# Effect of Urban Tree Planting Campaigns on Temperature Reduction in Lahore'S Busy Markets

**Furqan Naseer**

MSCS, PMAS Arid Agriculture University, RWP, Pakistan, MBA, Al Khair University, Ajk Pakistan

## ABSTRACT

The urban heat islands (UHIs) are a worrying problem to the giant urban metropolises in third world countries, such as Lahore, Pakistan. This has led to increased surface and air temperature in commercial locations due to rapid urbanization, high vehicular emissions as well as the loss of vegetation. This is a pilot study that examines how urban tree planting campaign will reduce the temperature in the busiest markets in Lahore City, which include Liberty Market, Anarkali Bazaar, and Ichhra. The study examines the connection between city vegetation and enhancement of microclimate, based on satellite images and local temperature measurements and field data. The initial results reveal that the tree-cover market areas record 2 to 3 degrees C lower surfaces than areas without trees highlighting the need of tree forestry as a sustainable climate change response. The paper demonstrates that there is an urgent need to develop integrated urban greening measures to reduce heat stress, expand thermal comfort, and increase environmental sustainability in business areas in Lahore.

**Keywords** Urban Heat Island (UHI), green infrastructure, urban forestry, canopy of trees, microclimate, temperature control, Lahore, sustainable development.

**Corresponding Author:** Furqan Naseer
**Email:** furqannaseer@hotmail.com
Received: 07-06-2025
Revised: 23-06-2025
Accepted:09-07-2025

## INTRODUCTION

The last few decades have witnessed a rapid urbanization process in the cities of South Asia that comes along with a rise in the level of infrastructure development and a spurt in vehicular and industrial emissions. This change has played a major role in transforming the urban places and has also led to the Urban Heat Island (UHI) phenomenon where the metropolitan regions have increased temperatures as compared to rural areas (Oke, 1989; Rizwan, Dennis, and Liu, 2008). This is quite prevalent in Lahore, the second-largest city in Pakistan owing to unplanned infrastructural development, low level of green cover, and congestion. The Pakistan Meteorological Department (2021) found out that the average temperature of Lahore has risen by 1.5o C in the past 20 years and certain commercial hotspots in the area have registered higher temperature changes during summer seasons.

Urban greening programs, including tree planting campaigns, have been known to possess the ability to reduce the impact of UHIs and improve the microclimatic conditions (Akbari, Pomerantz, and Taha, 2001). Shade is rendered by trees, evapotranspiration is enhanced and surface heat is absorbed through albedo and results in cool environment. It has been established that in cities like Singapore, Tokyo, and New Delhi, temperature has dropped by a maximum of 4 o C in areas with heavy vegetation (Ng et al.,

2012; Rahman et al., 2017). Following these international precedents, the city authorities of Lahore, with the help of NGOs and other groups organized by citizens, have launched urban tree planting campaigns as part of such projects as Clean Green Pakistan Movement and Miyawaki Urban Forest. These campaigns have the purpose of beautifying the city as well as controlling of the microclimates in the busy commercial places.

The effects of these tree planting campaigns in the markets of Lahore have not been well researched though. Although urban greening has been adopted in residential and parklands, commercial areas including Liberty Market, Ichhra and Anarkali Bazaar tend to be hot spots with little vegetation cover and large areas of concrete. According to the scholars of urban design, the role of shaded streets and vegetated streets in business districts in reducing the localized heat stress can be very crucial (Gill et al., 2007). The Punjab Environmental Protection Agency (EPA, 2020) too has focused on the advantages of tree-lined streets in enhancing the quality of air and comfort of pedestrians. However, there is limited empirical evidence on the thermal benefits of this type of campaign to the densely built markets in Pakistan.

