

# **PARK USAGE IN FORMAL AND INFORMAL SETTLEMENTS OF RAWALPINDI CITY, PAKISTAN**



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Islamabad, Pakistan

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A thesis submitted to the National University of Sciences and Technology, Islamabad,

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Master of Science in  
Urban and Regional Planning

Supervisor: Dr. Irfan Ahmad Rana

School of Civil and Environmental Engineering

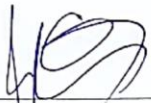
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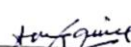
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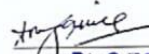
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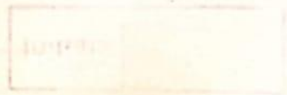
  
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**Dedicated to my beloved parents and my husband whose tremendous support, prayers, and cooperation led me to this wonderful accomplishment.**

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# LIST OF ABBREVIATIONS

<b>GI</b>	Green Infrastructure
<b>UGS</b>	Urban Green Spaces
<b>CC</b>	Climate Change
<b>CCM</b>	Climate Change Mitigation
<b>FOC</b>	Fear of Crime
<b>RWP</b>	Rawalpindi
<b>DRR</b>	Disaster Risk Reduction
<b>RDA</b>	Rawalpindi Development Authority
<b>GIS</b>	Geographic Information System
<b>GLOF</b>	Glacial Lake Outburst Flood
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>IUCN</b>	International Union for Conservation of Nature
<b>UN</b>	United Nations
<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>NDMA</b>	National Disaster Management Authority
<b>NGO</b>	Non-Governmental Organization
<b>CCP</b>	Climate Change Perceptions
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>PDMA</b>	Punjab Disaster Management Authority
<b>PEPAC</b>	Pakistan Environmental Planning and Architectural Consultants

## ABSTRACT

This study presents a comprehensive investigation into the utilization of parks among households in Rawalpindi city, with a specific focus on comparing formal and informal settlements. The research covers a spectrum of factors influencing park usage such as, socio-economic dynamics, park amenities, safety perceptions, fear of crime, and the impact of climate change. Through an extensive questionnaire administered at four different locations in Rawalpindi, data was collected from 360 households, comprising 151 from formal and 209 from informal settlements. An in-depth analysis of park characteristics was also conducted, highlighting discrepancies in amenities provided between formal and informal settlements. Furthermore, the study investigates park safety factors and the fear of crime, expressing the relationship between park proximity to law enforcement facilities and residents' perceptions of safety. Lastly, the study delves into the effects of climate change on residential areas, underlining the difference in preparedness between formal and informal settlements. Formal settlements are found to have better green space coverage and receive more efficient assistance from management during disasters, such as urban floods. Whereas, the residents of informal settlements often rely on self-protection measures, facing challenges in accessing external support systems. Overall, this research provides valuable insights into the complex interplay of socio-economic, environmental, and infrastructural factors shaping park usage behavior in urban settings, highlighting the need for tailored interventions to promote equitable access to green spaces and enhance community well-being across diverse residential areas.

**Keywords:** *Park Usage, climate change, Green Infrastructure, Crime Perceptions, Formal and Informal Settlements.*

# CHAPTER 1: INTRODUCTION

As the world becomes ever more of a global village by the passing day, more people are moving out of the so-called 'cow belt' and are moving towards settling into the cities and urban settings. According to the UN World Urbanization Report (Nations et al., 2018a) 55% of the world's population already lives in cities, and by 2050, this number will reach 68%. The highest percentages of urbanization are in the developed countries of the world, with the highest in North America (88%), South and Central America (81%), Europe (74%), Oceania (68%), Asia (50%) and Africa (43%) respectively according to these statistics, urban spaces leave the developing world with potential urbanization.

