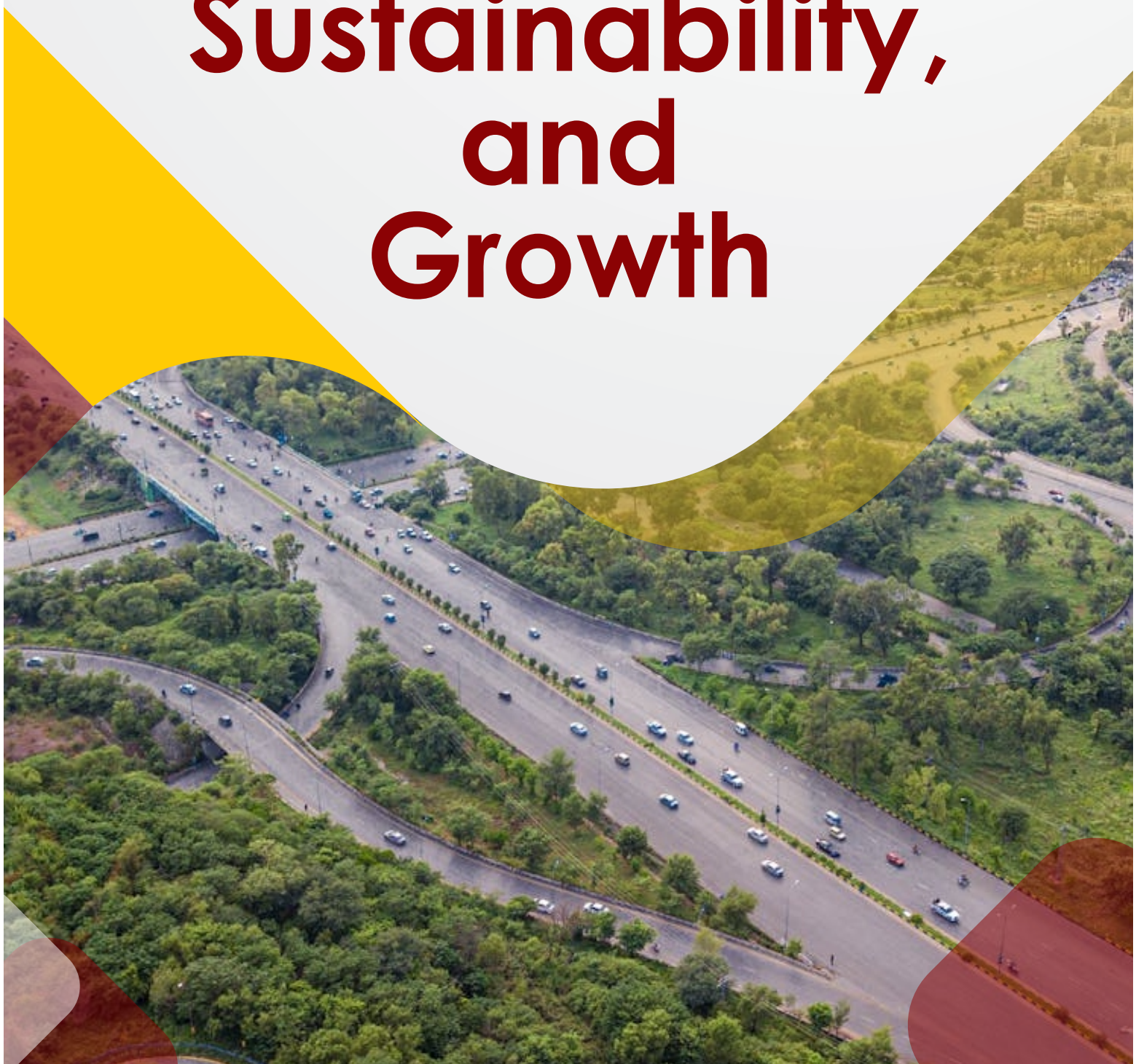




Transforming Pakistan's Cities

# Pathways to Resilience, Sustainability, and Growth



# KEY MESSAGES

## URBAN CENTERS FACE GROWING CLIMATE CHALLENGES

Pakistan's cities experience mounting vulnerabilities from heatwaves, flooding, and air pollution, intensified by climate change and unplanned urban growth.

### NATURE-BASED SOLUTIONS (NBS) ARE TRANSFORMATIVE

Scaling up urban forests, green roofs, and restored wetlands can mitigate urban heat islands, absorb emissions, and manage stormwater effectively.

### INNOVATIVE FINANCING UNLOCKS CLIMATE ACTION

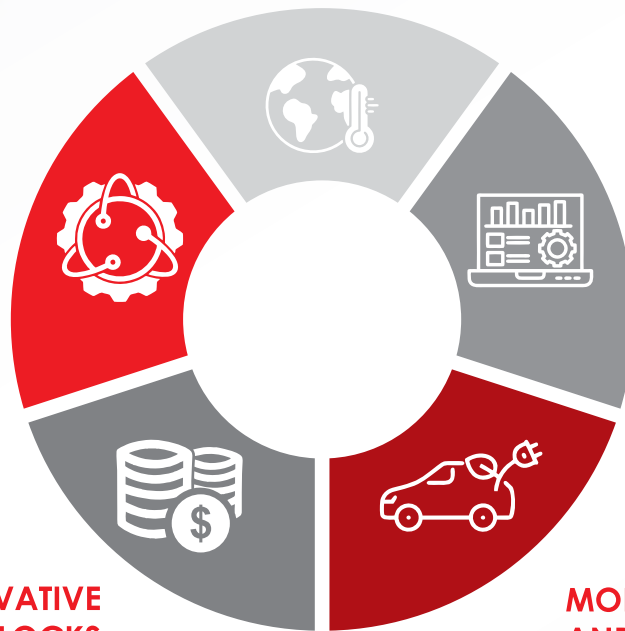
Property tax reforms, carbon markets, and public-private partnerships can mobilize resources for sustainable infrastructure and urban climate projects.

### DATA-DRIVEN PLANNING IS KEY

Integrating predictive tools like GIS and real-time monitoring systems enables targeted interventions, proactive planning, and disaster management.

### MODERN INFRASTRUCTURE AND GREEN MOBILITY ARE ESSENTIAL

Upgrading drainage systems, expanding public transit, and promoting energy-efficient buildings are critical to adapting cities to climate pressures.



## Introduction: Urbanization as an Opportunity and Challenge

Pakistan's cities are rapidly growing. Just under 40% of its population (nearly 92 million people) lives in urban areas. This fast-paced urbanisation is propelled by many factors including natural population growth (at 2.55% per annum<sup>1</sup>) and rural-to-urban migration. By 2050, 59% of the population is projected to be urban<sup>2</sup>. This transformation presents significant economic opportunities, as cities can become centers of economic activity and important drivers of productivity, innovation, and job creation<sup>3</sup>. Liveable cities even more so.

However, rapid urbanisation also poses challenges which are intensified by climate change. Unplanned urban growth, outdated infrastructure, and weak governance exacerbate vulnerabilities to climate risks such as floods, heatwaves, and air pollution. Karachi, a megacity, ranks as one of the least liveable cities<sup>4</sup> in the world whereas Lahore, Pakistan's second largest city, tops the charts of the world's most

polluted city. Almost 25 million people reside in the 8 largest cities of Pakistan<sup>5</sup>.

Pakistan's cities are pivotal to the country's economy. They contribute a substantial share to the GDP and federal tax revenue while remaining important hubs for trade and investment<sup>6</sup>. The existing economic pressures on cities to cater to a growing population is compounded by climate shocks that is further pushing rural populations into urban areas, creating a dual challenge of resource scarcity and inadequate infrastructure<sup>7</sup>. Recent migration trends<sup>8</sup>, driven by climate-induced crop failures and natural disasters, have increased the burden on informal housing, urban services and job creation<sup>9</sup>. This underscores the urgency of integrating climate adaptation into urban economic planning. If left unaddressed, these challenges could undermine gains of urbanisation, entrenching inequalities and slowing economic growth.



**40%**  
of Pakistan's  
population is urban



**55%**  
Cities' contribution  
to GDP



Between  
**15 TO 30%**  
of the population  
Pakistan's major cities  
is migrants



**59% BY 2050**  
Projected to reach



**95%**  
Contribution to  
federal tax revenue



**70%**  
of urban workforce is  
informal and vulnerable  
to climate impact

<sup>1</sup> Population census 2023

<sup>2</sup> According to projections by the World Bank, Pakistan's urban population is expected to increase from 37% in 2020 to 60% by 2050. <https://www.worldbank.org/en/news/press-release/2022/11/10/pakistan-urgently-needs-significant-investments-in-climate-resilience-to-secure-its-economy-and-reduce-poverty>

<sup>3</sup> <https://www.adb.org/news/features/economic-corridors-boost-pakistans-prospects-regional-economic-hub>

<sup>4</sup> Global Liveability Index 2024 ranks Karachi at 169 out of 173 countries <https://www.eiu.com/n/campaigns/global-liveability-index-2024/>

<sup>5</sup> <https://www.unicef.org/pakistan/media/2926/file/Profiles%20of%20Underserved%20Areas%20of%2008%20Largest%20Cities%20of%20Pakistan.pdf>