The geography and climatic conditions of Lahore make it a significant case study to examine the association between the cover of tree canopy and temperatures moderation. The hot summers and the little rainfall experienced in the city make it semi-arid, and this makes asphalt and concrete surfaces more heat retentive. It is in such settings that even small growths in canopy cover of trees can result in the quantifiable cooling effects (Shashua-Bar, Tsiros, and Hoffman, 2010). The Urban Unit (2021) aerial imagery showed that the commercial areas where the percentage of trees was more than 20% had much lower land surface temperatures than barren areas. That implies that even small scale interventions such as tree planting can lead to significant environmental payoffs.

Government initiatives, especially the Ten Billion Tree Tsunami Program (TBTTP), have recently spread into urban areas, where road medians, sidewalks and marketplaces are the intended targets. In this project, various thousands of native trees, such as Amaltas (Cassia fistula), Neem (Azadirachta indica), and Kachnar (Bauhinia variegata) have been planted in Lahore. Research by Hussain and Ali (2021) and Mahmood et al. (2022) shows that these are excellent species to be used in urban heat mitigation because they have very big canopies, drought-tolerant, and transpire at a high rate. Nonetheless, even though the government has engaged in massive afforestation, the nature of distribution of the planted trees within the commercial districts makes them have a minimal effect on the temperature in specific areas.

In addition, the involvement of the populace and their maintenance has become one of the key factors which determine the success of the campaign. Iqbal and Raza (2020) report that most of the urban tree planting uptakes do not keep the environment balanced because of a lack of proper aftercare, water supply, and vendor encroachment. Having trees is not enough but they need to be placed effectively, well-maintained and incorporated in larger urban planning systems. Thus, the practical effect of these campaigns in relation to controlling the temperature should be evaluated to comprehend the role of such campaigns in the climate resilience plan of Lahore.

The idea of urban forestry has been adopted as an adaptive approach within the context of Sustainable Development Goals (SDGs) all around the globe, especially SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Considering the case of Lahore, coordinating the local tree planting initiatives with the global goals may rebrand the city in regard to climate adaptation. According to Rahman, Smith, and Zhang (2020), the use of trees in urban design contributes to the quality of the environment and social well-being by offering comfort, shade, and aestheticism.

Subsequently informed by these implications, the present study aims at empirically studying the impact of the promotion of the urban trees planting on the cool-down of the temperature in the busiest markets

in Lahore. The research compares the microclimatic conditions of the chosen locations that differ in the density level of tree cover and whether vegetation cover caused by campaigns differs in their levels of toning temperature. The findings will inform urban planners, environmental policy makers and local administrations in developing effective interventions of green infrastructure to support the urban commercial landscape in Pakistan. Through this, this study is able to add to the greater discussion on sustainable urban development, green resilience, and environmental justice in the urbanizing South Asian cities.

## LITERATURE REVIEW

The urban heat islands (UHIs) are a worrying problem to the giant urban metropolises in third world countries, such as Lahore, Pakistan. This has led to increased surface and air temperature in commercial locations due to rapid urbanization, high vehicular emissions as well as the loss of vegetation. This is a pilot study that examines how urban tree planting campaign will reduce the temperature in the busiest markets in Lahore City, which include Liberty Market, Anarkali Bazaar, and Ichhra. The study examines the connection between city vegetation and enhancement of microclimate, based on satellite images and local temperature measurements and field data. The initial results reveal that the tree-cover market areas record 2 to 3 degrees C lower surfaces than areas without trees highlighting the need of tree forestry as a sustainable climate change response. The paper demonstrates that there is an urgent need to develop integrated urban greening measures to reduce heat stress, expand thermal comfort, and increase environmental sustainability in business areas in Lahore.

## METHODOLOGY

This study employed a **mixed-method research design** to examine the effect of urban tree planting campaigns on temperature reduction in Lahore's busy markets. The design integrated both quantitative and qualitative methods to provide a comprehensive understanding of how tree planting initiatives influence urban microclimates, community engagement, and environmental sustainability. The combination of numerical data and observational insights ensured a more holistic assessment of the campaigns' impact.

### Research Design

The study was descriptive and analytical in nature, as it aimed at analyzing the above changes in temperature and environmental changes in particular markets, prior to and after the tree plantation campaigns. The descriptive element revealed current situations and current practices regarding the urban forestry in the markets of Lahore whereas the analytical component examined the correlation between higher tree cover and lower temperature.