The word urban is associated with a place that is related to a town or city, and the inhabitants are assumed to be elegant, have refined manners, and have sophisticated lifestyles (Weeks, 2010b). Urban also means non-agricultural and thus defines a concentrated population residing in an area with employment in nonagricultural activities. Urbanization refers to the movement of people from rural settings to cities or the population migration from low-density settlements to a place of higher population density (Nations et al., 2018a). Traditionally, rural settlements are characterized by agriculture-based occupations and work environments with people mostly working with crops, either livestock or related workloads. On the contrary, urban spaces nowadays are considered the hubs of economic growth and technological advancement. Urbanization is the increase in the percentage of people living in urban spaces. This increased urbanization can be a result of natural growth, which is caused when the birth rate is higher than the death rate, which may be due to better health facilities. The rural-urban population migration can cause the population density of an already urbanized region to increase. Urban centers can also increase if a rural center is equipped with facilities and the population of that region increases, so it is now categorized as an urban space. Although it is not straightforward to define what urban means, it can be based on four characteristics: (1) population size, (2) land area, (3) population density, and (4) economic and social organization (Weeks, 2010a). Towns and cities are well-thought-out areas of living, and these areas are developed through a process known as urban planning. Urban planning is a discipline that



provides the guiding principles for directing the use and development of land, environment and infrastructure, ecosystem, and services. In such a way, the population residing in that area can benefit most from this development in terms of quality of life, economic opportunities, use of natural resources, and infrastructural facilities (Bibri & Krogstie, 2017). Therefore, urbanization is characterized by urban and spatial planning, resulting in planned-out cities having basic facilities for their residents, such as transportation, health, business, and access to basic necessities in close proximity. These planned urban spaces give rise to population centers known as formal settlements.

On the other hand, lack of planning and uncontrolled urbanization lead to population centers known as informal settlements. Informal settlements are given different names in different parts of the world, such as shantytowns, slums, favelas, ghettos, and squatter settlements. These settlements are becoming prevalent in developing countries due to the high growth rate and are most commonly encountered in South and South East Asia, Sub-Saharan Africa, and South America (Ghasempour, 2015). According to a UN report, almost one-sixth of the world's population (1 billion people) currently resides in these informal settlements (UN HABITAT, 2021). Informal settlements are not accounted for in urban plans for a city. They are, therefore, characterized by a lack of basic facilities such as proper housing, sanitation, green areas, utilities, poverty, and other social and societal deprivations (Williams et al., 2020). These settlements are also primarily illegal, and government support is lacking in providing these facilities (Weimann & Oni, 2019). Informal settlements arise due to increasing urbanization factors, such as the concentration of employment opportunities in specific locations and cities rather than being spread out into entire countries. Cities near ports and borders are more developed due to better opportunities for trade than inland cities, and they are, therefore, used for informal settlement (Niva et al., 2019). People from rural areas migrating to cities are generally impoverished and cannot afford to commute to the city daily; hence, they need to settle nearby. Due to unaffordable formal housing, a satellite city is established in the suburbs as an informal settlement (Sekhani et al., 2022).

The uncontrolled growth of urban areas is resulting in environmental stress. This stress is largely because population overgrowth results in the encroachment of ecological

environments, and the cities, these ecological environments include green areas (Kamjou et al., 2024). Where formal settlements have planned boundaries for green areas, informal settlements lack regulations to protect these green areas and parks. Due to the lack of these green areas, informal settlements are more prone to environmental factors such as climate change, of which urban flooding and heat stress are two major factors (World Cities Report, 2020). These urban green areas and parks are part of a concept known as Green Infrastructure (GI), and although the term has existed for a few decades now, its importance has only been realized since the 2010s. As per a broad definition of the concept, GI is a set of either human-made or human-influenced structures that help mitigate the increasingly adverse climate effects within cities, primarily flooding and extreme temperature fluctuations (Naumann, 2011). GI is not limited to parks and green areas and can include any type of structure that contributes to neutralizing the effects of climate change. These structures can include open spaces, tree canopies, wetlands, green walls and roofs, and bio-filtration systems (Norton et al., 2015). One of the significant results of unplanned urban areas is the rise of heat stress events. Also known as extreme heat events (EHE), these events can and have led to greater mortality rates of up to 130% in cities such as Chicago, Paris, and Moscow, and these events are likely to be more frequent with increasing climate change (Alexander & Arblaster, 2009). These EHEs are a result of Urban Heat Islands (UHI) (Gabriel & Endlicher, 2011), areas in the cities that absorb more heat during the day release less heat at night, thus accumulating the heat. These areas are concrete jungles from which rainwater is drained quickly and thus leaves no moisture for the ground to cool the surrounding settlements, further compounding the heat stress (Coutts et al., 2007).