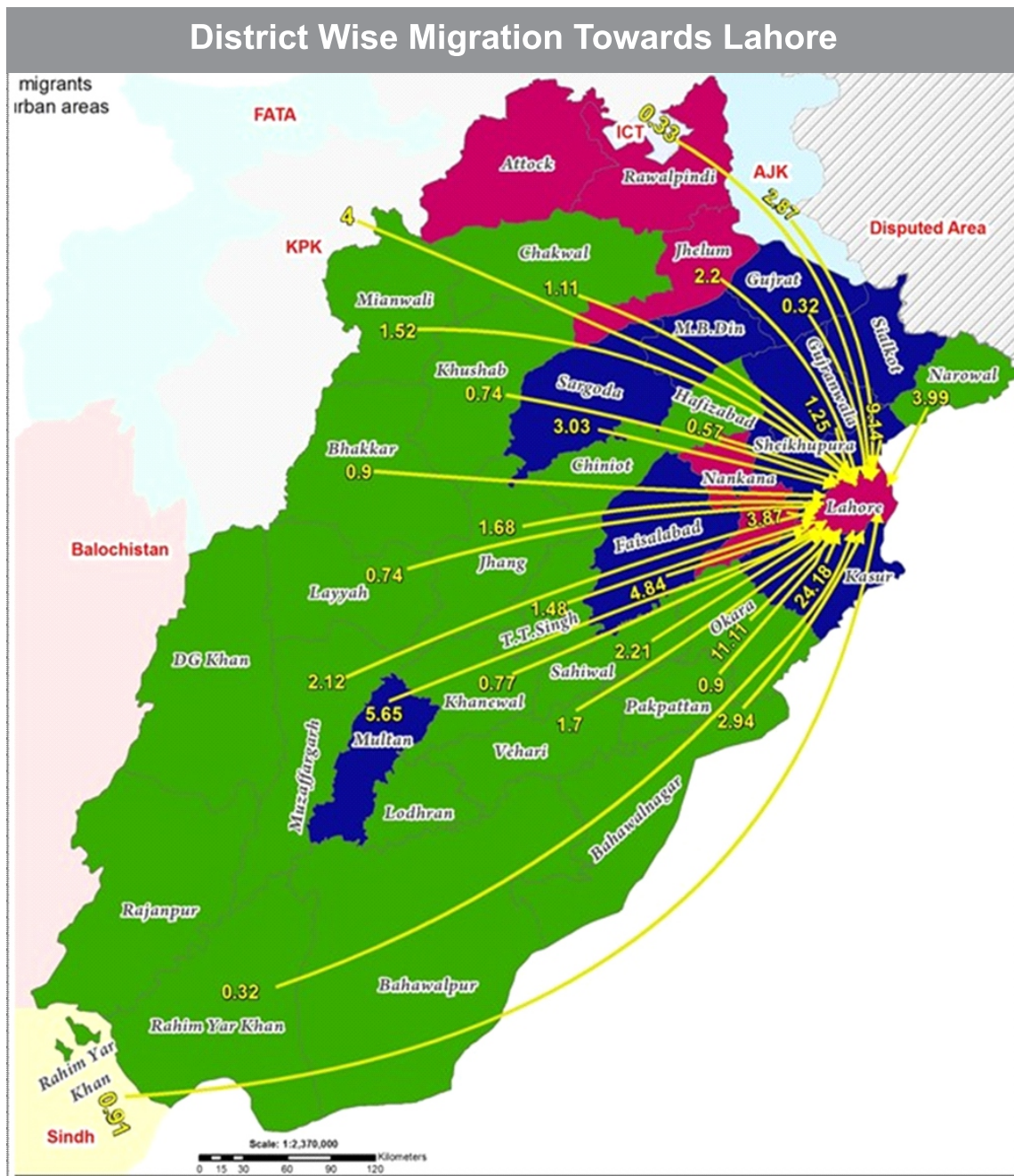
<sup>6</sup> <https://www.undp.org/pakistan/urbanisation-pakistan>

<sup>7</sup> [https://actionaid.org/sites/default/files/publications/ActionAid%20CANSAs%20-%20South%20Asia%20Climate%20Migration%20report%20-%20Dec%202020\\_3.pdf](https://actionaid.org/sites/default/files/publications/ActionAid%20CANSAs%20-%20South%20Asia%20Climate%20Migration%20report%20-%20Dec%202020_3.pdf)

<sup>8</sup> <https://www.adb.org/sites/default/files/institutional-document/988626/pakistan-national-urban-assessment.pdf>

<sup>9</sup> According to the Pakistan Labour Force Survey 2020-21, approximately 71.7% of non-agricultural employment is in the informal sector. This includes 68.3% in urban areas <https://www.pbs.gov.pk/publication/labour-force-survey-2020-21-annual-report?>

**Figure-1: Unanticipated Migration Patterns Towards Cities**



When drought hits in the marginalized areas, people move to big cities and try to build houses near nullahs to escape droughts, which are already vulnerable to floods. Increasing more vulnerability.

Source: <https://urbanunit.gov.pk/Download/publications/Files/12/2021/1-Drivers-for-Change-1.pdf>

This growth brief examines how Pakistan can navigate the dual challenge of urbanisation and climate vulnerability. While there are numerous challenges facing Pakistan's urban centers - ranging from inadequate housing and water scarcity to waste management and energy inefficiency - this growth brief focuses on three core vulnerabilities: air pollution, urban flooding, and heatwaves all exacerbated by an influx of migrants. These issues have been selected due to their immediate salience, far-reaching impacts, and potential to reverse

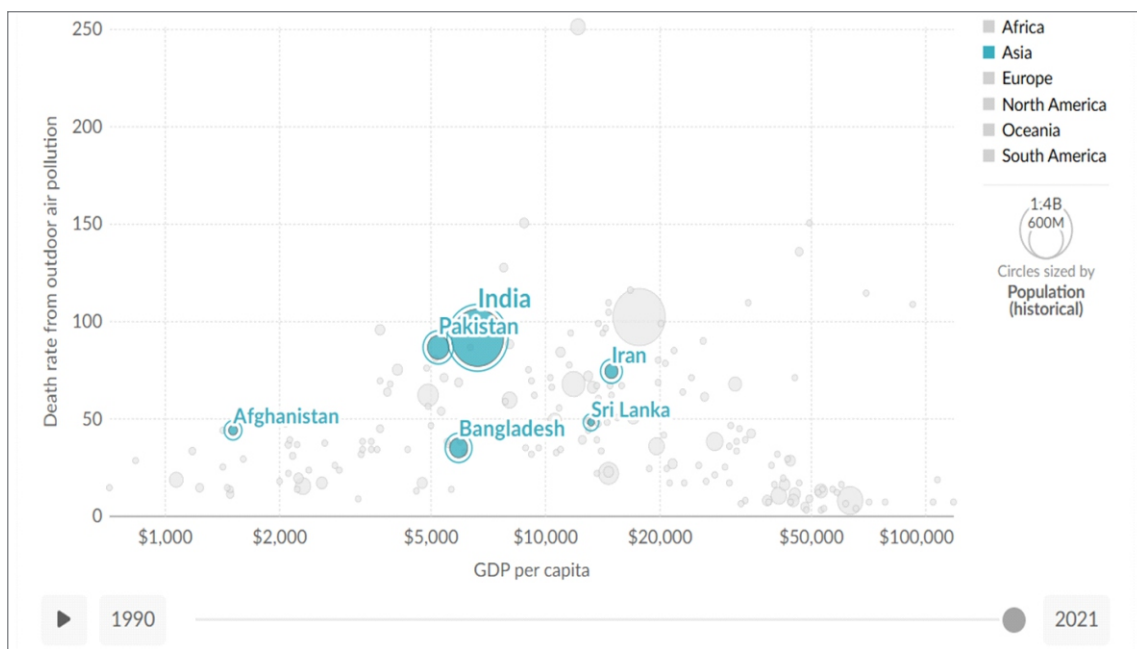
developmental gains if left unaddressed. By addressing these areas, this brief aim to highlight critical pathways for building urban resilience and ensuring sustainable growth. This focus is not exhaustive but represents an entry point to tackle broader urban sustainability concerns, offering actionable recommendations that can serve as a foundation for addressing other pressing challenges in the future. Climate action in cities remains central to both national and global efforts to mitigate climate change.

## Key Message 1: Pakistan's Cities are Becoming Increasingly Vulnerable to Climate Risks

Due to rising intensity of global warming, Pakistan's cities face mounting pressures from more frequent and severe climate-related events that threaten the lives, health, and livelihoods of millions<sup>10</sup>. By 2070, average yearly temperatures in Pakistan could reach that of African Sahara, highlighting the urgency to decarbonize<sup>11</sup>. Scientific estimates suggest

climate change may have made the heatwave episodes in South Asia (including Pakistan) 30 to 100 times more likely<sup>12</sup>. At the same time, Pakistan's citizens remain exposed to air pollution levels far above the threshold stipulated by WHO, leading to severe public health concerns and a comparatively high death rate relative to its GDP per capita (figure 2).

**Figure-2: Linking Air Pollution Mortality to Economic Growth: A Global Perspective (1990-2021)**



The chart illustrates the relationship between GDP per capita and death rates from outdoor air pollution across countries from 1990 to 2021. Larger circles represent countries with higher populations, and it highlights how lower-income countries tend to experience higher air pollution-related mortality rates compared to wealthier nations. Despite a lower GDP per capita compared to many nations, Pakistan experiences significant health impacts from air pollution. Its proximity to similarly affected countries like India and Bangladesh underscores the regional nature of the issue, with industrial emissions, vehicle pollution, and urbanization being key contributors.

**Source:** [https://earth.org/data\\_visualization/pollution/](https://earth.org/data_visualization/pollution/)

However, cities not only bear the brunt of but also contribute to climate change due to the dense concentration of infrastructure, industries, and population. Karachi alone adds almost 15%

to the country's total Green House Gas (GHG) emissions<sup>13</sup>. Yet urban centres provide a unique opportunity for scalable solutions to climate adaptation and mitigations.

