

CLIMATE CHANGE IMPACT ASSESSMENT OF EXTREME HEAT, PUBLIC HEALTH,
SOCIAL INEQUALITY, AND INFRASTRUCTURE ISSUES: A CASE STUDY OF
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Keywords

Article History

Received on 20 Sep 2025

Accepted on 29 Sep 2025

Published on 27 Oct 2025

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Abstract

Karachi, the financial capital of Pakistan and one of the most densely populated cities globally, faces significant challenges due to climate change. The city's Climate Action Plan (KCAP) is a recent initiative aimed at addressing these challenges, highlighting Karachi's vulnerability to climate extremes such as heatwaves and flooding. The plan urges immediate climate action, emphasizing the need for adaptive strategies to mitigate the impacts of rising temperatures and severe weather events. **Key Issues: Extreme Heat:** Karachi has experienced record-breaking heatwaves, with temperatures reaching dangerous levels, leading to health crises and increased mortality. In 2015, a severe heatwave claimed over 1,300 lives, illustrating the city's susceptibility to climate-induced health risks. **Public Health:** Climate change has contributed to the outbreaks of diseases such as malaria and dengue fever, increasing morbidity and mortality rates among the population. The health impacts are a direct consequence of environmental changes disrupting the ecological cycle. **Social Inequality:** As climate extremes reshape daily life, they expose and exacerbate existing social inequalities within the city, disproportionately affecting the most vulnerable populations. **Flooding:** The city has been affected by catastrophic flooding due to extreme rainfall events in 2020 and 2022. These floods have modified existing infrastructure issues and highlighted inadequacies in urban governance and crisis response. A preliminary vulnerability assessment reveals that critical urban systems, especially drainage networks, transportation corridors, and low-lying residential zones, are highly prone to flood-related breakdowns. The assessment highlights how inadequate maintenance, suboptimal land-use planning, and insufficient adaptive mechanisms have heightened the city's overall susceptibility to extreme climate events. **Commitment to Action:**

Karachi's recent re-entry into the C40 Cities network signifies a renewed commitment to tackling climate change and promoting sustainability. The city is actively seeking to implement strategies that reduce greenhouse gas emissions while enhancing resilience to climate impacts. In response to the infrastructure failure, the government has implemented a series of measures, including the refurbishment of drainage infrastructure, enhancement of flood warning systems, and modification of building and zoning codes to minimize vulnerability in flood-prone areas. By drawing attention to these actions, this study aims to investigate their practical impact within the wider context of adaptation to climate hazards and urban robustness, accenting the disparity between policy formulation and field-level application.

INTRODUCTION

The study identifies and prioritizes the people and assets at possible risk and the key actions required to make Karachi a resilient city, in addition to identifying the critical governance, institutional, and technological gaps and constraints. The study said that Karachi accounted for 95 per cent of Pakistan's foreign trade and contributed 30 per cent to national industrial production. It accounted for 40 per cent of national employment in large-scale manufacturing and contributed 25 per cent of national and 40 per cent of provincial revenues (Asian Development Bank report 2005).

But, despite serving as the country's commercial backbone, Karachi hasn't been made a secure place for its inhabitants and serious gaps in governance put it an increased risk in times of a calamity.

There is increasing socioeconomic disparity and growing environmental degradation. Human settlements such as slums and hill settlements are exposed to fluvial, stormwater flooding risk and hill torrents in the absence of appropriate protection and emergency response systems.