Another issue that an informal settlement faces is that of urban flooding. Urban flooding is mostly due to poor storm water drainage in the area. Overconstruction has turned rainwater into runoff water (Recanatesi et al., 2017). Earlier, rainwater was absorbed by the soil or taken care of by evaporation and transpiration. In cities, concrete has replaced soil, which cannot perform the functions of soil (Yang et al., 2020). Formal settlements have well-built drainage facilities such as gutters, channels, and pipes to divert the runoff water to detention and collection points. However, informal settlements mostly rely on natural rainwater drainage. This natural drainage is insufficient in heavy rains (Ferguson, 2016). With densely and closely packed houses and poor solid waste management, which

blocks the already inadequate drainage, rainwater has little outlet, resulting in massive urban flooding (Sakijege et al., 2012).

Pakistan has the highest rate of urbanization in the South Asian region, with almost 37% of the total population residing in urban areas as of 2017. The same figure was at 22% in the 1960s, around a 70% increase in the urban population (Nations et al., 2018b) (Figure 1).

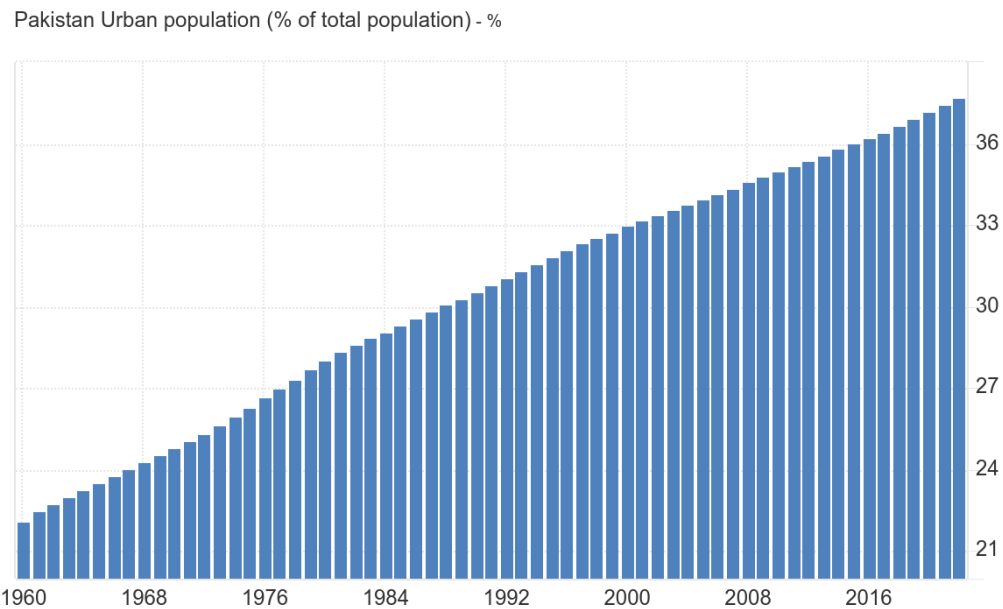


Figure 1: Percentage of Pakistan's Urban Population (Nations et al., 2018b)

It is estimated that by the year 2025, this percentage will reach nearly 50%, and with an annual growth rate of around 2.5%, this is very much possible (Gondal Muhammad Sarwar, 2023). Pakistan is the sixth most populous country in the world, with a population of around 240 million. Pakistan has traditionally been an agricultural country, but that trend is gradually changing, and almost 55% of GDP is now generated by the cities, with Karachi alone contributing 12-15% of the GDP. Although urbanization may seem associated with better living conditions, this is not true in Pakistan. The overwhelming migration of the rural population to cities and towns has heralded a new era of overburdening urban centers, coupled with no jobs, growth, or productivity. This gives rise to the mushrooming of slums

characterized by poverty, inequality, environmental degradation, and social injustice (Kiani & Siyal, 1991), (Kugelman, 2014).