<sup>11</sup> <https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-6/?>

<sup>11</sup> <https://www.pnas.org/content/117/21/11350>

<sup>12</sup> <https://earth.org/climate-change-made-deadly-indian-heatwave-30-100-times-more-likely/>

<sup>13</sup> [https://urbanunit.gov.pk/Download/Project%20files/8/KCAP\\_Deliverables%20B%20%20C%20GHG%20inventory%20-Pathway%20Projects.pdf](https://urbanunit.gov.pk/Download/Project%20files/8/KCAP_Deliverables%20B%20%20C%20GHG%20inventory%20-Pathway%20Projects.pdf)

## Cities Face Multiple Spatial Vulnerabilities

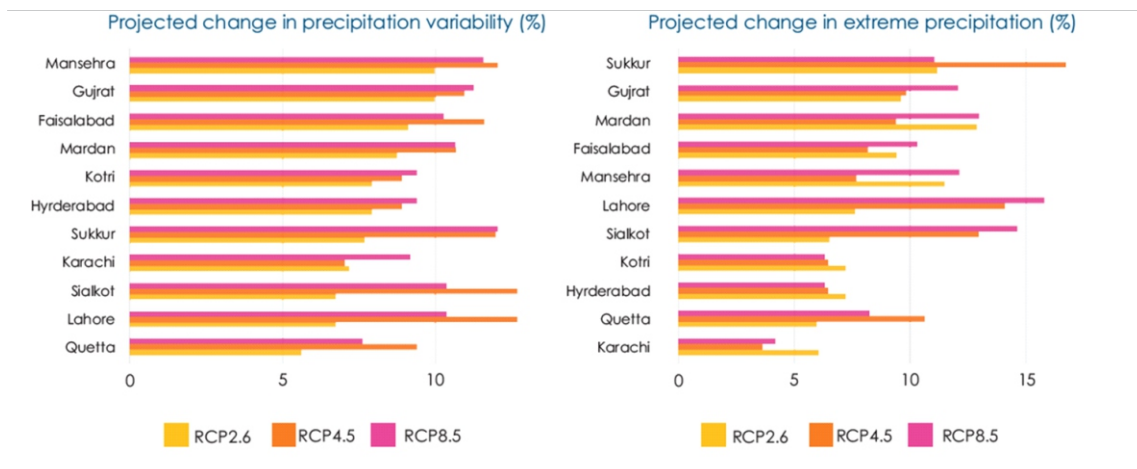
### Heatwaves and Urban Heat Islands (UHI):

Climate change is intensifying heatwaves in Pakistan's cities, with dense urban infrastructure trapping heat and making urban centres significantly warmer than surrounding rural areas. In May 2022, temperatures reached nearly 50°C (122°F), with Jacobabad ranking among the hottest places on Earth<sup>14</sup>. Cities in Punjab and Sindh regularly face extreme heat events, worsened by the Urban Heat Island (UHI) effect caused by limited green spaces and dense infrastructure. Due to the UHI effect, temperatures in Karachi have gone up by almost 5-7°C compared to rural suburbs, increasing incidence of heat-related illnesses and deaths, further straining public health systems<sup>15</sup>. The 2015 heatwave in Karachi caused over 1,200 fatalities<sup>16</sup>. Lahore's temperatures have also shown a significant increase. Between 1950 and 2007, mean maximum and minimum temperatures went up by 0.89°C and 2.52°C, respectively<sup>17</sup>. In the absence of corrective measures, Lahore's peripheral areas could see

an additional 0.6°C increase by 2050<sup>18</sup>.

**Urban Flooding:** Urban flooding is a growing threat in Pakistan, driven by high precipitation, poor drainage, urban sprawl, and loss of green spaces but worsened by climate change. There is an increase in the frequency of short-duration heavy rainfall that leads to a higher water runoff. The UHI effect further intensifies rainfall in urban areas. These vulnerabilities are compounded by low quality Infrastructure. Between the 1980s and 2020, Karachi's urban area expanded by 286%, resulting in the obstruction or elimination of approximately 870 km of natural streams<sup>19</sup>. Lahore has the largest settlement area exposed to fluvial flooding (163 sq. km) and to pluvial flooding (129 sq. km)<sup>20</sup>. Karachi has the second largest settlement area exposed to pluvial flooding<sup>21</sup>. Even smaller cities like Sialkot have seen a sevenfold increase in flood-exposed settlements<sup>22</sup>. Integrated urban planning and upgraded drainage systems can mitigate flooding risks.

**Figure-3: Projected Changes in Precipitation Variability and Extreme Events in Major Cities**



Climate projections show that precipitation variability and extreme precipitation in cities are both expected to rise.

Source: Pakistan's National Adaptation Plan 2023

<sup>14</sup> <https://www.aljazeera.com/news/2022/8/31/furnace-to-flood-worlds-hottest-city-in-pakistan-under-water>

<sup>15</sup> <https://earthobservatory.nasa.gov/images/153065/beating-the-heat-in-pakistan>

<sup>16</sup> <https://www.theguardian.com/world/2018/may/22/death-toll-climbs-in-karachi-heatwave#:~:text=A%20heatwave%20in%202015%20left,outside%20in%20the%20sweltering%20heat.>

<sup>17</sup> <https://www.emerald.com/insight/content/doi/10.1108/17568690910977483/full/html>

<sup>18</sup> CCDR World Bank

<sup>19</sup> <https://link.springer.com/article/10.1007/s44327-024-00010-w>

<sup>20</sup> Fluvial flooding: when a river overflows its banks, Pluvial flooding: when heavy rainfall overwhelms a city's drainage system.

<sup>21</sup> CCDR World Bank

<sup>22</sup> <https://documents1.worldbank.org/curated/en/099060624114031544/pdf/P1756071546dd400e1ba7b1b6a2bdeb3a49.pdf>

**Air Pollution:** Pakistan is one of top-most polluted countries globally. In 2024, Multan's Air Quality Index (AQI) exceeded 2000, highlighting the severity of the crisis<sup>23</sup>. Air pollution, driven by industrial emissions, vehicular pollution, and unsustainable urban practices, costs the country up to 6.5% of its GDP annually<sup>24</sup> reflecting both health care expenditures and productivity losses. Bad air contributes to 128,000 deaths annually<sup>25</sup> and reduces life expectancy by 3.8 to 4.3 years on average and nearly 7 years in

Lahore<sup>26</sup>. Air pollution also worsens climate change by contributing to carbon emissions, creating a feedback loop that intensifies both challenges. Thus, policies promoting energy efficiency and renewable energy can address both air pollution and climate change simultaneously<sup>27</sup>. Targeted measures (clean transportation, improved industrial technologies, eliminating open burning) can reduce air pollution.



### Climate Change Intensifies Vulnerabilities in Agriculture-dependent Small Cities

Smaller cities in Pakistan face unique vulnerabilities to climate change due to their reliance on agriculture as an economic backbone. This makes their economies more susceptible to climate shocks directly impacting crop yields and local economies. Rising temperatures and unpredictable weather patterns affect crop yields, with losses projected to range between 14% and 50% under varying climate scenarios<sup>28</sup>. Since agriculture consumes more than 90% of water in Pakistan, inadequate water management systems make these cities more vulnerable to water scarcity arising from

changing precipitation patterns<sup>29</sup>. Deforestation and soil degradation in regions surrounding smaller cities diminish natural capital and reduce resilience of agricultural systems. As agricultural productivity declines, many rural inhabitants migrate to larger cities in search of opportunities. Almost 60% migrants are settled in 7 big cities whereas 69% migrants are from rural to urban areas<sup>30</sup>. This not only depletes the labour pool in smaller cities but also places additional stress on larger urban centres, underscoring need to support smart climate agriculture.

### Climate Vulnerabilities Disproportionately Impact Low-income and Marginalized Groups

Global estimates suggest that the bottom 40% of income groups in developing countries can suffer up to 20% higher income losses compared to wealthier populations due to climate change

impact<sup>31</sup>. The 2022 floods in Pakistan pushed an estimated 8.4 to 9.1 million people into poverty<sup>32</sup>, with significant impacts on urban poor households due to destroyed infrastructure. An

<sup>23</sup> <https://www.msn.com/en-in/news/world/pakistan-chokes-with-alarming-levels-of-pollution-as-aqi-crosses-2100-multan-under-lockdown/ar-AA1tMfRn>

<sup>24</sup> <https://openknowledge.worldbank.org/server/api/core/bitstreams/2d1af64a-8d35-5946-a047-17dc143797ad/content>

<sup>25</sup> [https://www.stateofglobalair.org/sites/default/files/soga\\_2019\\_pakistan.pdf](https://www.stateofglobalair.org/sites/default/files/soga_2019_pakistan.pdf)

<sup>26</sup> <https://aqli.epic.uchicago.edu/wp-content/uploads/2019/02/Pakistan-Report.pdf>

<sup>27</sup> [https://aqli.epic.uchicago.edu/wp-content/uploads/2021/08/PakistanFactSheet\\_update.pdf](https://aqli.epic.uchicago.edu/wp-content/uploads/2021/08/PakistanFactSheet_update.pdf)

<sup>28</sup> <https://climateknowledgeportal.worldbank.org/sites/default/files/2019-06/CSA-in-Pakistan.pdf>

<sup>29</sup> <https://www.pbc.org.pk/wp-content/uploads/The-State-of-Pakistans-Agriculture.pdf>

<sup>30</sup> Urban Unit presentation

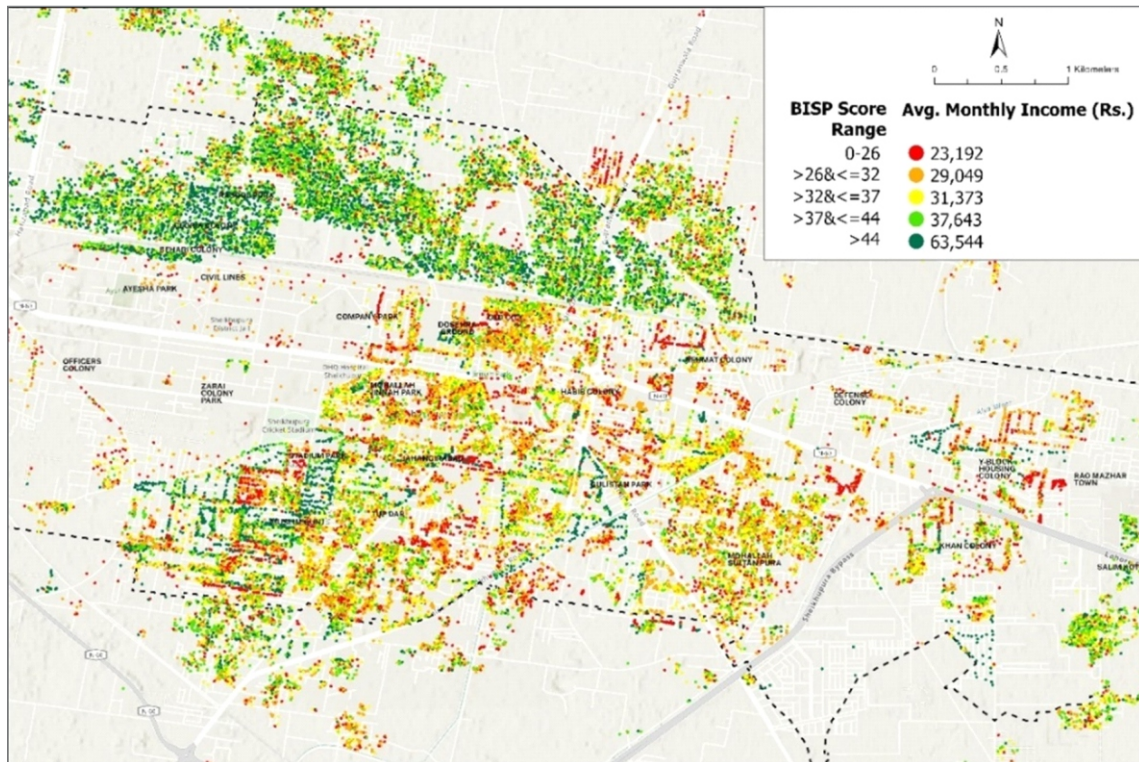
<sup>31</sup> White Paper on Sustainability - IGC