### Study Area

The research was based in three big and highly populated commercial districts of Lahore namely, Anarkali Bazaar, Liberty Market and Ichhra Market. These markets were chosen because of the high level of human activities and traffic and significant engagement in recent urban greening projects like Clean and Green Punjab Campaign and Miyawaki Urban Forest Project. These regions are also a reflection of various socioeconomic groups and this factor was useful in getting a range of responses and views.

### Population and Sample Size

The target group used in this research comprised of local storekeepers, street traders, city employees, and

the local population of the areas near the chosen markets. To balance representation across the various types of market and the different types of participants in the market, a stratified random sample of 120 respondents was selected. The sample size was 60 shopkeepers and 30 Vendors and 30 municipal/ environmental workers. To produce the perception difference and observed impact between the stakeholder groups, stratification was required.

**Data Collection Methods**
Both **primary** and **secondary data sources** were utilized.

**Primary Data**:

- **Structured Questionnaire:** The pre-tested questionnaire was administered to the respondents and was used to collect quantitative data on how temperature change, perceived comfort, and level of satisfaction were with the tree planting campaigns. The questionnaire contained Likert scale questions and multiple-choice questions concerning campaign awareness, mainting trees and environmental benefit.

- **Field Observations:** Digital thermometers were used to measure the direct temperature of the shade and unshaded areas in each market at three points of the day (9 AM, 1 PM and 5 PM). It was also observed that trees are dense, well covered by the canopy, and in a good condition.

- **Interviews:** ten municipal officials and five campaign volunteers were interviewed semi-structured to give qualitative data about the implementation difficulties and policy views.

**Secondary Data**:The official reports by the Punjab Forest Department, Lahore Development Authority (LDA), Pakistan Meteorological Department (PMD), and the articles of journals and case studies were used to provide data. The sources offered background information on the trends in the urban heat islands and campaign developments and statistics of vegetation covers.

**Research Instruments**

The primary tools were questionnaires, observation checklist, and interview guides. The quiz had 20 questions, organized into three blocks which included awareness and participation, environment perception, and perceived benefits. Normal environmental monitoring forms were used to record the field observations. To achieve content validity and reliability, all the tools were confirmed by two academic specialists in environmental studies.

**Data Analysis Techniques**

Statistical Package of Social Sciences (SPSS) was used to analyze quantitative data. Mean, frequency and standard deviation were calculated as the descriptive statistics in order to summarize responses. Paired t-tests and correlation analysis were used as inferential analyses to test relationships between density of trees and temperature reduction. The main findings were illustrated with the help of graphs and tables.

Thematically, qualitative data of interviews and observation was processed and patterns like the level of community participation, sustainability concerns and perceived changes brought by campaigns on local climate were identified. This assisted in triangulating the quantitative results and offered more background knowledge.

**Reliability and Validity**

Cronbachs alpha was relied upon and the result of the alpha was 0.82 which showed that there was a lot of internal consistency in the questionnaire. Validity was also achieved by means of expert review and pilot testing in 10 respondents who were not included in the main sample. The validity of the study was also enhanced by triangulation of data that were obtained by various sources.

**Ethical Considerations**

The relevant academic authority had to give ethical approval to data collection before data was collected. The respondents were advised on the objective of the research and their consent was sought prior to the research. No names were given and no names were revealed during the process and the participants were assured that their answers were strictly academic.

**Limitations of the Study**

Even though the research is very insightful, time and resource constraints limited the research by the number of markets and participants researched. The measurements of temperature were made over a given time-span and the changes by season were not reflected. In addition, some of the environmental variables such as humidity and air pollution were not measured but they were cited in the secondary sources.

Finally, it can be concluded that the methodology used in the given study was capable of guaranteeing scientific rigor, as well as contextual relevance. It was complemented by field based data, statistical analysis, and qualitative reflections to give a comprehensive approach to measuring the role played by urban tree planting campaigns in lowering the temperatures and enhancing the livability of Lahore in its busy markets.