Climate change adaptation and mitigation is a paramount challenge for Asia

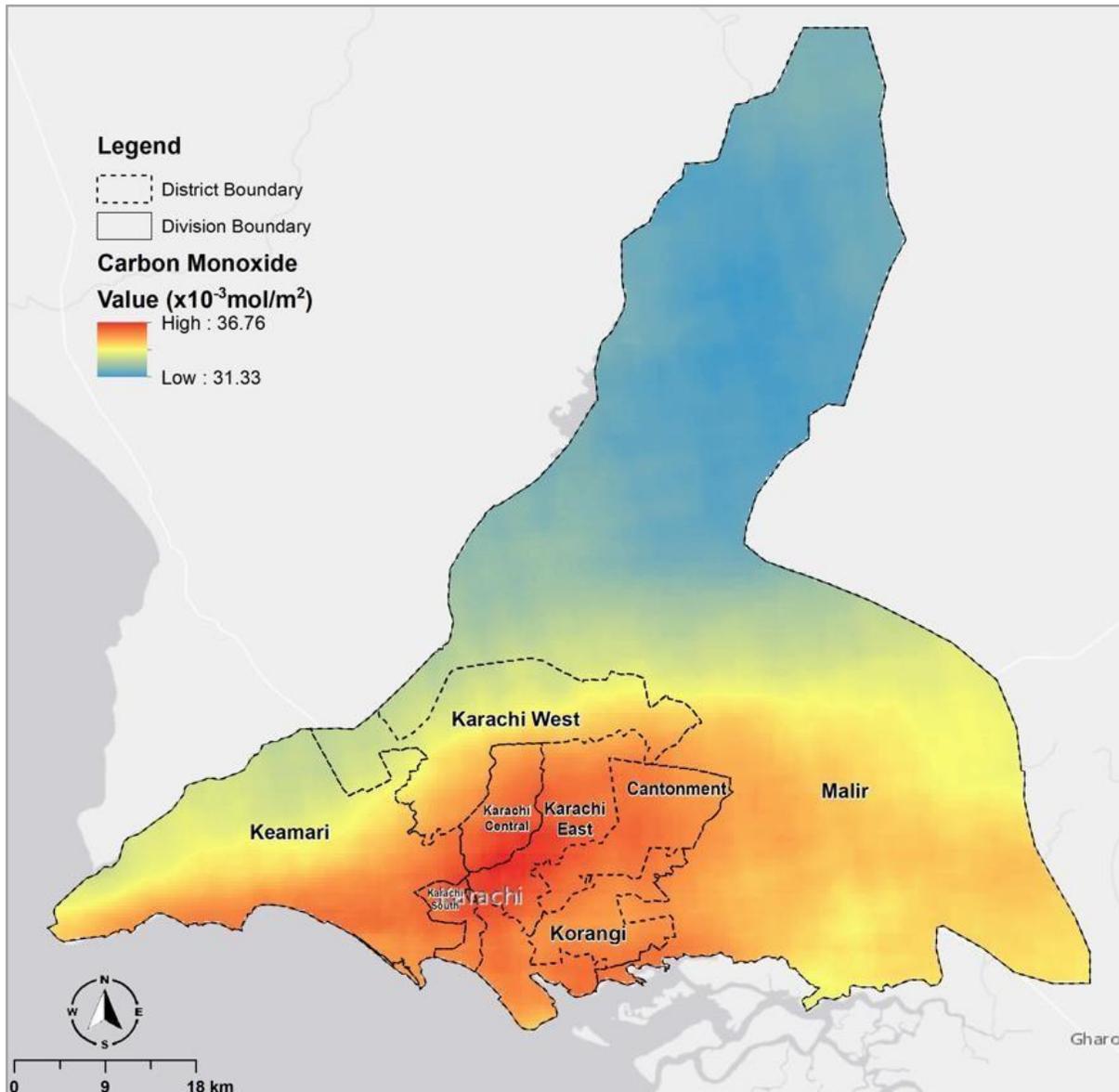
and the Pacific, which must grapple with vulnerabilities like extreme temperatures, water scarcity, food insecurity and natural disasters. Asia-Pacific countries are among those most severely affected by extreme weather events such as storms, floods and heatwaves.

Highlighting more gaps, the study said that the city faced energy shortages and substantial energy losses. Energy consumption was increasing and no efforts were being made to promote energy conservation. Due to rising population density in inner city and increased traffic/congestion the likelihood of the heat island effect taking place was likely.

Karachi for numerous reasons needs to get its house in order. The global focus on climate change and the availability of related substantial financial resources offers a window of opportunity for urban managers across the world to access the resources and plan and implement measures to not only prepare for possible climate change impacts but generally improve the sustainability profile of their cities. Karachi, one of the fastest-growing mega cities in the world, can definitely make progress in this regard.

Over the past two decades, Karachi has experienced severe heatwaves (notably in 2015 and 2022), unpredictable rainstorm events, sea-level rise, and, most notably, serious urban flooding, especially in 2020 and 2022. These climatic stresses are disrupting transportation systems, waste management, control networks, communication frameworks, and the general

functioning of the city. This case study investigates in depth how climate change, particularly through flooding, influences Karachi's transportation and urban infrastructure, along with the social and financial consequences, and explores potential measures for adaptation.



Annual Average Concentration of Carbon Monoxide (Nov 2022 - Oct 2023)

Alarming rise in CO₂ emission While analyzing the city's potential risk for urban heat island effect, the study cited data from 'The preliminary study of urbanization, fossil fuels consumption and CO₂ emission in Karachi', a research conducted in 2010, and said that there had been a 287 per cent increase in carbon dioxide (CO₂) emission in atmosphere over Karachi from 1980 to 2007 that was the result of mass urbanization and energy consumption in the city.

Air pollution levels in Karachi are extremely high by international standards and are rising each year. Vehicle-generated air pollution is severe, with high concentrations of fine and ultra-fine particles in the air, which can cause respiratory problems among a large number of Karachi's urban residents," it said while referring to a report of the ADB.

The rate of emission of CO₂ is not only rapid but showing a regular and positive trend without any significant downfall throughout the computed time. The CO₂ emission in atmosphere has reached up to 151 million tons in 2006 that was just 39 million tons in 1980. Automobile load on the city roads, the report said, was increasing with more emphasis on the use of private vehicles. There were 1.113 million registered vehicles in Karachi in 2002 and 8.420 million registered vehicles in 2007. The observed growth during this period is about 656 per cent and it was many times more than the growth in urban population.

An appalling lack of focus and priority on providing the city with socially, environmentally and financially viable transport options has led to a phenomenal growth in the numbers of private vehicle usage that is now globally being discouraged as a sustainable mode of transport in terms of adverse impacts on the environment and sustainable growth of urban settlements.

On urbanization, the author showed concern that there was limited, if any, focus on urban settlements and even the recently notified Climate Change Policy for Pakistan, approved by the federal cabinet and to be implemented by the federal disaster management ministry, directed attention mostly to agriculture, forestry and water resources and separates out urban activities into a sector-based categorization rather than consider them in a holistic urban context. The study identified unplanned and unregulated growth in the development sector as one of the major risk factors that increases the city's vulnerability to climate change impacts.