<sup>32</sup> <https://thedocs.worldbank.org/en/doc/4a0114eb7d1cecbbf2f65c5ce0789db-0310012022/original/Pakistan-Floods-2022-PDNA-Main-Report.pdf>

estimated 50% of Karachi's urban population resides in informal settlements<sup>33</sup>, highly vulnerable to climate-induced shocks like floods and heatwaves. These people lack the financial resources to invest in adaptive measures like resilient housing, cooling systems, or relocation. Low-income neighbourhoods are also disproportionately impacted by floods, as drainage systems and infrastructure are often

neglected. Informal workers who labour outdoors without adequate protection are also exposed to extreme heat and its associated health risks, exacerbated due to UHI effect. The figure below reinforces the need for targeted policies and equity focused climate action that address the intersection of poverty, urban vulnerabilities, and climate risks.

**Figure-4: Income Distribution and Vulnerability in Sheikhpura**



The map highlights income disparities across Sheikhpura, with lower-income households concentrated in specific areas. Lower-income households (red and yellow zones) in Sheikhpura are likely more susceptible to climate risks such as floods, heatwaves, and poor air quality.

**Source:** Analysis by Urban Unit based on Data from National Socio-Economic Registry

## Key Message 2: Nature-based Solutions (NBS) Offer Cost-effective and Scalable Pathways for Climate Resilience

Nature-Based Solutions (NBS) present a transformative (but underutilised) opportunity to address climate risks and improve urban liveability. Such interventions offer cost-effective strategies to mitigate climate hazards due to their ability to provide multiple co-benefits at a lower cost compared to traditional engineered solutions/conventional infrastructure. Green infrastructure, including urban forests, green roofs, parks, and permeable surfaces, can

combat UHI effects, reduce air pollution, manage stormwater, and mitigate flooding. While such initiatives are limited in Pakistan, success stories from cities globally underscore their effectiveness in flood control, temperature regulation, and carbon sequestration, highlighting significant scope for integrating NBS into urban planning to enhance the climate resilience of Pakistan's cities. These solutions require less upfront capital investment and lower

<sup>33</sup> <https://www.iiied.org/karachi-informal-settlements-covid-19>



maintenance costs, provide long-term benefits and multiple co-benefits (such as carbon sequestration, biodiversity conservation, and

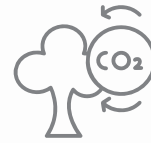
livelihood generation). Following are some opportunities for implementing NBS in Pakistan.



**Green cover can reduce land surface temperatures by 3°C**

**Urban forests can reduce PM2.5 by**

**25%**



**A mature tree can absorb 21 kg of CO<sub>2</sub> annually**

## Restoring Floodplains and Wetlands Mitigates Urban Flooding Risks

Urban flooding is a persistent challenge in cities like Karachi, Lahore, and Sialkot, driven by heavy rainfall, inadequate drainage systems, and rapid urbanization. Restoring natural floodplains and wetlands offers a sustainable way to absorb excess water during heavy rainfall, acting as natural buffers against floods. Wetland restoration in urban peripheries can reduce flood risks, enhance groundwater recharge, and

provide critical support in water-stressed regions such as Sindh and Punjab<sup>34</sup>. In Pakistan, groundwater recharge is particularly critical as agriculture consumes more than 90% of available water, and groundwater levels in urban areas are depleting rapidly. By restoring wetlands, excess water can be redirected to replenish aquifers, ensuring a more sustainable water supply for urban and rural needs.

## Expanding Urban Green Cover Helps Combat UHI Effects

The UHI effect is particularly severe in dense cities like Lahore and Karachi, where concrete infrastructure retains heat, raising temperatures significantly above those in surrounding rural areas. Green roofs, urban forests, and street-level vegetation can lower ambient temperatures, providing thermal comfort and reducing energy demands for cooling. Increasing urban green cover (trees, green

roofs, and urban forests) can decrease land surface temperatures by 0.3 to 3°C<sup>35</sup>, mitigating the UHI effect and enhancing public health. Large green spaces can experience land surface temperatures 1 to 4°C lower than surrounding built-up areas<sup>36</sup>, demonstrating their potential for high-impact climate adaptation. Urban green policies can mandate a minimum green cover percentage in city planning.

## Urban Green Spaces Reduce Pollution and Capture Carbon

Urban green spaces function as carbon sinks and air filters, simultaneously addressing air pollution and climate change. Lahore's urban forest initiatives<sup>37</sup> exemplifies the effectiveness of targeted reforestation in improving urban liveability<sup>38</sup>. A mature tree can absorb approximately 21 kg of CO<sub>2</sub> annually, making urban forestry an efficient and scalable solution for reducing urban carbon footprints<sup>39</sup>. Urban

vegetation also traps particulate matter (PM2.5, PM10), nitrogen oxides, and sulphur dioxide, improving air quality in high-density areas by up to 25%<sup>40</sup>. Such interventions provide substantial health benefits<sup>41</sup>. Nationwide urban forestry programs, afforestation in high-density urban areas, and incentives for private entities can help manage and expand urban green spaces.

<sup>34</sup> World Bank Country Climate Development Report for Pakistan

<sup>35</sup> <https://www.frontiersin.org/journals/remote-sensing/articles/10.3389/frsen.2022.897397/full>;

<sup>36</sup> <https://www.sciencedirect.com/science/article/abs/pii/S0264837721005974>

<sup>37</sup> <https://una.city/nbs/lahore/liberty-market-forest>

<sup>38</sup> <https://urbanunit.gov.pk/Download/publications/Files/8/2021/Afforestation%20for%20Greener%20Punjab..pdf>

<sup>39</sup> <https://www.eea.europa.eu/articles/forests-health-and-climate-change>

<sup>40</sup> <https://doi.org/10.1016/j.buildenv.2019.03.007>, <https://doi.org/10.1016/j.scitotenv.2021.148605>, <https://www.mdpi.com/2073-445X/11/6/776>

<sup>41</sup> <https://doi.org/10.1016/j.buildenv.2019.03.007>, <https://doi.org/10.1016/j.scitotenv.2021.148605>, <https://www.mdpi.com/2073-445X/11/6/776>

## Key Message 3: Data-driven Planning and Governance can Transform Climate-resilient Urban Planning

Despite escalating climate risks, urban responses in Pakistan remain reactive, constrained by fragmented data and limited predictive tools, exacerbating vulnerabilities in high-risk areas. Data-driven approaches can revolutionize urban governance by enabling precise

mapping, resource allocation, and climate planning. Empowering local governments with these tools and decentralized models is vital for integrating climate resilience into urban development. Sections below outline strategies to address this.

### Climate Risk Management can Improve via Integrated Data Systems

Inadequate integration of data-driven systems results in reactive responses to climate risks. While various government departments collect climate-related data, the lack of coordination and integration leads to inefficiencies in


planning and disaster response. A centralized data integration platform can help consolidate climate, socio-economic, and urbanization data across government departments.

 The Urban Unit in Punjab has developed spatial mouza boundaries dashboards that integrate climate and socio-economic data to guide urban planning<sup>42, 43</sup>.

 Overlaying income data with climate risks through the National Socio-Economic Registry enables focused social protection and infrastructure planning.

 Call Detail Records (CDR) provide real-time insights into migration and population density changes, essential for adaptive resource allocation<sup>44</sup>.

 Punjab EPA's expansion of monitoring networks improves data accessibility for better pollution management.

 In collaboration with the Punjab Agriculture Department, IGC researchers are overlaying flood data with transport routes, to evaluate climate-driven vulnerabilities affecting market access and food security, providing insights into resilience and mitigation practices in agricultural supply chains.

### Predictive Tools and Early Warning Systems can make Resource Allocation more Responsive to Climate Shocks

The absence of advanced predictive tools limits the ability to anticipate climate risks. Geospatial mapping, remote sensing, and digital dashboards can enable informed decision-making and targeted resource allocation and allow precise mapping of vulnerable zones, such as flood-prone areas and urban heat islands. Cities like Jakarta have successfully utilized GIS to create detailed flood hazard maps, improving preparedness and planning<sup>45</sup>. Pakistan can adopt similar approaches by incorporating geospatial tools into district planning, zoning, and infrastructure projects, including those

under CPEC. Annual Development Plans (ADPs) should integrate these tools to prioritize climate-resilient infrastructure, such as drainage systems, urban green spaces, and flood mitigation projects. These systems can also act as early warning mechanism. The IGC-supported Lahore Smog Alert System demonstrates how real-time air quality data can issue timely alerts and actionable recommendations for citizens and policymakers. Scaling such platforms nationwide and integrating them with governance frameworks and disaster management protocols can strengthen early

<sup>42</sup> <https://urbanunit.gov.pk/Download/publications/Files/11/2021/Digital%20Mouza%20Boundries.pdf>

<sup>43</sup> <https://pu.edu.pk/home/subdepartment/67030>

<sup>44</sup> <https://new.24justice.pk/laws-of-pakistan/evidence/cdr-data/>

<sup>45</sup> <https://link.springer.com/article/10.1007/s00267-024-02059-0>

warning systems. Mandatory use of predictive tools and spatial planning can align urban

development with climate resilience goals more effectively.