**DATA ANALYSIS AND FINDINGS**

This part includes the analysis of the obtained data in terms of quantitative and qualitative analysis of data gathered during the work with respondents and fieldwork in Anarkali Bazaar, Liberty Market, and Ichhra Market, Lahore. The results are structured in such a way that they depict the quantifiable effect of tree planting movements within cities on both the local temperature and environmental comfort as well as awareness of citizens. The outcomes were produced on the basis of the sample of 120 respondents with the help of the record of environmental temperatures and thematic analysis of interviews.

**Demographic Profile of Respondents**

The demographic distribution helped understand the characteristics of individuals affected by the tree planting initiatives.

**Table 1: Demographic Profile of Respondents (N = 120)**

| Variable | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Gender | Male | 85 | 70.8 |
| | Female | 35 | 29.2 |
| Age Group | 18–30 years | 28 | 23.3 |
| | 31–45 years | 50 | 41.7 |

| | | | |
|---|---|---|---|
| | 46 and above | 42 | 35.0 |
| Occupation | Shopkeeper | 60 | 50.0 |
| | Vendor | 30 | 25.0 |
| | Municipal Worker | 20 | 16.7 |
| | Local Resident | 10 | 8.3 |
| Education Level | Primary | 28 | 23.3 |
| | Secondary | 55 | 45.8 |
| | Graduate | 37 | 30.8 |

The majority of respondents were males between the ages of 31 and 45, reflecting the dominant workforce in market environments. About 45% of respondents possessed at least secondary education, which enabled them to understand environmental initiatives.

**Awareness and Participation in Tree Planting Campaigns**

Respondents were asked whether they were aware of, or had participated in, the **urban tree planting campaigns** conducted under the *Clean and Green Punjab* initiative.

**Table 2: Awareness and Participation Levels**

| **Market** | **Aware of Campaign (%)** | **Participated in Campaign (%)** |
|---|---|---|
| Anarkali Bazaar | 92 | 65 |
| Liberty Market | 88 | 70 |
| Ichhra Market | 79 | 54 |
| **Average** | **86.3** | **63.0** |

The results show a high overall awareness (86.3%) across all markets, with the highest participation recorded in Liberty Market (70%). This indicates that exposure to public campaigns and collaboration with local NGOs played a key role in enhancing participation.

Interview responses from market union leaders revealed that campaign teams collaborated with traders and volunteers, motivating them to adopt eco-friendly measures like installing tree pots and maintaining green patches.

**Temperature Variation Analysis**

To assess the direct impact of tree planting on temperature, field measurements were taken in shaded and unshaded areas of each market. Temperatures were recorded at 9 AM, 1 PM, and 5 PM using digital thermometers.

**Table 3: Comparative Temperature Readings (°C)**

| **Market** | **Shaded Area (Avg.)** | **Unshaded Area (Avg.)** | **Difference** |
|---|---|---|---|
| Anarkali Bazaar | 31.2 | 35.8 | 4.6 |

| | | | |
|---|---|---|---|
| Liberty Market | 30.5 | 34.7 | 4.2 |
| Ichhra Market | 32.1 | 36.3 | 4.2 |
| **Average** | **31.3** | **35.6** | **4.3** |

The findings reveal that shaded areas had an average temperature reduction of **4.3°C** compared to unshaded zones. This aligns with findings from environmental studies showing that tree canopies significantly reduce surface heat and ambient temperature in urban spaces. The results confirm that urban tree planting has a tangible cooling effect, especially in high-density areas with limited airflow.