Pakistan is no stranger to disasters, with earthquakes and floods a recurring event in the country; however, in recent years, the country has been at the forefront of the effects of climate change and has been deemed one of the top ten countries to be affected by the phenomenon as shown by the Climate Risk Index reported by Germanwatch in 2021 (Figure 1). Pakistan produces less than 1% of the global greenhouse gases but still faces serious threats from global warming, being listed as the fifth most vulnerable country to climate change. Issues such as water stress, extreme weather events, agricultural impacts, and glacier retreats are now frequent (Hussain et al., 2020).

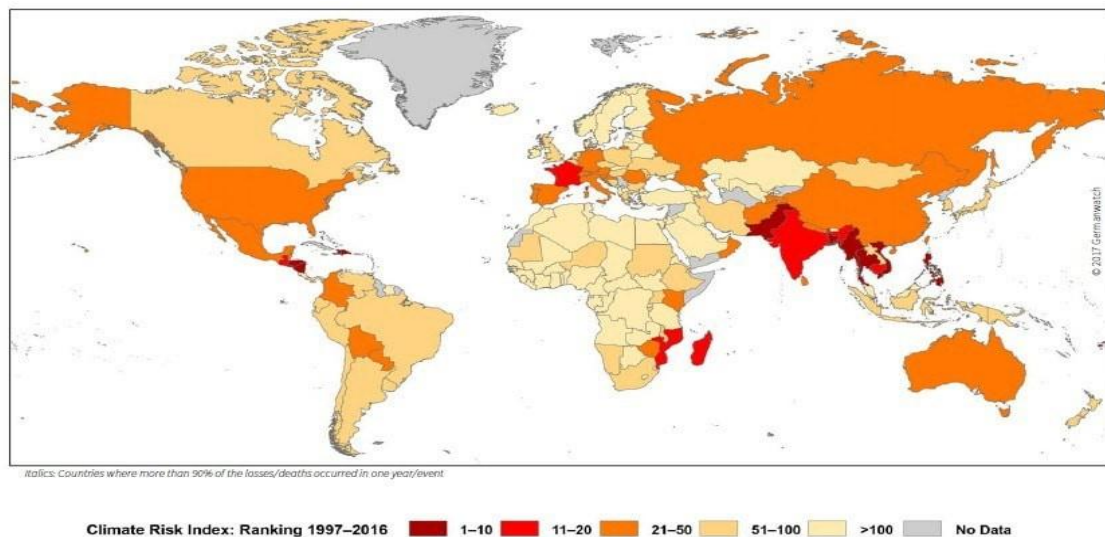


Figure 2: Climate Risk Index (Ishaque et al., 2022)

Pakistan has a recent history of floods, with recent major floods occurring in 2010, 2011, 2013, 2019, and 2021. Floods come with the loss of human life and millions of dollars worth of damage to the infrastructure, stressing even more an already under-stressed economy. The 2010 floods incurred estimated losses of around 10 billion dollars, displacing 20 million people, destroying 1.9 million homes, and inundating one-fifth of the total land. In 2021, floods wreaked havoc again in the country, and one-third of the country was inundated, with around 1500 deaths. The country has suffered a loss of around ten thousand lives and damages of around 3.8 billion dollars between 1999-2018. The damage

from the floods in 2021-22 was estimated to be 25-30 billion dollars, with 33 million people displaced from their homes (Ishaque et al., 2022).