## Innovative use of Data can Transform Urban Climate Planning

Pakistan lacks an integrated database to monitor migration patterns and climate-induced urbanization<sup>46</sup>, leaving cities like Karachi and Lahore struggling to absorb the influx of climate migrants. Mobile data, such as CDR, can provide real-time insights into migration patterns, aiding resource allocation and adaptive infrastructure planning. Cities such as Dhaka<sup>47</sup> have effectively used such data to map heat exposure<sup>48</sup> and population density, enabling targeted interventions like cooling shelters.

Similarly, effective air quality management depends on reliable data collection and utilization. In Punjab, plans to expand air quality monitoring – with 30 new air quality monitors in the province - and leverage the NSER to overlay income data with climate risks can identify vulnerable communities and guide social protection efforts. However, gaps in monitoring leave critical areas unaddressed, weakening pollution management. Innovative uses of existing data, better integration, real-time monitoring, and public accessibility can drive targeted interventions.

## Improving Local Planning and Resource Allocation are key to Data-informed Climate Interventions

Despite the availability of climate data, its inadequate integration into urban planning often leads to ad hoc decision-making.<sup>49</sup> Establishing comprehensive monitoring systems and data platforms requires significant investment, often deprioritized in favor of other urban development needs<sup>50</sup>. For instance, while urban heat islands in Lahore are well-documented, investments in green roofs, urban forestry, and cooling infrastructure remain insufficient due to fragmented planning and funding priorities. At the same time, decentralized governance is critical to enabling

municipalities to address local climate challenges effectively. Countries like the Philippines have successfully reduced disaster response times and enhanced climate planning by empowering local governments with the authority and resources to act<sup>51</sup>. Pakistan can adopt similar decentralized models by establishing a phased roadmap that includes capacity-building programs, clear mandates for municipalities, and robust monitoring and evaluation mechanisms to align urban development with long-term climate goals.

## Key Message 4: Sustainable Urban Development in Pakistan Requires Innovative Financing Solutions

Pakistani cities face significant challenges in addressing urban climate vulnerabilities due to limited fiscal capacity and heavy reliance on intergovernmental transfers. To address these challenges and fund sustainable infrastructure development, cities must explore innovative

financing solutions such as property tax reforms, carbon markets, and international climate funds. With high estimates of adaptation needs - 70% of which will be required for infrastructure - mobilizing resources through these mechanisms is imperative<sup>52</sup>.



Annual cost of urban climate adaptation is

**\$7–14 bn**

**until 2050**

<sup>46</sup> [https://unhabitat.org/sites/default/files/2023/06/4.\\_pakistan\\_country\\_report\\_2023\\_b5\\_final\\_compressed.pdf](https://unhabitat.org/sites/default/files/2023/06/4._pakistan_country_report_2023_b5_final_compressed.pdf)

<sup>47</sup> [https://link.springer.com/chapter/10.1007/978-981-13-2526-7\\_3](https://link.springer.com/chapter/10.1007/978-981-13-2526-7_3)

<sup>48</sup> <https://eprints.whiterose.ac.uk/149133/1/draft2.pdf>

<sup>49</sup> CCDR, World Bank

<sup>50</sup> <https://link.springer.com/article/10.1007/s00704-024-04959-x><https://link.springer.com/article/10.1007/s00704-024-04959-x>

<sup>51</sup> <https://www.undp.org/philippines/press-releases/dilg-and-undp-sign-mou-strengthen-local-and-community-level-disaster-and-climate-resilience>

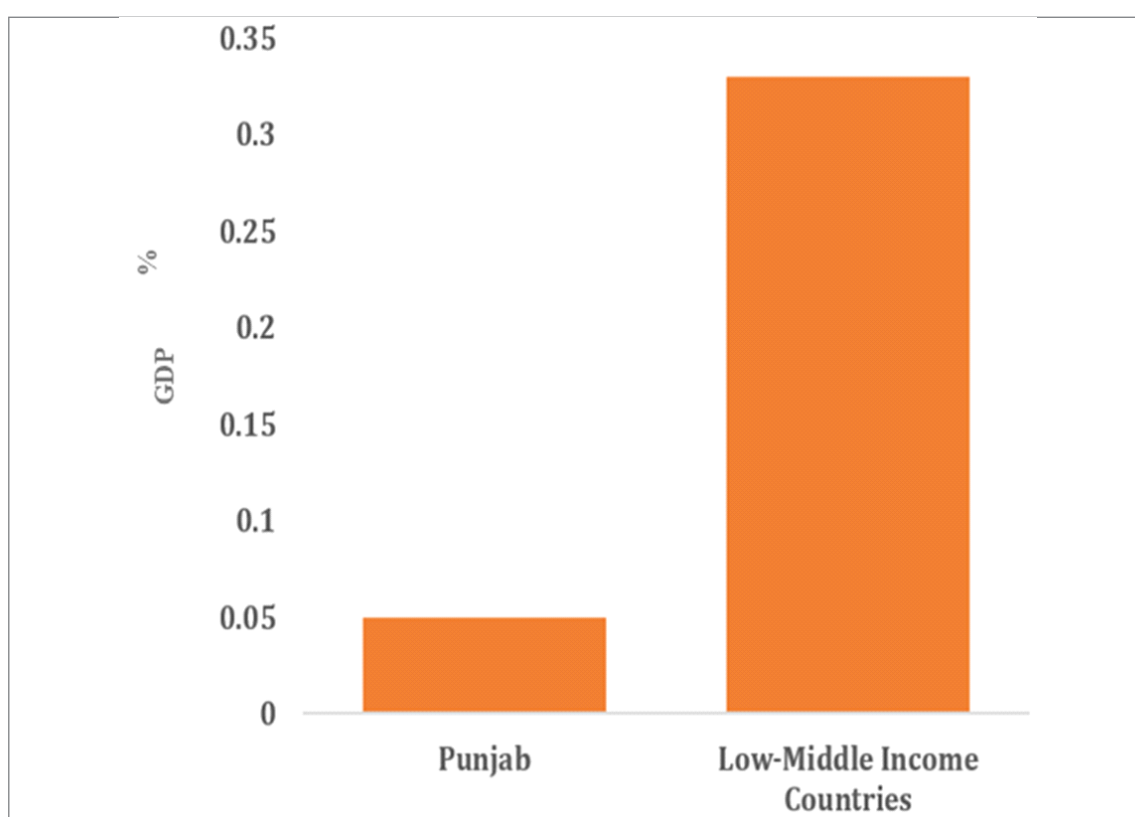
<sup>52</sup> Government of Pakistan, National Determined Contributions (NDC), 2021.

## Property Tax Reforms can Unlock Revenue for Climate-resilient Urban Planning

Property taxes remain an underutilized revenue source in Pakistan, contributing only 0.05% of GDP, far below the average of 0.35% for low-middle-income countries.<sup>53</sup> Property tax revenue in Pakistan lags significantly behind regional peers due to outdated valuation methods, limited coverage, and inefficiencies in collection systems. IGC research in Pakistan has shown how to improve tax collection and valuation. Countries like the Philippines and India have successfully implemented GIS-based property mapping to improve valuation accuracy, expand tax coverage, and ensure

transparent allocation of revenues to urban infrastructure projects. Adopting similar reforms in Pakistan, such as expanding Punjab's GIS-based system nationwide, could increase collection efficiency by up to 30%<sup>54</sup> and generate significant funds for climate-resilient infrastructure, including energy-efficient buildings<sup>55</sup>, drainage systems, and green mobility solutions. Linking property taxes to visible urban improvements, such as waste management or public transport, can improve taxpayer compliance and trust as shown by IGC research.

**Figure-5: Punjab's Property Tax Utilisation Compared to Low-middle-income Countries**



*Punjab collects 0.05% of its GDP as property taxes, nearly 7 times lower than average utilization in low-middle income countries (2021-22).*

**Source:** World Bank Atlas, IMF, Punjab Annual Budget Statement (2021-22)

<https://www.theigc.org/sites/default/files/2023-03/Abbas%20et%20al%20Policy%20brief%20December%202022.pdf>

<sup>53</sup> <https://www.theigc.org/sites/default/files/2023-03/Abbas%20et%20al%20Policy%20brief%20December%202022.pdf>

<sup>54</sup> <https://urbanunit.gov.pk/Download/publications/Files/11/2021/GIS%20Integrated%20Urban%20Immovable%20Property%20Tax.pdf>

<sup>55</sup> <https://www.theigc.org/sites/default/files/2020/11/Wani-et-al-2020-Policy-Brief.pdf>,

<https://www.theigc.org/sites/default/files/2022/10/Khan-et-al-Final-Report-August-2022.pdf>,

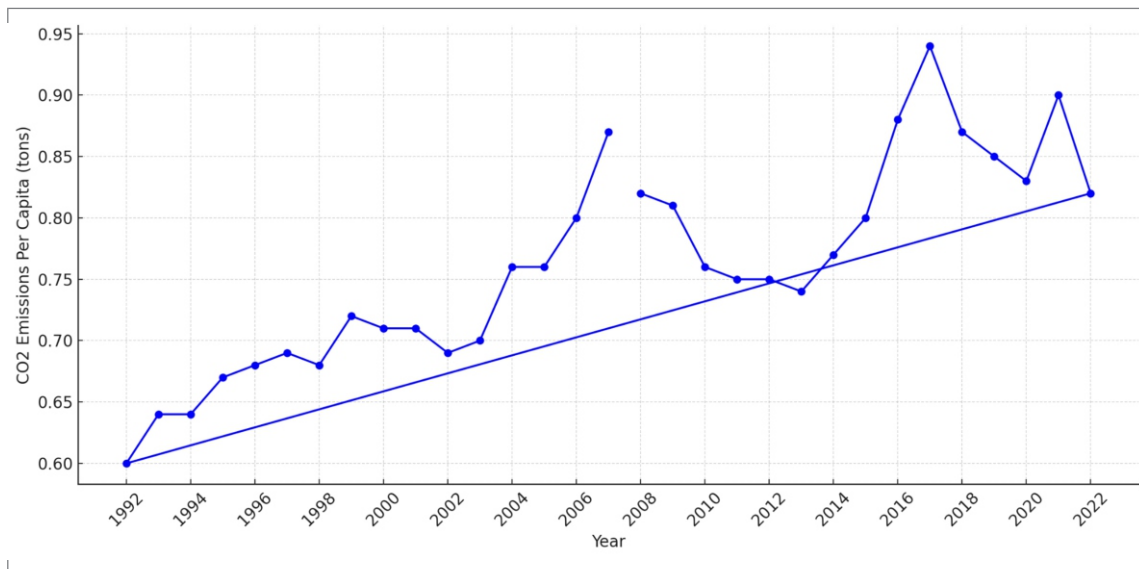
<https://www.theigc.org/sites/default/files/2023-03/Abbas%20et%20al%20Policy%20brief%20December%202022.pdf>,