**Perceptions of Environmental Benefits**

Respondents were asked to rate their perception of environmental benefits resulting from the tree planting initiatives on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

**Table 4: Perception of Environmental Benefits**

| **Statement** | **Mean** | **Std. Deviation** |
|---|---|---|
| Trees have reduced heat in the market | 4.35 | 0.64 |
| The market feels more comfortable during the day | 4.10 | 0.73 |
| Air quality has improved after tree planting | 4.25 | 0.71 |
| The campaigns increased awareness of climate issues | 4.50 | 0.60 |
| Green areas improve customer attraction | 3.95 | 0.81 |

The overall mean responses indicate strong agreement among respondents regarding the positive environmental effects of tree planting. The highest-rated statement was “The campaigns increased awareness of climate issues” (M = 4.50), suggesting that these initiatives not only improved the microclimate but also fostered a sense of environmental responsibility among market communities.

**Correlation Between Tree Density and Temperature Reduction**

To statistically test the relationship between the number of trees planted and temperature reduction, Pearson’s correlation coefficient was calculated.

**Table 5: Correlation Analysis between Tree Density and Temperature Reduction**

| **Variables** | **Pearson Correlation (r)** | **Significance (p-value)** |
|---|---|---|
| Tree Density & Temperature Reduction | 0.82 | 0.001 |

The correlation analysis revealed a strong positive relationship ($r = 0.82$, $p < 0.01$), indicating that an increase in tree density directly corresponds to a decrease in ambient temperature. This supports the hypothesis that vegetation cover significantly mitigates heat in urban environments.

**Qualitative Findings**

Thematic analysis of interviews and field notes identified the following recurring themes:

1. **Community Involvement:** Many participants noted that the campaigns succeeded largely due to cooperation between traders, NGOs, and government departments.
2. **Sustainability Challenges:** Respondents expressed concerns about the lack of proper maintenance and irrigation, which sometimes led to tree mortality.
3. **Perceived Benefits:** Interviewees reported improved customer comfort, enhanced market aesthetics, and lower electricity use due to reduced cooling needs.
4. **Policy and Institutional Support:** Municipal officers emphasized that consistent monitoring and financial support are essential for sustaining the environmental gains achieved.

**Comparative Analysis Across Markets**

Further analysis compared the three markets in terms of perceived satisfaction and observed benefits.

**Table 6: Comparative Market Evaluation**

| Indicator | Anarkali Bazaar | Liberty Market | Ichhra Market |
|---|---|---|---|
| Average Temperature Drop (°C) | 4.6 | 4.2 | 4.2 |
| Satisfaction with Campaign (%) | 88 | 91 | 80 |
| Tree Survival Rate (%) | 85 | 89 | 75 |
| Reported Increase in Foot Traffic (%) | 12 | 15 | 8 |

The data indicates that **Liberty Market** performed best in terms of community satisfaction and tree survival rate due to active involvement of market committees and regular maintenance. Ichhra Market showed comparatively lower outcomes, primarily due to space limitations and insufficient watering facilities.

**Summary of Findings**

Results indicate that the campaigns of planting trees in urban markets in Lahore have played a significant role in the reduction of the temperature in the areas, increase of comfort and awareness of the environment. The mean difference of 4 o C to 5 o C between shaded and unshaded regions is testimony to a quantifiable success of the campaigns. In addition, the level of involvement of the populace indicates that community-based environmental interventions can be sustainable in case they are supported by a policy and maintained through appropriate mechanisms.

**CONCLUSION**

The research problem addressed in the current work is how the urban tree planting campaigns affect the lowering of the temperature in the busy markets of Lahore, especially in the three big commercial areas, including Anarkali Bazaar, Liberty Market, and Ichhra Market. The quantitative and qualitative designs were used to quantify the change in environment, assess the perception of people and the sustainability of such efforts.

The results give strong evidence of the fact that the tree planting campaigns in cities have played a major role in cooling the environment, creating awareness, and also engaging the community in the densely populated commercial regions of Lahore. Meanwhile, it was found that on average shaded zones experienced 4.3degC lower temperature than unshaded areas, which proves that vegetation is an important element in reducing the urban heat island effect. The finding is consistent with other studies carried out on the same in other parts of the world which show the cooling effect of green infrastructure

in cities.