Karachi suffers greatly from fragmented jurisdiction. As the largest city in Pakistan, it routinely ranks near the bottom of the Global Livability Survey of the Economist Intelligence Unit. Housing estates, home to tens of thousands of families, are run by public sector authorities outside the local government's control, which contributes to overlapping and unclear jurisdictions unable to coordinate critical infrastructure. This situation can lead to disasters like the August 2020 floods that swept through Karachi, Pakistan but left better-governed cities like Lahore relatively unscathed. At present, one-third of all migrants come from Asia and the Pacific, while the region is home to 24 per cent of the world's migrants, some 66.6 million people. The Asia-Pacific region is home to over 2.2 billion city dwellers and many of the planet's largest megacities. Over half of the 30 largest urban areas in the world call this region home. By 2050, this urban population is expected to grow by 50 per cent, with an addition of 1.2 billion people. From being 16 per cent urban in 1960, roughly 36pc of South and South-West Asians live in cities as of this decade.

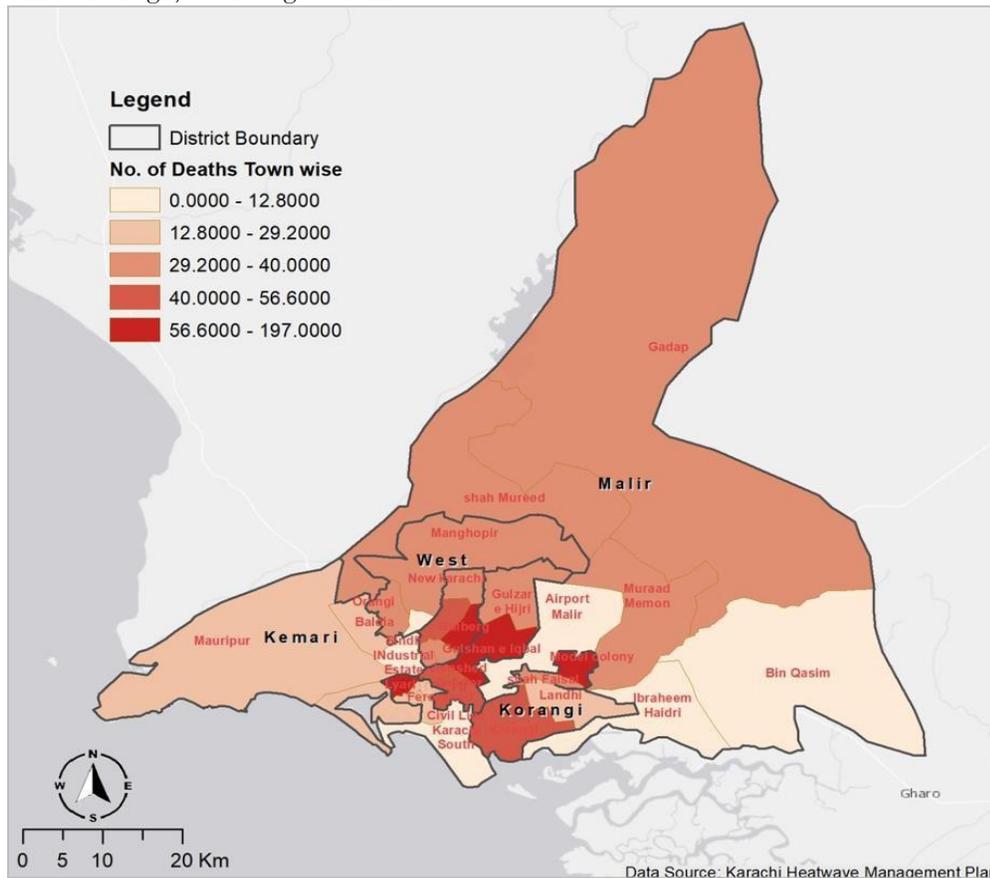
Problem Statement: Climate Change in Karachi

Karachi, Pakistan’s largest metropolitan city and economic hub, is increasingly vulnerable to the impacts of climate change. Over the past few decades, the city has experienced rising average temperatures, erratic rainfall patterns, intense heatwaves, and coastal flooding due to sea-level rise. These climatic changes have severely affected the city’s infrastructure, public health, and socio-economic stability.

The combination of unplanned urbanization, poor waste management, deforestation, and insufficient drainage systems has amplified the effects of climate change, making Karachi

more prone to urban flooding and heat stress. Vulnerable populations living in informal settlements face the greatest risks, with limited access to clean water, healthcare, and cooling facilities.

Despite growing awareness, there remains a significant gap in implementing sustainable urban planning, climate-resilient infrastructure, and effective disaster management strategies. Addressing the issue requires coordinated efforts between government bodies, researchers, and the local community to mitigate greenhouse gas emissions and adapt to the changing climate.