## Carbon Markets Provide Opportunities to Fund Sustainable Urban Infrastructure and Incentivize Low Carbon Growth

Carbon markets can generate revenue and incentivize low-carbon development by creating tradable carbon credits from activities like renewable energy, reforestation, energy efficiency, and methane capture. These credits can be sold in compliance or voluntary markets, projected to grow from \$2 billion in 2021 to \$10–40 billion by 2030<sup>56</sup>. However, caution is

necessary. Transparency, credibility, and fair international rules governing carbon trading must be established to prevent greenwashing and ensure meaningful emission reductions. Effective regulatory frameworks are essential to ensure that carbon credits are genuine, verifiable, and equitably distributed to avoid market manipulation and inequitable benefits.

**Figure-6: CO<sub>2</sub> Emissions Per Capita in Pakistan (1992-2022)**

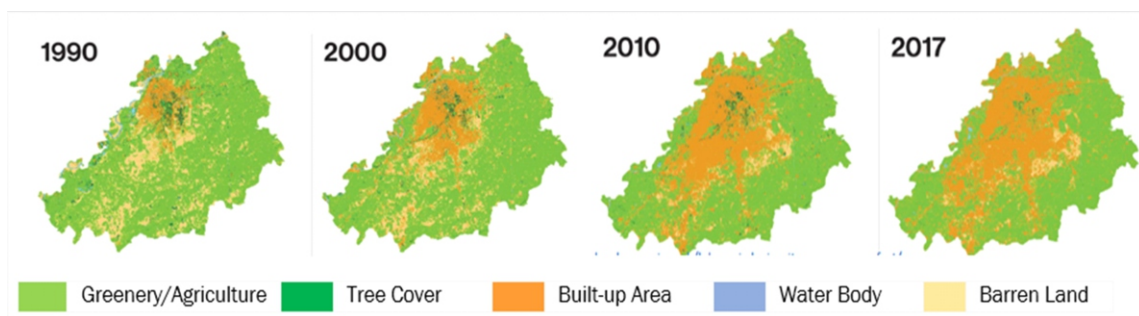


Source: <https://www.worldometers.info/co2-emissions/pakistan-co2-emissions/>

**Urban forestry:** Urban forestry enhances carbon sequestration and reduces particulate matter by 7–15% in cities like Lahore<sup>57</sup>. Pakistan's 126 Miyawaki urban forest projects show potential but require further research to address high costs

and local climate suitability<sup>58</sup>. Expanding such projects with research-driven methods tailored to Pakistan's climate zones can maximize cost-effectiveness and long-term benefits.

**Figure-7: Land Use Transformation in Lahore: 1990 to 2017**



The maps show a steady expansion of built-up areas (orange) and a decline in greenery/agriculture (light green) from 1990 to 2017. Tree cover (dark green) remains relatively stable but still declining, while water bodies (blue) and barren land (yellow) show minimal change. This highlights increasing urbanization and the need for sustainable land management.

Source: Urban Unit.

<sup>56</sup> <https://www.reuters.com/markets/carbon/voluntary-carbon-markets-set-become-least-five-times-bigger-by-2030-shell-2023-01-19/>

<sup>57</sup> <https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2022.1064586/full>

<sup>58</sup> <https://dialogue.earth/en/forests/will-urban-forests-pakistan-have-lasting-environmental-impact/>

**Urban waste:** Urban waste in cities like Karachi and Lahore contributes significantly to methane emissions, a greenhouse gas 25 times more potent than CO<sub>2</sub>. Lahore generates 2.5 million metric tons of waste annually<sup>59</sup>, while Karachi produces 14,000–16,000 tons daily - equivalent to 0.44 kg of waste per person per day<sup>60</sup>.

Methane capture technologies could reduce emissions and generate energy, with Lahore's waste alone capable of producing 341 MW of electricity per day<sup>61</sup>. Successful examples from Brazil<sup>62</sup> and China<sup>63</sup> highlight the potential of waste-to-energy systems, which could also generate revenue through carbon credits.



**Pakistan is amongst the top ten methane-emitting countries globally.**

**Some dumps in Lahore have shown via satellite 126 metric tons of Methane in an hour - equivalent to annual emissions of 6200 cars in the UK!**



**Renewable Energy:** Pakistan has immense renewable energy potential, with over 50,000 MW possible from wind and solar, and 2.9 million MW annually from solar alone<sup>64</sup>. Solar power, now the world's cheapest electricity at below 1.5 US cents/kWh, makes Pakistan the sixth-largest solar market globally<sup>65</sup>. However, urban renewable energy adoption remains limited. Expanding solarization in public buildings, as seen in Lahore and Islamabad, could cut

emissions, reduce energy costs, and generate carbon credits. With 134 million square feet already solarized in Punjab, scaling such initiatives and linking them to carbon credit systems could accelerate Pakistan's shift to cleaner energy<sup>66</sup>. A focused policy to expand solar and wind energy adoption in public infrastructure, linked to carbon credit systems, can accelerate Pakistan's transition to cleaner energy.

<sup>59</sup> <https://www.trade.gov/country-commercial-guides/pakistan-waste-management>

<sup>60</sup> Urban Unit presentation for WB conference in DC

<sup>61</sup> <https://www.tandfonline.com/doi/pdf/10.1080/17583004.2021.1976675>

<sup>62</sup> <https://cdm.unfccc.int/Projects/DB/DNV-CUK1095236970.6/history>

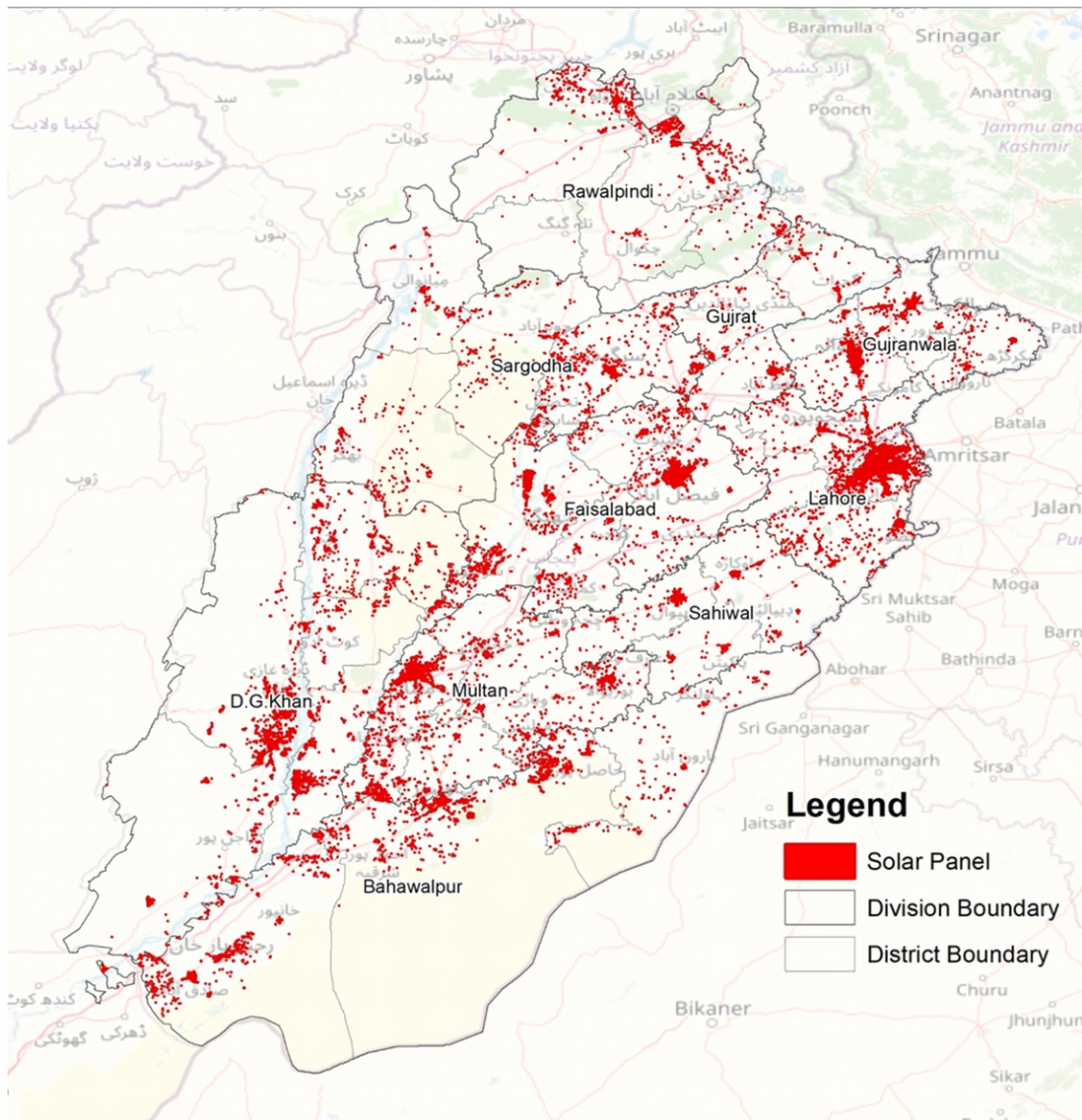
<sup>63</sup> <https://www.globaldata.com/store/report/beijing-asuwei-domestic-waste-incineration-power-plant-profile-snapshot/>

<sup>64</sup> According to the Alternative Energy Development Board (AEDB)

<sup>65</sup> <https://www.vox.com/future-perfect/388506/solar-energy-power-projections-climate-change-pakistan>

<sup>66</sup> <https://doi.org/10.3390/ASEC2023-15274>.