Moreover, the findings indicate a high level of awareness and satisfaction of the campaigns with the population, particularly with market sellers and shopkeepers who have stated that they feel more comfortable and their electricity consumption has been reduced in terms of cooling. More than 86 percent of the respondents were familiar with the campaigns and over 63 percent of them had attended the campaigns. These figures demonstrate how effective the environmental outreach efforts have been and how much sustainability-related initiatives are becoming accepted in urban Pakistan.

The correlation analysis demonstrated that the relationship between the density of trees and the decrease in temperature was significantly positive ($r = 0.82$), and hence, it is true that the greater the tree coverage in an area, the greater the cooling effect. Nevertheless, there were differences in the markets with Liberty Market recording the highest levels of satisfaction and tree survival whereas Ichhra Market was experiencing difficulties because of poor maintenance and less variety in space to plant vegetation. These results elucidate the significance of ensuring that the planting drives are not only initiated but also the follow-ups and the maintenance of the same over the long term to maintain the benefits of the environment.

The qualitative data collected via interviews with the municipal officials and campaign volunteers also highlighted the fact that the effectiveness of such efforts depends heavily on the institutional assistance, community involvement, and constant follow-up. Although campaigns were initially led by an enthusiasm and local engagement, a number of respondents mentioned that regarding the absence of regular watering, pruning, and protection, new trees in the gardens could easily die, which undermined the overall efficiency of the campaigns.

The research also determined some of the problems like shortage of technical knowledge, inadequate irrigation networks, and low co-ordination of the city governments and local business societies. However, the campaigns proved that in crowded business districts, there can be an observable climate change even when the green interventions are planned and reinforced by policy frameworks.

## RECOMMENDATIONS

Based on the findings, the following recommendations are proposed to enhance the effectiveness and sustainability of future urban tree planting initiatives:

### Learn to Institutionalize Maintenance Mechanisms

The local governments are supposed to strategize by setting aside special funds and putting staff to take care of trees that are already planted. Institutionalization of watering schedules, soil management and pest control should be done instead of being left as a volunteer activity.

### Community Ownership and Incentive Programs

The campaigns must have systems that will create an ownership feeling among the shopkeepers, vendors and the local residents. Communities can be encouraged to retain planted trees by giving them recognition certificates, small tax breaks, or taking them out to appreciation events.

### Choice of Heat-resistant and Native Species

Urban greening is subject to the success of the trees species chosen to adapt to the local climate. Priority

should be given to native species which are resilient to heat and low maintenance needs like Amaltas (Cassia fistula), Neem (Azadirachta indica), and Sukhchain (Pongamia pinnata).

**Incorporation with Urban Planning**

Planting forestry programs should be part of the larger city plans. It involves establishing a combination of tree planting with pedestrian areas, public transportation areas, and new developments to have the canopy cover intact.

**Public-Private Partnerships (PPPs)**

The partnership among the governmental bodies, the private enterprises, and the NGOs can be used to mobilize the financial and technical resources. Through their corporate social responsibility (CSR) programs, banks, corporations and market associations can sponsor sections of greening projects.

**Data-Driven Monitoring**

Applying GIS and remote sensing instruments to track the vegetation cover, canopy development, and temperature variations can give the scientific data of the impact and inform future growth. The city officials of Lahore ought to have an open database of urban forestry indicators.

**Sensitization and Environmental Education**

Awareness efforts should be done through educational campaigns to inform about the ecological and health benefits of cities greenery. Local schools, universities and local centers can be attracted to make sure that the behavioral change is permanent.

**Duplication in the Other Urban Centers**

Due to the success demonstrated in Lahore, other cities that experience heat stress like Faisalabad, Multan, and Karachi should also have similar projects. The campaigns in Lahore can be used to create a template that other cities in the country can follow in order to cool down.

**Policy Reinforcement**

Urban Green Infrastructure Regulations which require that commercial development projects have a minimum percentage of green cover should be introduced by the Punjab government. This will make it sustainable beyond voluntarism.

**Climate Adaptation Planning.**

Lastly, the planting of trees must be in tandem with other climate change adaptation and mitigation strategies in Pakistan. By bridging urban greening and climate resilience planning, authorities will be able to receive financial support and tech support on the international level.

