, its causes and sustainable development in Delhi, India. *Journal of Applied and Natural Science*, 13(4), 1294–1304. <https://doi.org/10.31018/jans.v13i4.2978>
- Delhi Development Authority. (2017). *DELHI DEVELOPMENT AUTHORITY Master Plan for Delhi-2021*. <http://52.172.182.107/BPAMSCClient/seConfigFiles/Downloads/MPD2021.pdf>
- Qureshi, S. (2010). *Wayback Machine*. Web.archive.org. <https://web.archive.org/web/20210811225318/https://www.africaneditors.org/journal/JGRP/full-text-pdf/37548-123147>
- Karachi needs climate resilient infrastructure, better use of public spaces.*” (2022). [www.thenews.com.pk. https://www.thenews.com.pk/print/972570-karachi-needs-climate-resilient-infrastructure-better-use-of-public-spaces](https://www.thenews.com.pk/print/972570-karachi-needs-climate-resilient-infrastructure-better-use-of-public-spaces)
- Mukheibir, P., and G. Ziervogel. 2007. “Developing a Municipal Adaptation Plan (MAP) for Climate Change: The City of Cape Town.” *Environment & Urbanization* 19 (1): 143–58.
- Hoornweg, D. A., J. Lee, M., Bhada-Tata, P., Yuen, B., & Freire, M. (2011). *Cities and climate change : responding to an urgent agenda*. World Bank.
- Shrangi, V. (2022). *Delhi’s forest cover sees marginal rise, tree shield shrinks*. The New Indian Express. <https://www.newindianexpress.com/cities/delhi/2022/jan/14/delhis-forest-cover-sees-marginal-rise-tree-shield-shrinks-2406734.html>
- Anwar, N., Khan, H., Abdullah, A., Macktoom, S., & Fatima, A. (2022). *DESIGNED TO FAIL? HEAT GOVERNANCE IN URBAN SOUTH ASIA: THE CASE OF KARACHI A SCOPING STUDY DESIGNED TO FAIL? HEAT GOVERNANCE IN URBAN SOUTH ASIA: THE CASE OF KARACHI -A SCOPING STUDY 2 ACKNOWLEDGEMENT*.

<https://era.ed.ac.uk/bitstream/handle/1842/38928/UNIED%20Resilient%20cities%20KARACHI.pdf?sequence=1&isAllowed=y>

UN. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations.

<https://sdgs.un.org/2030agenda>

citiesabc. (2022). *Karachi - citiesabc the digital Magna Carta social impact platform for cities*.

<https://www.citiesabc.com/city/karachi/>

Mangi, F., Kay, C., & Chaudhary, A. (2019, January 25). A Water Crisis Is Brewing Between South Asia's Arch-Rivals. *Bloomberg.com*. <https://www.bloomberg.com/news/features/2019-01-25/a-water-crisis-is-brewing-between-south-asia-s-arch-rivals#xj4y7vzkg>

Ravillion, M. (2007). *Finance and Development*. Finance and Development | F&D.

<https://www.imf.org/external/pubs/ft/fandd/2007/09/ravalli.htm>

United Nations Trust Fund for Human Security. (n.d.). *Human Security and Agenda 2030 SDGs*.

<https://www.un.org/humansecurity/wp-content/uploads/2017/10/Human-Security-and-the-SDGs.pdf>