**Figure-8: Mapping Solarization in Punjab**



The map highlights widespread solarization across Punjab, with dense clusters in central regions like Faisalabad, Lahore, and Sargodha, and notable adoption in rural and agricultural areas for off-grid electrification and irrigation. The distribution reflects the scalability of solar energy and the impact of government and private sector efforts in promoting renewable energy in Punjab.

## **Key Message 5: Prioritize Infrastructure and Sustainable Mobility for Climate-adapted Urban Development**

Without targeted investments in modern infrastructure and sustainable urban mobility, cities will struggle to cope with rising climate

pressures, threatening public safety, economic stability, and urban liveability. Some quick wins are discussed below.

### **Upgrading Drainage Systems are Essential to Address Urban Flooding**

Outdated drainage systems and poor planning exacerbate urban flooding, with large settlement areas in Lahore (129 km<sup>2</sup>) and Karachi (61 km<sup>2</sup>) exposed to flood risks. Poorly maintained networks in low-lying neighborhoods worsen the issue. Nature-based solutions (NBS)

like green roofs, bioswales, and wetlands can complement traditional drainage systems by absorbing and slowing stormwater runoff. Singapore's Active, Beautiful, Clean (ABC) Waters program<sup>67</sup> exemplifies how integrating NBS with conventional systems can effectively

<sup>67</sup> <https://ap-plat.nies.go.jp/inas/goodpractices/development/10.html>

manage floods. There is an urgent need to upgrade drainage systems while mandating NBS

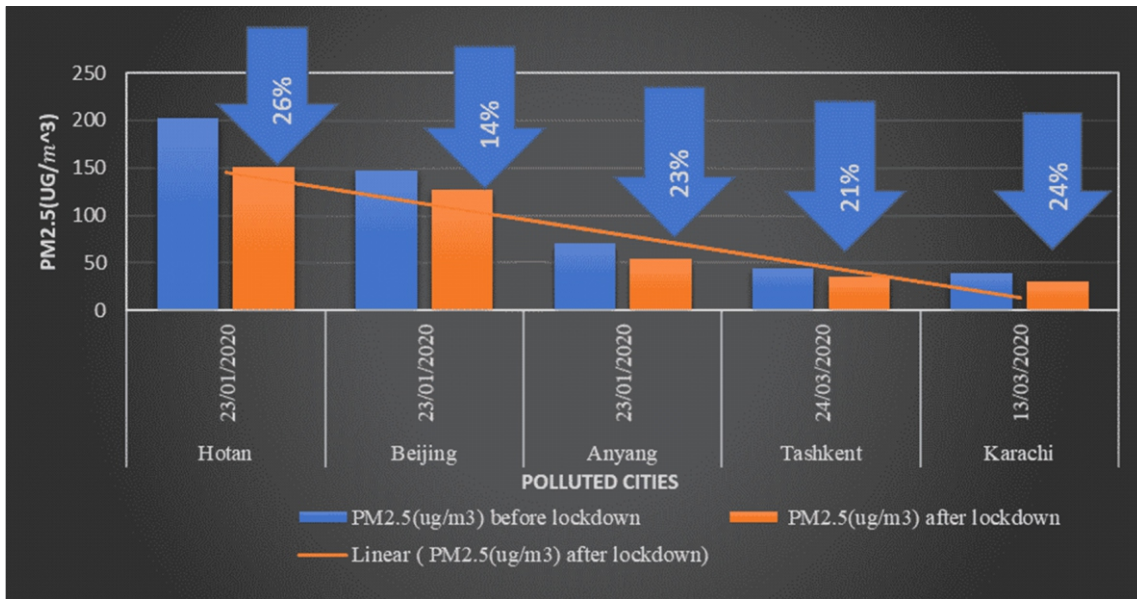
integration into urban designs to enhance resilience.

### Expanding Public Transport and Incentivizing Electric Vehicles can Encourage Green Mobility

Sustainable urban mobility is vital for reducing greenhouse gas emissions, improving air quality, and optimizing urban connectivity. Systems like Bus Rapid Transit (BRT) reduce reliance on private vehicles, with a bus replacing up to 40 cars and emitting CO<sub>2</sub> equivalent to only 3.6 cars per kilometre<sup>68</sup>. Lahore's BRT has achieved a 4%

modal shift, decreasing private vehicle use and emissions<sup>69</sup>. Expanding electric vehicles (EVs), especially for 2-3 wheelers, and supporting charging infrastructure can further enhance sustainability. Implementing policies like car parking fees, coupled with viable alternative commuting options, can encourage sustainable urban mobility in Pakistan<sup>70</sup>.

**Figure-9: Pollution Trends Before and After Lockdown due COVID-19**



The chart shows significant reductions in PM2.5 levels across cities during COVID-19 lockdowns, with decreases of 26% in Hotan, 24% in Karachi, and 23% in Tashkent. Reduced industrial activity and transportation contributed to these improvements in air quality

**Source:** Real Time Air Quality Index (2020) <https://pide.org.pk/research/a-smart-shift-from-private-cars-to-public-transport-can-help-to-reduce-smog-air-pollution-in-pakistan-2/>

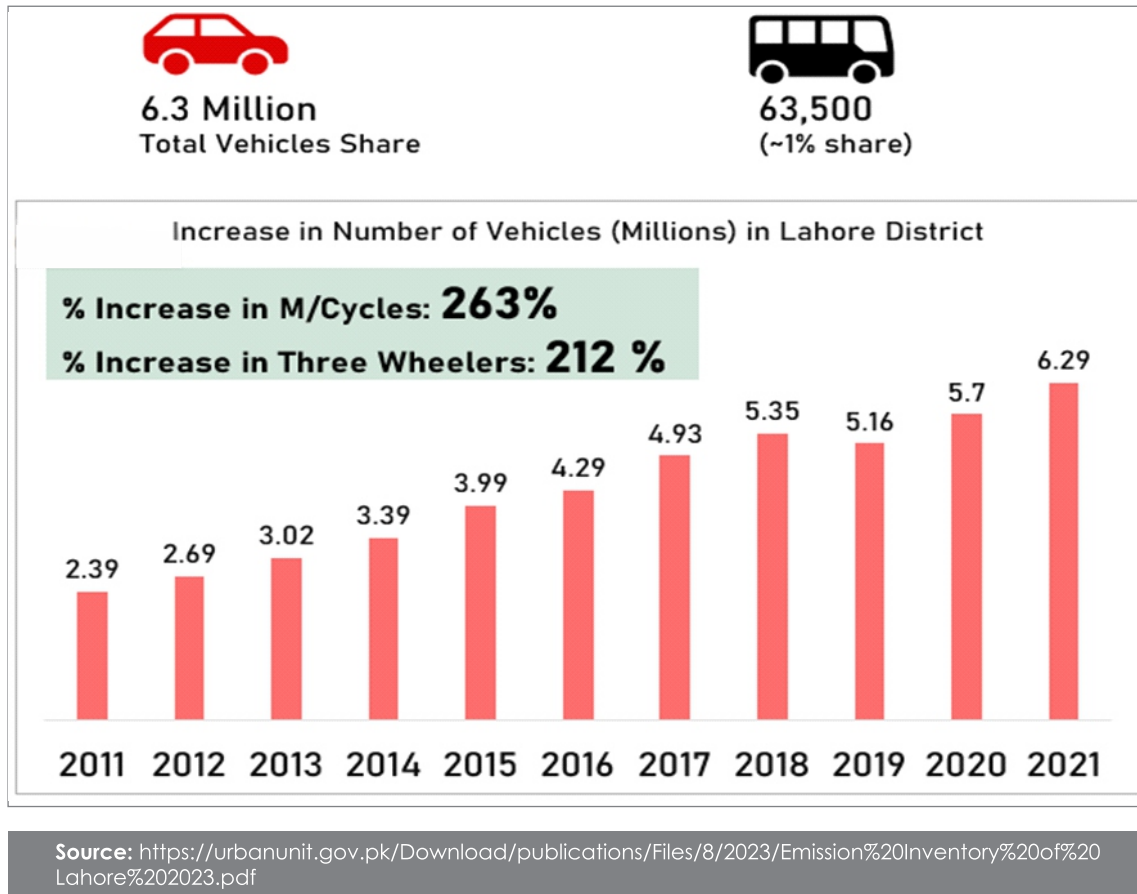
<sup>68</sup> <https://file.pide.org.pk/uploads/par-vol3i2-03-a-smart-shift-from-private-cars-to-public-transport.pdf>

<sup>69</sup> [https://lahoreschoolofeconomics.edu.pk/assets/uploads/lje/Volume25/02\\_Batool\\_1.pdf](https://lahoreschoolofeconomics.edu.pk/assets/uploads/lje/Volume25/02_Batool_1.pdf)

<sup>70</sup> <https://pide.org.pk/research/a-smart-shift-from-private-cars-to-public-transport-can-help-to-reduce-smog-air-pollution-in-pakistan-2/>



**Figure-10: Registered Vehicles (2011-2021) and Vehicle Categories in Lahore**



### Using AI to Optimize Traffic Flow and Reduce Urban Emissions

Google's AI-powered project Green Light already collaborating with 12 cities including Manchester, Rio de Janeiro, Jakarta, and Abu Dhabi, is expanding to Lahore. It will help reduce stop-and-start traffic events through AI-supported traffic light management with early indicators showing potential for up to a 30% reduction in stops, which could reduce emissions at intersections by up to 10%<sup>71</sup>.