Pakistan enjoys a large presence of glaciers in its north and is one of the eight countries known as the Third Pole. Home to 7000 glaciers, Pakistan has the highest number of any country in the world. Climate change is causing these glaciers to melt unprecedentedly (Qasim et al., 2014). In 2018, almost 3000 lakes formed due to glacier melting, the most famous being the Attabad Lake in the Gilgit-Baltistan region, which was formed in 2010 due to a landslide. This glacier melting causes extreme flooding downstream and results in human and animal life loss in informal settlements formed on the riverbanks and flash flood areas. Further to these natural calamities, heat waves have been quite frequent in urban areas due to the creation of heat islands. Over the past few years, Pakistan's most populous city, Karachi, which has a population of more than 20 million, has seen several heat waves, with multiple people losing their lives to heat strokes. Temperatures during these heat waves can reach more than 45 degrees Celsius. The deadliest of which was in 2015, in which 1200 people lost their lives due to heat-related illnesses.

Green infrastructure, particularly parks and green spaces is significant in urban communities, especially with climatic changes. Pakistan is one of the most affected countries by climate change (Adnan et al., 2024). Parks in any area add to the green spaces in a community and are considered necessary for better physical and mental well-being. However, access to parks may be restricted at times due to the fear of crime and the trauma people might feel afterward. Urban parks are crucial in contemporary cities, especially considering the prevailing climatic shifts. Being significantly affected by climate change, Pakistan underscores the importance of green spaces within its urban landscapes. These parks contribute to the overall physical and mental well-being of the community. Despite their positive impact, access to parks can sometimes be limited due to concerns about crime and the resulting emotional distress. In a developing country like Pakistan, grappling with issues such as poverty, there is a pressing need for enhanced facilities, larger play areas for children, and increased security in parks. This becomes essential to address the psychological well-being of individuals facing adversities. Promoting sustainable urban

development or transforming existing developments into sustainable ones is crucial (Abdul & Yu, 2020).

Urban green spaces significantly advance sustainability by offering residents exposure to the natural environment (Younis & Khan, 2016a). However, despite their positive aspects, parks are associated with social issues such as "Crime" or the "fear of crime," potentially hindering frequent park visits. Community parks may attract strangers from distant areas, reducing familiarity among park visitors. Some studies even suggest higher assault rates in areas with parks compared to those without (Taylor et al., 2019a). The perception of crime in neighborhood parks raises concerns about societal well-being and anxiety levels, contributing to neighborhood structural decline (Taylor et al., 2019a). The US Department of Health and Human Services emphasizes the positive impact of regular physical activity on life quality and disease reduction (Morrow et al., 1999). There appears to be an inconsistent relationship between gender, crime, built environment, and population factors. In contrast, most studies suggest that the elderly and women, as well as people from low-income backgrounds, are more exposed to fear of crime (Foster & Giles-Corti, 2008)(Foster & Giles-Corti, 2008). The fear of crime increases when people feel unsafe, leading to more incidents if authorities fail to act. Fear of crime is higher in diverse societies compared to uniform ones (Iqbal & Midhat, 2022). Crime perceptions are also influenced by coming across any crime indirectly as well i.e. is a neighbour or any news about a crime event in the area being reported (Foster & Giles-Corti, 2008). Rawalpindi, part of the Punjab province in Pakistan and closely linked to Islamabad, is known as one of the twin cities. According to the UN, one in four individuals reside in slums or informal settlements, with urban poverty rising rapidly in the developed world (United Nations Human Settlements Programme (UN-Habitat), 2021).

### **1.1. Justification of the study**

This comprehensive study has analyzed many aspects related to park usage, including household distance, crime perceptions, and climate change perceptions. The main focus of this study is the critical role of green infrastructure in society. By comparing formal and informal settlements in the Rawalpindi area of Pakistan, this analysis has identified key issues related to the lack of green infrastructure in deprived areas. The study

aims to deepen knowledge and develop advanced techniques to improve people's lives. Rawalpindi is a major city in Pakistan, and its informal areas, once highly developed in the late 90s, require significant maintenance to restore a pollution-free and cleaner environment. Developing green infrastructure, particularly in parks, can reduce pollutants, enhance environmental and social protection, and provide overall benefits to the community's environment (Epa & Source Control Branch, 2017).