Town-wise Heatwave Vulnerability based on Total Deaths in Karachi City in 2015²⁰

Flooding Impacts on Transportation Systems

Karachi’s street infrastructure is not designed to withstand prolonged standing water. Repeated submersion leads to bitumen

stripping, pothole formation, and surface rutting. Major roads such as Shahrah-e-Faisal, Korangi Industrial Road, University Road, and M.A. Jinnah Road are frequently inundated, disrupting daily commuting and freight transportation. According to the National

Disaster Management Authority (NDMA), flood-induced road damage in Karachi during 2020 resulted in repair costs exceeding PKR 5 billion. Karachi's public transport system, comprising minibuses, rickshaws, and buses, is largely informal and heavily dependent on road networks. When streets are flooded, transport operations come to a halt, leaving commuters stranded. Moreover, most transport spots and bus stops lack adequate elevation or drainage systems. Low-lying terminals—particularly in Saddar and Korangi—often become inaccessible during floods. Efforts to revive the Karachi Circular Railway (KCR), intended to reduce road congestion, also face drainage-related challenges along railway embankments. Flooding significantly reduces road capacity, resulting in traffic gridlocks that can last several hours. Drivers encounter heightened risks of accidents due to poor visibility and submerged road edges. Additionally, pedestrian safety deteriorates as sidewalks disappear beneath water, forcing individuals to wade through deep and contaminated floodwaters to reach their destinations.

Methodology on Climate Change in Karachi

Addressing climate change in Karachi requires a comprehensive methodology that combines data collection, stakeholder engagement, and adaptive management strategies. Below is a detailed outline of the methodology designed to assess and respond to climate change impacts in the city.

1. Data Collection and Analysis

- **Climate Data Monitoring:**
 - Utilize meteorological data from local weather stations to track temperature, precipitation, and extreme weather events over time.
 - Analyze historical climate data to identify trends and anomalies.
- **Vulnerability Assessment:**

Conduct surveys and assessments to evaluate the vulnerability of different sectors (health, infrastructure, agriculture) to climate impacts.

Use GIS (Geographic Information Systems) to map vulnerable areas and populations, particularly informal settlements.

Ecosystem Assessment:

Study local ecosystems and biodiversity to understand how climate change affects flora and fauna in Karachi.

Evaluate the role of green spaces and urban forests in mitigating urban heat and improving air quality.

Infrastructure and Transportation Data:

Reports and road condition surveys from Karachi Development Authority (KDA), KMC, and Sindh Transport Department.

Project documentation for Karachi Circular Railway (KCR) and BRT system to evaluate flood-related constraints.

2. Stakeholder Engagement

Community Involvement:

Organize workshops and focus groups with community members to gather insights on local climate impacts and adaptation needs.

Establish partnerships with local NGOs, academic institutions, and community organizations to facilitate knowledge sharing.

Government Collaboration:

Work with municipal and provincial governments to align climate policies with local needs and capacities.

Involve policymakers in the development of climate action plans to ensure they are practical and implementable.

3. Risk Assessment and Management

Climate Risk Scenarios:

Develop climate risk scenarios that consider various factors such as population growth, urbanization, and socio-economic changes.

Use modeling tools to simulate potential impacts of climate change on infrastructure and public health.

Adaptation Strategies:

- Propose specific adaptation strategies based on the risk assessment, such as enhancing drainage systems, promoting sustainable urban planning, and improving public health infrastructure.
- Encourage the creation of climate-resilient infrastructure, including flood defenses and heat-resistant buildings.

4. Monitoring and Evaluation

- **Implementation Tracking:**
 - Establish a monitoring framework to track the implementation of climate adaptation strategies and policies.
 - Use indicators such as reduction in heat-related illnesses, improvement in drainage capacity, and community engagement levels to evaluate success.
- **Feedback Mechanisms:**
 - Create channels for continuous feedback from stakeholders to refine adaptation strategies over time.

Conduct periodic reviews and updates of the climate action plan based on new data and changing conditions.

5. Public Awareness and Education

Awareness Campaigns:

Launch educational campaigns to raise awareness about climate change impacts and the importance of adaptation.

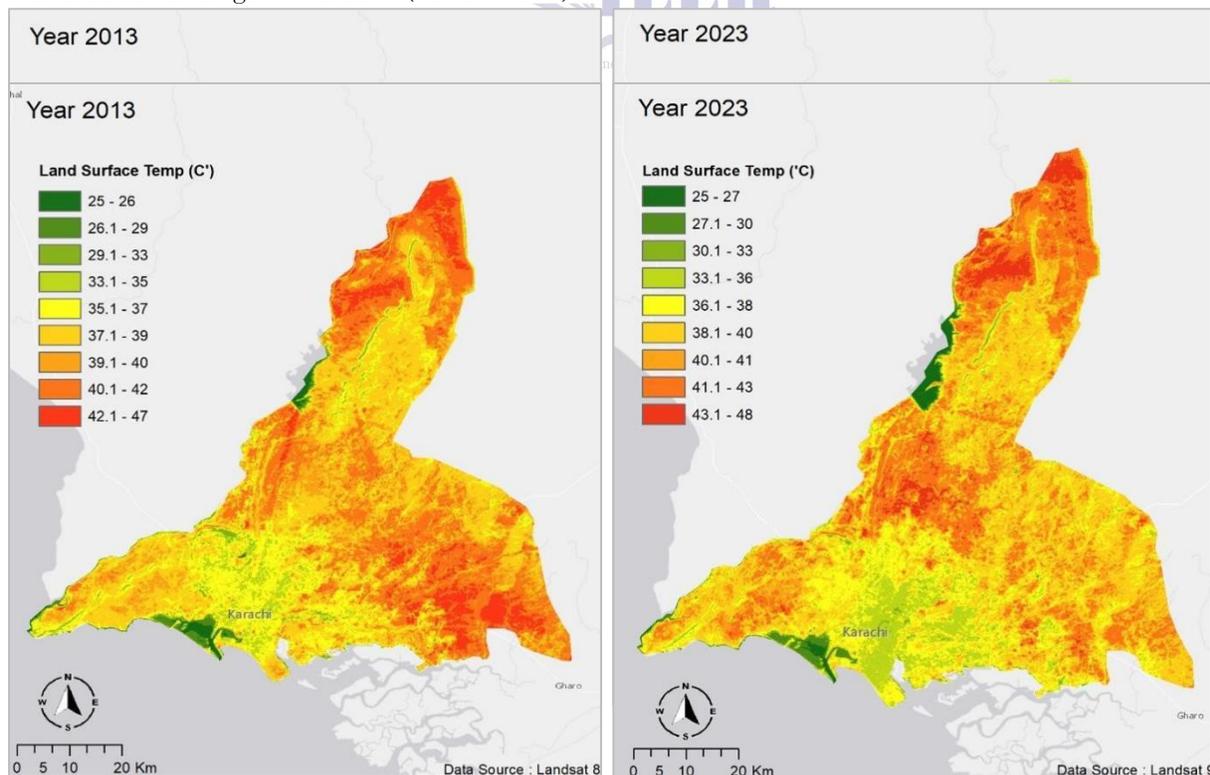
Develop educational materials for schools and community centers to promote understanding of climate issues.