Conclusively, urban tree planting drives should be considered as one of the most viable, cheap, and community-based measures of fighting the increasing urban temperatures in the metropolis areas in Pakistan. The facts in the markets of Lahore demonstrate that green infrastructure does not only cool down the local areas, but also improves the level of living locally, promotes local economies, and the social cohesion.

Those efforts need to be supported by the government regularly, by the general public, and long-term perspective. When large-scale, urban tree planting would become a key pillar in the national environmental resilience infrastructure of Pakistan - turning overheated, crowded cities into healthier and sustainable landscapes to be enjoyed by the generations to come.

**REFERENCES**

Akbari, H., Pomerantz, M., & Taha, H. (2001). Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. *Solar Energy, 70*(3), 295–310. https://doi.org/10.1016/S0038-092X(00)00089-X

Ali, M., & Khan, N. (2020). Evaluating the impact of urban greening initiatives on microclimate in developing cities. *Environmental Management Journal, 25*(2), 112–124.

Aslam, F., & Saeed, T. (2022). Urban heat mitigation through community-driven afforestation programs: Evidence from Lahore, Pakistan. *Pakistan Journal of Environmental Studies, 9*(1), 45–62.

Baldauf, R., Isakov, V., Deshmukh, P., & Venkatram, A. (2016). Influence of vegetation barriers on near-road air quality. *Atmospheric Environment, 136*, 88–97.

Batool, R., & Nawaz, S. (2019). Public participation and sustainability of environmental projects in Pakistan. *Journal of Sustainable Development, 12*(4), 201–213. https://doi.org/10.5539/jsd.v12n4p201

Chaudhry, Q. Z., & Rasul, G. (2017). *Climate change profile of Pakistan*. Asian Development Bank.

Fahim, S., & Latif, M. (2021). Role of green infrastructure in improving urban air quality and reducing heat stress. *International Journal of Climate Studies, 14*(2), 91–104.

Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: The role of the green infrastructure. *Built Environment, 33*(1), 115–133. https://doi.org/10.2148/benv.33.1.115

Government of Punjab. (2022). *Clean and Green Punjab Initiative: Annual report*. Lahore: Environment Protection Department.

Haider, S., & Raza, M. (2020). Urban microclimate management through tree cover enhancement: Evidence from South Asian cities. *Asian Journal of Environmental Research, 8*(3), 145–159.

Iqbal, Z., & Mehmood, A. (2019). Evaluating the role of municipal bodies in urban environmental management in Pakistan. *Journal of Urban Affairs, 41*(5), 587–602.

Lahore Development Authority. (2023). *Urban forestry and landscape improvement report*. Lahore: LDA Publications.

Loughner, C. P., Allen, D. J., Zhang, D.-L., Pickering, K. E., Dickerson, R. R., & Landry, L. (2012). Roles of urban tree canopy and buildings in urban heat island effects. *Journal of Applied Meteorology and Climatology, 51*(5), 999–1013. https://doi.org/10.1175/JAMC-D-11-0228.1

Pakistan Meteorological Department. (2022). *Annual climate summary for Punjab region*. Islamabad: PMD Publications.

Rahman, M. A., Moser, A., Gold, A., & Pauleit, S. (2019). Cooling effect of urban trees: A case study of shade provision and thermal comfort in tropical cities. *Urban Forestry & Urban Greening, 38*, 24–35. https://doi.org/10.1016/j.ufug.2018.11.010

Rashid, K., & Javed, H. (2020). Green campaigns and sustainable city development in Pakistan: Assessing the gaps and challenges. *Pakistan Development Review, 59*(4), 677–693.

Shafqat, F., & Malik, R. (2021). Social acceptance of green public spaces and environmental awareness among urban populations. *Urban Studies Review, 16*(3), 305–322.

World Bank. (2021). *Pakistan: Urban resilience and environmental sustainability report*. Washington, DC: World Bank Group.