## **1.2.Statement of problem**

The convergence of rapid urbanization and extreme climate change has created a challenging situation for many people, as they are forced to adapt to non-sanitary living conditions without access to adequate green infrastructure or nearby green spaces. This is a concerning issue that requires urgent attention. While planned formal settlements may be free from some of the issues that plague informal settlements, they still face challenges, such as the impact of climate change. These settlements need to take action to mitigate the effects of climate change, as it can directly affect the well-being of their residents. Unlike informal settlements, planned formal settlements tend to have better infrastructure and services and a more organized layout. However, even with these advantages, formal settlements cannot escape the consequences of climate change. Extreme weather events, such as flooding or drought, can directly impact the livelihoods of residents and the overall sustainability of the settlement. As such, it is crucial to take proactive measures to address the effects of climate change. This can include initiatives such as incorporating green spaces, improving drainage systems, and implementing sustainable building practices. By doing so, any settlements can better protect their residents and ensure their long-term viability.

1. Rapid urbanization and extreme climate change create challenging living conditions, especially in non-sanitary areas without adequate green infrastructure.
2. Formal settlements, while better planned and equipped than informal ones, still face climate change impacts threatening residents' well-being.
3. Formal settlements have better infrastructure and services but are still vulnerable to extreme weather events like flooding and drought.

4. Proactive measures are crucial, including incorporating green spaces, improving drainage systems, and implementing sustainable building practices.
5. Addressing climate change effects is essential for protecting residents and ensuring the long-term viability of any settlement.

### **1.3. Research Questions**

In order to investigate the urban challenges in Green Infrastructure, socio-economic indicators, crime perceptions, and climate change perception, the following questions are targeted:

- What are the key challenges faced by residents of formal and informal settlements when visiting the parks near their houses?
- To what extent safety precautions being observed in the parks affect the crime perceptions of residents in both formal and informal settlements?
- Do residents have any knowledge of climate change, and if so, how do they perceive its effects in residential areas?
- Are people able to face and counter the challenges imposed by climate change on their own, or do governmental authorities play any part in it?

### **1.4. Objectives of the study**

Rawalpindi city is rapidly expanding, with many areas undergoing unplanned and informal settlements, while some developments are being made as formal and organized settlements. To better understand the usage of green infrastructure in urban areas, this study aimed to identify various socioeconomic indicators affecting park usage in both formal and informal locations of Rawalpindi. In addition, the study sought to quantify crime and safety perceptions in parks and their accessibility. Furthermore, climate change perceptions' role in park use was also investigated. Finally, based on the research findings, the study suggested several solutions for enhancing park use in Rawalpindi. The study has the following objectives:

1. To identify socioeconomic indicators affecting the use of parks in urban areas.
2. To quantify crime and safety perceptions in parks and their accessibility



3. To identify the role of climate change perceptions on park use
4. To suggest solutions for enhancing park use.

### 1.5. Scope of the study

This study was conducted in selected areas of Rawalpindi, Pakistan. Two formal and two informal locations were selected mainly. This study reflects the impacts of parks on the households near them. Several factors have been identified considering the current situation of the area, from park usage to crime and security. Finally, climate change has been addressed. Quantitative data was collected by surveys. This research was conducted to determine the effects of green areas, i.e., green infrastructures in the city of Rawalpindi, and how people perceive the changing environment and community. The study focuses on the current issues the residents face and provides adequate solutions for their future well-being and living.