Training Programs:

Implement training programs for local officials and community leaders on climate resilience and sustainable practices.

Foster skills development in areas such as disaster preparedness and sustainable agriculture.

Land cover Change in Karachi (2013 - 2023)



(a) Land Surface Temperature 2013 (b) Land Surface Temperature 2023

Case Study Approach for transportation

Karachi is treated as a single in-depth case study, focusing on:

1. Five key flood-affected zones: Saddar, Lyari, Korangi, Gulshan-e-Iqbal, and Clifton.
 2. Three main transport corridors: Shahrah-e-Faisal, University Road, and Korangi Expressway.
 3. Critical infrastructure nodes: Drainage outfalls, power substations, and industrial clusters.
- This approach allows a spatially specific and sector-focused understanding of how flooding impacts mobility and infrastructure.

Outcomes of Climate Change in Karachi

The impacts of climate change in Karachi are multifaceted and have significant implications for the environment, economy, and public health. Here are some key outcomes observed in the city:

1. Increased Temperature and Heatwaves

- **Rising Temperatures:** Karachi has experienced a notable increase in average temperatures, with extreme heat events becoming more frequent. The city recorded its highest temperature of 50°C in June 2021.
- **Health Risks:** The rise in temperatures has led to increased cases of heat-related illnesses, including heat exhaustion and heatstroke, particularly among vulnerable populations such as the elderly and low-income groups.

2. Flooding and Water Insecurity

- **Increased Rainfall Intensity:** Climate change has resulted in more intense rainfall, leading to urban flooding. The monsoon seasons have become unpredictable, with heavy downpours causing significant disruptions.
- **Infrastructure Strain:** The existing drainage systems are often inadequate to handle the increased water flow, leading to widespread flooding in low-lying areas, damaging property and infrastructure.

Water Scarcity: Conversely, prolonged dry spells have also been observed, exacerbating water scarcity issues in the city, affecting both drinking water supply and agricultural activities.

3. Public Health Challenges

Disease Outbreaks: The changing climate has contributed to the spread of vector-borne diseases such as dengue fever and malaria. Increased rainfall and stagnant water create breeding grounds for mosquitoes.

Respiratory Issues: Higher temperatures and increased air pollution levels have led to a rise in respiratory illnesses, particularly among children and the elderly.

4. Economic Impacts

Impact on Livelihoods: Agriculture, which is vital for many livelihoods in and around Karachi, is threatened by erratic weather patterns and water shortages. Crop yields are declining due to heat stress and lack of irrigation.

Damage to Infrastructure: Frequent flooding and extreme weather events have resulted in substantial economic losses due to damage to public infrastructure, homes, and businesses, affecting overall economic stability.

5. Social Inequality and Displacement

Vulnerable Populations: Low-income communities are disproportionately affected by climate change, lacking the resources to adapt or recover from climate impacts. This exacerbates existing social inequalities.

Displacement: Rising sea levels and flooding may lead to displacement of communities, particularly those living in informal settlements along the coastline.

6. Environmental Degradation

Coastal Erosion: Karachi's coastline is facing erosion due to rising sea levels and increased storm intensity, threatening coastal ecosystems and human settlements.

- **Loss of Biodiversity:** Changes in climate patterns are impacting local biodiversity, with some species facing extinction due to habitat loss and changing environmental conditions.

7. Road Network Damage

- Floodwaters cause erosion of asphalt, formation of potholes, and cracking of road surfaces.
- Major routes such as Shahrah-e-Faisal, I.I. Chundrigar Road, and M.A. Jinnah Road often become impassable during heavy rains.
- Standing water leads to long-term degradation of road base layers, increasing maintenance costs.

ffic Disruptions

Flooding results in traffic gridlocks, making commuting times unpredictable.

Public transport like buses and rickshaws are often immobilized.

Emergency response vehicles face delays, endangering lives during floods.