### Energy Efficiency in Urban Buildings can Reduce Emissions and Save Energy

Buildings are major contributors to urban emissions. Climate-smart designs and retrofitting older buildings with energy-efficient technologies can reduce energy consumption and enhance disaster resilience. Rooftop solarization, as seen in Lahore, demonstrates the potential for clean energy adoption. Enhancing building envelope efficiency can lower air conditioning energy use by 20%<sup>72</sup>. The sector

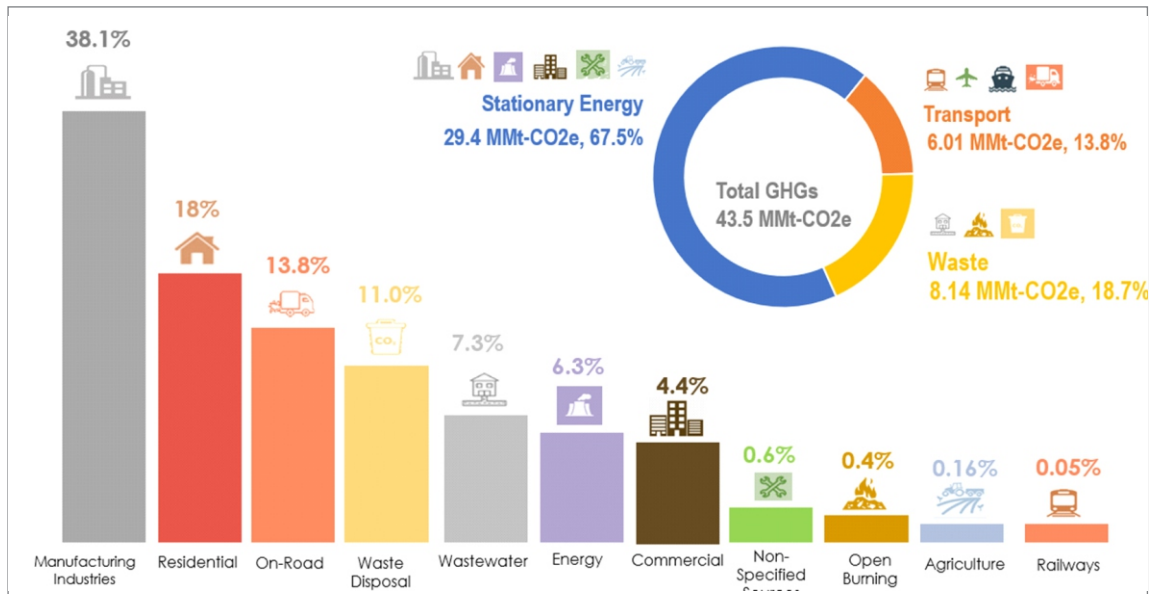
consumes the most electricity in urban areas, with effective Energy Efficiency and Conservation (EE&C) measures saving up to 2.63 million tons of oil equivalent (MTOE) annually<sup>73</sup>. Policymakers should mandate green building standards, promote retrofitting programs, and incentivize rooftop solar installations for public and private buildings.

<sup>71</sup> <https://www.dawn.com/news/1873633>

<sup>72</sup> <https://pide.org.pk/research/energy-efficiency-in-buildings/> Sustainable Energy Efficiency Program, ADB (2009)

<sup>73</sup> <https://neeca.gov.pk/SiteImage/Downloads/DRAFT%20NEEC%20ACTION%20PLAN%202023-2030.pdf>

**Figure-11: Greenhouse Gas Emissions by Sector in Karachi (2024)**



**Source:** Climate Action Plan Karachi City, Urban Unit. The chart shows total GHG emissions (43.5 MMt-CO<sub>2</sub>e) by sector, with manufacturing industries (38.1%) as the largest contributor, followed by residential buildings (18%). Residential emissions highlight the need for energy-efficient designs and renewable energy to reduce their carbon footprint.

## Ten Policy Pathways to Unlocking Climate Resilience in Urban Pakistan

**Prioritize vulnerable populations to ensure equity in climate adaptation:** Identify and map vulnerable populations, particularly low-income communities, informal workers, and climate migrants, to prioritize targeted interventions. Integrate equity-focused policies to protect these groups, such as climate-adaptive housing, social protection and health services for heatwaves and floods. Leverage tools like the National Socio-Economic Registry (NSER) to design programs aimed at building resilience in marginalized communities.

**Use incentives to drive behavioural and financial climate action:** Implement policy guidelines to encourage private sector and citizen participation in climate adaptation through incentives like tax credits and subsidies. Example is the Green Credit Program in Punjab to promote investments in renewable energy, energy-efficient technologies, and nature-based solutions. Introduce public awareness campaigns and reward systems to foster behavioural shifts towards sustainable practices in civil society<sup>74</sup>.

**Leverage land use planning and zoning for climate-resilient development:** Use land zoning as a key tool for climate resilience, relocating industrial zones away from residential areas and incentivizing environment-friendly practices.

Allocate dedicated spaces for renewable energy projects, such as EV charging stations and solar farms, through zoning policies. Encourage urban nature-based solutions (NBS) by creating green corridors, urban forests, and community parks.

**Adopt predictive tools and data-driven strategies for climate planning:** Expand the use of predictive tools, such as geospatial mapping, weather forecasting, and climate risk dashboards, for proactive urban planning. Institutionalize evidence-based interventions by integrating dynamic socio-economic and climate data into decision-making processes. Leverage data from air quality monitors and remote sensing technologies to identify and prioritize climate interventions. Promote partnerships with research institutions to develop predictive climate models and evidence-based policies. By making the ADP a tool for proactive climate planning, cities can allocate resources more effectively, target high-impact areas, and ensure sustainable urban development aligned with long-term adaptation goals.

**Seize low-hanging fruits to accelerate climate gains:** Mainstream green building standards and codes, such as those of the Pakistan Engineering Council, into local government bylaws for energy efficiency in new constructions. Prioritize retrofitting residential and commercial buildings

<sup>74</sup> <https://greencredit.punjab.gov.pk/>

to reduce GHG emissions. Promote affordable solarization programs for households and small businesses, focusing on high-pollution urban areas.

**Expand green mobility through policies and infrastructure development:** Develop policies to promote electric vehicles (EVs), especially for two- and three-wheelers, through subsidies and infrastructure development. Optimize public transport systems, such as Bus Rapid Transit (BRT), with AI-supported route planning for reduced emissions and congestion. Enhance green public transport systems and integrate climate resilience into urban mobility plans.

**Integrate nature-based solutions (NBS) into urban climate policies:** Scale up urban forestry and green roofing projects to mitigate urban heat islands, absorb carbon emissions and improve air quality. Use wetlands and restored floodplains for natural flood mitigation, particularly in cities prone to urban flooding like Lahore and Karachi. Incentivize private and public partnerships for large-scale NBS implementation.

**Strengthen local governments to implement climate-resilient policies:** Empower municipalities with the authority and resources to

integrate climate resilience into city planning. Conduct training programs for local governments to use climate and socio-economic data for informed decision-making. Decentralize governance structures to allow local governments to tailor responses to specific urban vulnerabilities.

**Reform financing mechanisms to unlock resources for green projects:** Reform property tax systems with GIS-based valuation to fund green infrastructure (drainage, renewable energy etc) and climate-resilient projects. Tap into international carbon markets by creating tradable credits from urban reforestation and renewable energy projects. Foster public-private partnerships to reduce fiscal burdens on government budgets while accelerating project implementation.

**Scale up digital platforms for climate monitoring and early warnings:** Expand early warning systems for floods, heatwaves, and air quality to cover all major urban centers. Integrate digital platforms like Lahore's Smog Alert System with governance frameworks for actionable citizen guidance, enable timely responses and build public trust. Use mobile data to enhance real-time monitoring of migration, heat exposure, and pollution hotspots.

## Quick Wins for Climate-Resilient Cities

Pakistan's cities are at a critical juncture. By integrating climate adaptation into urban planning, leveraging nature-based solutions, and strengthening governance, Pakistan can

transform its cities into resilient, liveable hubs of economic growth. Immediate, evidence-based action is essential to ensure sustainable urban development.

Policy Pathway	Actionable Points	Impact
Ensure equity in climate adaptation	<p>Map vulnerable populations, including low-income groups and informal workers.</p> <p>Introduce climate-adaptive housing and tailored social protection programs.</p>	Targeted interventions for marginalized groups, reducing climate-induced inequalities.
Leverage Nature-Based Solutions (NBS)	<p>Scale up urban forestry and restore wetlands and floodplains.</p> <p>Incentivize green roofs and private investments in NBS projects.</p>	Improved air quality, reduced urban heat islands, and effective flood management.
Modernize drainage systems	Conduct drainage system audits and integrate NBS like bioswales and permeable surfaces.	Reduced urban flooding and enhanced stormwater management.

<p>Expand green mobility</p>	<p>Optimize public transport systems with BRT and AI-driven route planning.</p> <p>Promote EV adoption, focusing on two- and three-wheelers, through subsidies and charging infrastructure.</p>	<p>Lower emissions, reduced congestion, and better connectivity.</p>
<p>Enhance building energy efficiency</p>	<p>Mandate green building codes and retrofit high-emission buildings for energy efficiency.</p> <p>Promote rooftop solarization for public and private buildings.</p>	<p>Lower GHG emissions, reduced energy costs, and improved resilience to climate shocks.</p>
<p>Adopt predictive tools and data systems</p>	<p>Develop centralized GIS platforms for mapping vulnerabilities and prioritizing interventions.</p> <p>Expand air quality monitoring networks and leverage mobile data for tracking climate risks.</p>	<p>Data-driven decision-making and proactive disaster management.</p>
<p>Empower local governance</p>	<p>Decentralize authority and provide resources for municipalities to integrate climate resilience into urban planning.</p> <p>Train local governments in predictive and data-informed planning.</p>	<p>Faster response to climate risks and improved alignment with local needs.</p>
<p>Reform financing mechanisms</p>	<p>Modernize property tax systems using GIS-based valuation for funding climate projects.</p> <p>Leverage carbon markets through urban reforestation and renewable energy initiatives.</p>	<p>Increased resources for urban resilience projects and reduced fiscal strain.</p>
<p>Scale up digital platforms for early warnings</p>	<p>Expand digital platforms for flood, smog, and heatwave alerts with citizen engagement features.</p> <p>Integrate real-time monitoring into urban governance systems for timely interventions.</p>	<p>Enhanced disaster preparedness and public trust in climate governance.</p>