### 1.6. Conceptual Framework

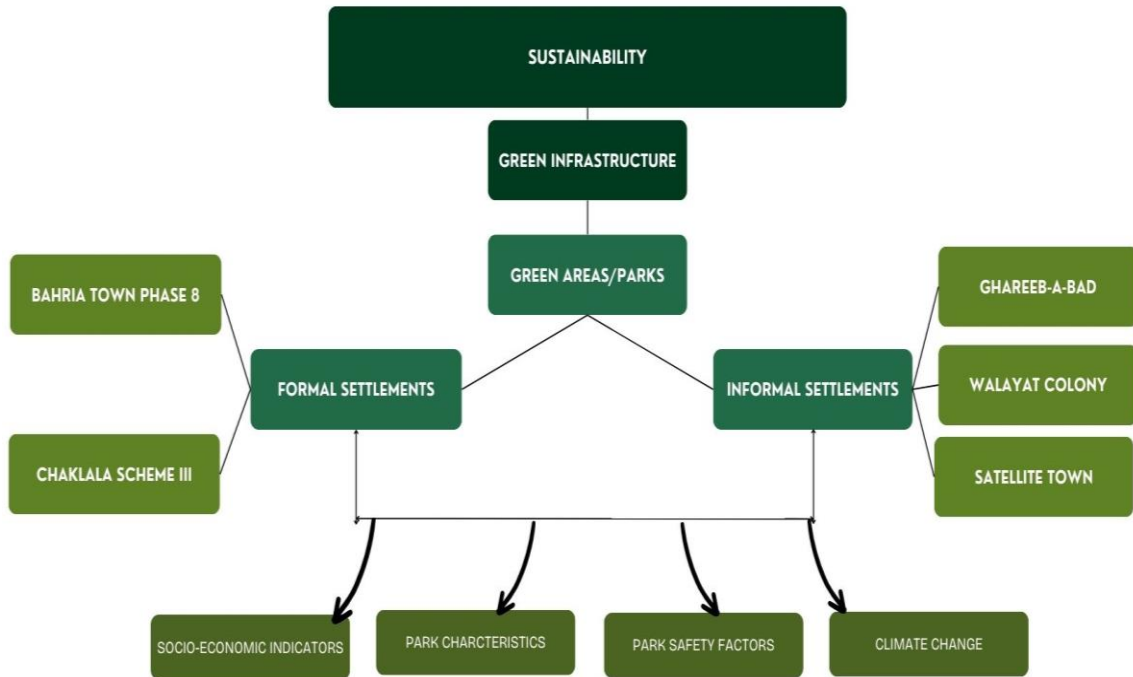


Figure 3: Conceptual Framework of the study

## **CHAPTER 2: LITERATURE REVIEW**

### **2.1. Formal and Informal Settlements**

An urban environment has different types of settlements, one being a formal settlement and the other being an informal settlement. When it comes to examining formal and informal settlements, it is important to consider the distinct characteristics of each type of settlement. Formal settlements typically refer to housing and infrastructure developed and maintained through legal and official channels, providing high-end facilities for the residents, often with the support of government authorities. In contrast, informal settlements lack formal land tenure, inadequate infrastructure, and limited access to essential services such as water, sanitation, and electricity. These are the ones that either outgrow the prescribed planned society or are not planned in the first place. Informal settlements represent residential areas characterized by unplanned development, lacking security measures, essential livelihood resources, infrastructure, and adherence to building regulations.

Typically devoid of green spaces and often situated in hazard-prone locations, these settlements serve as the primary option for affordable housing for the lower middle-class demographic (UN Conference on Housing and Sustainable Urban Development, 2015). The term encompasses slums and substandard living conditions, with the definition varying depending on a country's legal framework (Rana et al., 2022). Constructed using non-conventional materials and methods, informal settlements, as a form of low-cost housing, are associated with an increased risk of disasters and higher crime rates than normal settlements (Aggarwal Aashima, 2016). The legality of informal settlements can vary based on specific circumstances. With the growing socioeconomic ties to urban areas, developers find opportunities to create affordable housing, often resulting in informal settlements (Aggarwal Aashima, 2016).