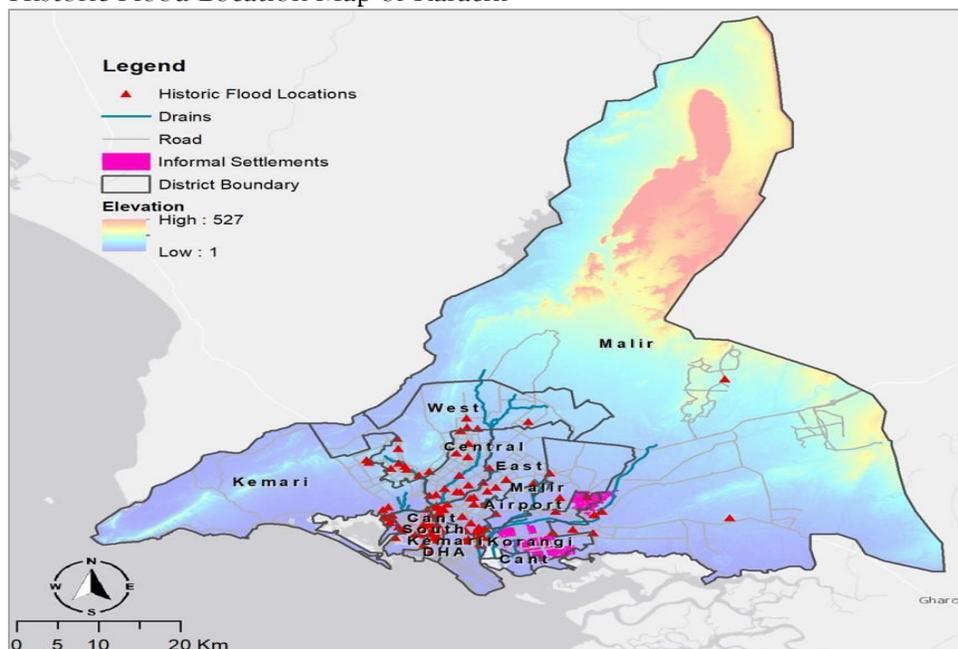
lic Transport Infrastructure

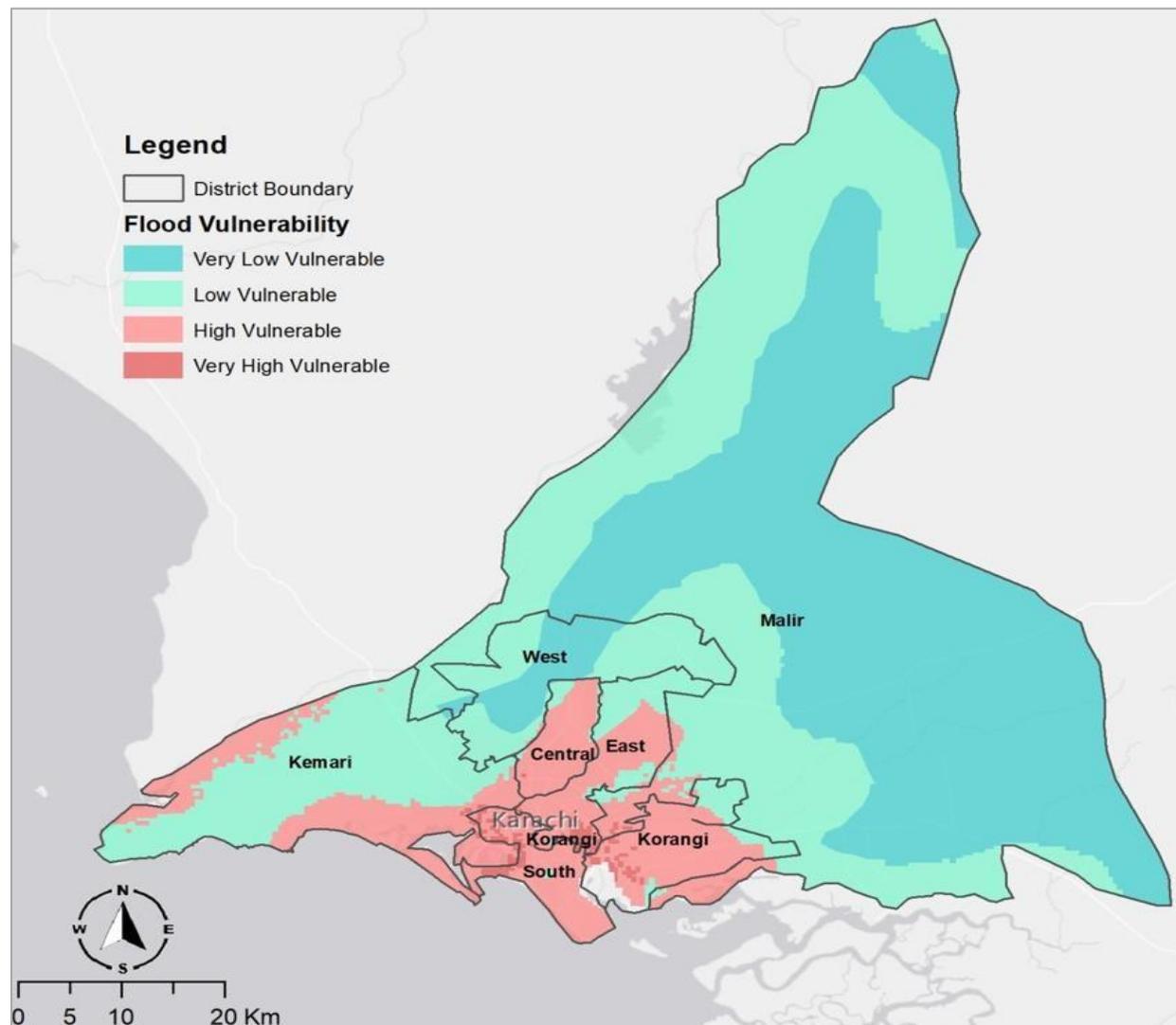
Bus terminals and stops are often not elevated or protected from stormwater, causing accessibility issues.

Railway tracks near low-lying areas are submerged, affecting intercity connectivity.

KCR (Karachi Circular Railway) revival projects face challenges in flood-prone zones.

Historic Flood Location Map of Karachi



Flood Vulnerability - Karachi⁴¹

Problem-Solving Remedies for Climate Change in Karachi

Addressing climate change in Karachi requires a multifaceted approach that incorporates adaptation, mitigation, and community engagement. Here are some effective remedies and strategies:

1. Urban Planning and Infrastructure Development

- **Sustainable Urban Design:** Implement zoning regulations that promote green spaces, parks, and urban forests to enhance biodiversity and reduce urban heat effects.

Improved Drainage Systems: Upgrade existing drainage infrastructure to handle increased rainfall and flooding. Implement sustainable drainage systems (SuDS) that allow for water absorption and reduce runoff.

Climate-Resilient Infrastructure: Develop buildings and infrastructure that can withstand extreme weather events. This includes using heat-resistant materials and constructing flood defenses.

2. Water Management Strategies

Rainwater Harvesting: Promote rainwater harvesting systems in residential and

commercial buildings to reduce dependence on municipal water supply and mitigate flooding.

- **Wastewater Treatment and Reuse:** Invest in wastewater treatment facilities to recycle water for non-potable uses, helping to alleviate water scarcity issues.
- **Integrated Water Resource Management (IWRM):** Implement IWRM practices that consider the entire watershed and promote collaboration among stakeholders for sustainable water use.

3. Disaster Preparedness and Response

- **Early Warning Systems:** Establish early warning systems for heatwaves, floods, and other climate-related disasters to enable timely responses and minimize impacts.
- **Community Training Programs:** Conduct training for communities on disaster preparedness and response, focusing on vulnerable populations to ensure they are equipped to handle emergencies.

4. Public Health Interventions

- **Vector Control Programs:** Implement comprehensive vector control strategies to manage mosquito populations and reduce the spread of diseases like dengue and malaria.
- **Health Education Campaigns:** Raise awareness about the health risks associated with climate change, promoting preventive measures and healthy practices among residents.

5. Community Engagement and Education

- **Awareness Campaigns:** Launch public awareness campaigns to educate residents about climate change impacts and encourage sustainable practices, such as energy conservation and waste reduction.
- **Engaging Local Communities:** Involve local communities in climate action planning and decision-making processes to ensure strategies align with their needs and knowledge.

6. Renewable Energy Initiatives

Promote Solar Energy: Encourage the installation of solar panels in residential and commercial buildings to reduce reliance on fossil fuels and lower greenhouse gas emissions.

Wind Energy Projects: Explore the potential for wind energy generation along the coastline of Karachi to harness renewable energy resources.

7. Policy Development and Governance

Climate Action Plans: Develop comprehensive climate action plans that outline specific goals, strategies, and timelines for addressing climate change impacts in Karachi.

Strengthening Governance: Foster collaboration between government agencies, NGOs, and the private sector to create a unified approach to climate resilience and sustainability.

8. Biodiversity Conservation

Restoration of Natural Habitats: Implement programs to restore degraded ecosystems, including mangroves and wetlands, which provide natural protection against climate impacts and support biodiversity.

Community-Based Conservation: Engage local communities in conservation efforts to protect local flora and fauna, promoting sustainable practices that enhance ecological resilience.

8. Transportation System Adaptation

Incorporate flood-resilient materials and design standards in road construction.

Install real-time monitoring sensors in key transport corridors to detect flooding and manage diversions.

Integrate climate risk assessments into transport master plans.

9. Urban Planning and Governance

Enforce zoning laws to prevent construction in natural drainage paths.

Relocate or upgrade informal settlements along nullahs.

Improve coordination between Sindh government, KMC, NDMA, and climate

research bodies for integrated flood management.

Climate Change Data Summary for Karachi

1. Temperature Trends:

- Karachi has observed an increase in average temperatures over the last few decades. The city frequently experiences heatwaves, with temperatures reaching as high as 50°C during summer months.

2. Rainfall Patterns:

- The monsoon seasons have become increasingly erratic, with periods of intense rainfall leading to flooding. Average annual rainfall has fluctuated, but heavy downpours are becoming more common.

3. Sea Level Rise:

- Karachi's coastal areas are threatened by rising sea levels, which are projected to rise by approximately 1-2 meters by the end of the century if current trends continue. This poses a risk to low-lying areas and coastal ecosystems.

4. Health Impacts:

- The rise in temperatures and changes in rainfall patterns have led to increased cases of heat-related illnesses and vector-borne diseases such as dengue fever.

5. Vulnerability Assessments:

- Studies indicate that low-income communities and informal settlements are particularly vulnerable to climate impacts, as they often lack adequate infrastructure and resources for adaptation.

6. Government Initiatives:

- The Karachi Climate Action Plan (KCAP) has been developed to address climate vulnerabilities and outline strategies for mitigation and adaptation, focusing on enhancing urban resilience.

Conclusion:

The challenges posed by climate change require immediate and coordinated actions. The Karachi Climate Action Plan serves as a crucial roadmap for addressing the city's

multifaceted environmental issues, aiming to foster a sustainable future amidst escalating climate threats. By employing a robust methodology that encompasses data-driven analysis, stakeholder engagement, and adaptive management, Karachi can effectively address the multifaceted challenges posed by climate change. This approach not only enhances the city's resilience but also supports sustainable development and improves the quality of life for its residents.

The outcomes of climate change in Karachi present significant challenges that require urgent and coordinated responses from government, communities, and stakeholders. Addressing these impacts through effective climate adaptation and mitigation strategies is essential to enhance the city's resilience and ensure sustainable development for its residents. By implementing these problem-solving remedies, Karachi can enhance its resilience to climate change impacts while promoting sustainable development. It requires collaborative efforts from government, communities, and various stakeholders to create a comprehensive and effective response to the challenges posed by climate change.

While specific datasets may not have been retrieved, the above summary provides a general overview of the current state of climate change in Karachi. For the most accurate and up-to-date information, local government reports, climate research studies, and regional climate monitoring agencies can provide detailed statistics and analyses. If you have specific aspects of climate change data you're interested in, please let me know!

References:

- 1) Salim A., et al., *Deadly Heat Wave in Karachi, July 2015: Negligence or... – analysis of the 2015 heatwave deaths, underlying causes (power outages, health system stress), and lessons learned.* [PMC](#)

- 2) Babar MS., et al., *Impact of climate change on health in Karachi, Pakistan* (2021) – review of climate-sensitive disease impacts (heat, vector-borne disease, gastroenteritis) with Karachi examples. Useful for framing health outcomes and exposure pathways. [ScienceDirect](#)
- 3) Khan UR., et al., *Heat Emergencies: Perceptions and Practices of ...* (2021, Int. J. Environ. Res. Public Health) – community and clinician perceptions around heat risk and response in Karachi; good for qualitative / KAP evidence. [MDPI](#)
- 4) Saadat A., et al., *The contemporary spell of heat stroke in Karachi amid ...* (2025, Frontiers in Public Health) – recent analysis (2010–2024) of heat-related mortality and modelling of urban vulnerability in Karachi; useful for recent trends and adaptive-capacity discussion. [Frontiers](#)
- 5) Rasool W., et al., *Health-related hazards of heatwaves in Pakistan* (2024) – broader Pakistan perspective with references to Karachi and projections from IPCC guidance; helpful for national context and mortality estimates. [ScienceDirect](#)
- 6) Afzal MT., et al., *Urban Heatwave Vulnerability Assessment* (2025) – LULC (land use/land cover) and heatwave mapping for Karachi (2000–2022) using AHP vulnerability methods; useful for methods combining remote sensing + socioeconomics. [ScienceDirect](#)
- 7) Slesinski SC., et al., *Social inequalities in exposure to heat stress and related...* (2025, Environ. Res. Lett.) – systematic evidence on socioeconomic gradients in heat exposure and adaptive capacity; frames inequality arguments you can apply to Karachi. [heathealth.info](#)
- 8) “Heat (in)action: The Thermopolitics of Extreme Urban Heat in Karachi” – qualitative/critical piece on how urban governance and spatial inequality produce thermal inequities in Karachi (useful for political/institutional analysis). [IJURR](#)
- 9) **Karachi Heatwave Management Plan** (Commissioner’s Office) – operational heatwave management plan (response actions, communication, data collection). Good model for local policy interventions. (PDF). [heathealth.info](#)
- 10) HeatHealth.info – evaluation and project reports on forecast-based heatwave messaging in Karachi (knowledge/attitude/practice study; operational lessons). Good for evaluation/design of early warning + messaging. [heathealth.info](#)
- 11) UNICEF / Economist Impact reporting on energy resilience and health (Pakistan) – links energy reliability to heat mortality reduction and health service resilience; useful when discussing infrastructure co-benefits. [AP News](#)
- 12) InsideClimateNews / EHN / PreventionWeb pieces on Karachi’s 2015 and more recent heat events – accessible summaries that highlight inequality, outages, and informal settlements as **Mortality & health data**: city health department / hospital ED records – several academic papers used manual review of death certificates from 2015 (see Khan et al., Annals/Global Health studies). Use those papers as a guide for obtaining and cleaning mortality data. [Annals of Global Health+1](#)
- 13) **Meteorological data**: Pakistan Meteorological Department (PMD) and ERA5 reanalysis for temperature extremes and heatwave definitions (use ERA5 for gridded long-term data). (PMD webpages

and reanalysis portals – check PMD for station data.) [PMC+1](#)

14) **Land surface / urban heat mapping:** Sentinel / Landsat LST and local LULC datasets – used in recent Karachi studies (see Afzal et al. 2025). Good for mapping intra-urban heat islands and linking to slum areas. [ScienceDirect](#)

15) **Vulnerability indices & methods:** AHP, composite vulnerability indices, heat vulnerability mapping (see systematic reviews for best practice). Slesinski 2025 and Qian 2025 systematic review give methodological guidance. [heathealth.info](#)