In certain cases, rapid urbanization or political initiatives may lead to the legalization of informal settlements, as seen in Turkey during the 1980s when increased numbers of such settlements prompted regulatory actions (Sadikoglu et al., 2018). To

calculate the population in informal settlements, The indicator considers two components to be computed as follows:

$$\begin{aligned} & \text{Percentage of people living in formal Settlements households (SISH)} \\ & = 100 \frac{\text{Number of people living in SISH}}{\text{Urban City Population}} \end{aligned} \tag{1.1}$$

(UN Conference on Housing and Sustainable Urban Development, 2015)

Pakistan is a developing country, and its infrastructure is approved by the government, which includes formal settlements (Khahro et al., 2023). Formal settlements have fixed standards the government sets in land-using planning (Kassahun Abebe, 2011). These settlements have many services and facilities, like good management, protection and security, water, sanitation, and other livelihood facilities close to every household ((CCCM), 2016).

In the United Kingdom, many dialogues suggest that vulnerability and homelessness among the population play a role in developing informal settlements, whereas, in the Netherlands, they are framed as informal providers (Gilbert, 2020). In many countries, people with low-income have no other option than to live in informal settlements as the housing authorities specifically target people with high and middle-income.

## **2.2.Urban Green Spaces**

The imperative for sustainable cities today includes the necessity for green urban spaces, defined as the vegetated sections of the community, whether or not they are accessible to users (Ali et al., 2018). The term "green" connotes environmentally friendly areas (Sangwan et al., 2022). These spaces play a vital role in reducing pollution, offering ecosystem services, mitigating heat islands, and enhancing overall quality of life while fostering physical and psychological health benefits. Factors such as spatial sorting, attitudes, and green space utilization contribute to their effectiveness (Schindler et al., 2018). Urban parks, integral to residents' mental and physical well-being, also contribute to developing social skills within communities (A. C. K. Lee & Maheswaran, 2011).

However, parks can be associated with concerns, particularly when non-residents use designated facilities, prompting unease among parents who may hesitate to send their children to such parks (Taylor et al., 2019b). The maintenance of green urban spaces is crucial to ensure ongoing usage by regular visitors, as the deterioration of facilities directly affects safety perceptions (A. C. K. Lee & Maheswaran, 2011). Challenges arise when communities do not have equal access to green areas or lack them altogether. Addressing these disparities is essential to ensure the equitable distribution and availability of these valuable urban spaces.

### **2.3. Crime Perception and Security in Park Usage**

Parks and recreational facilities within a community are important aspects of the environment, which help to enhance people's physical activity, mental health, and well-being, but there is a concern about safety for the residents of any area. In research, Taylor et al. (2019c) examined crime type and model version, where disorder crime, violent crime, and non-park related crimes were examined, which concluded that behavior patterns are to be noticed and are a result of views of the residents and park users. Studies determine that an individual's perception of safety is highly influenced by the behavior of people using the park facilities. The new urban design methods also involve designing public spaces so that benches are installed for sitting. Still, their design is such that they are not for lying down to avoid any unwanted fear of the residents of that area (Machielse June & Jansson, 2015). The presence of the homeless population and illegal activities impose negative effects on park usage. In areas where offenses are reported, they are usually declared unsafe (Machielse June & Jansson, 2015). Perceived safety concerns impact park visitation, demographic factors such as gender and age, where elderly and female respondents undertake behavior of avoidance where there is a perceived risk of crime (Türkseven Doğrusoy & Zengel, 2017).

The impact of security measures within parks helps to mitigate crime perception. Concepts like crime prevention through environmental design (CPTED) focus on factors such as surveillance, access control, neighborhood watch programs, volunteer patrolling, and public relations, etc., to prevent and reduce crimes and fear of crimes (P. Cozens & Sun, 2019). Personal safety and security are vital aspects of any area, and the concept of

CPTED helps in the effectiveness of a safe environment (P. Cozens, 2015). It is essential to consider justice during the implementation of security in parks. Communities with low-income minorities usually face higher levels of crime, and parks are perceived as unsafe in their locality (B. Han et al., 2018). Community surveys can help to identify perception of people regarding park safety. Crime perception influences park usage behavior, implementation of security measures and enhancement of security are important (P. M. Cozens, 2011).

#### **2.4.Fear of Crime**

Developing urban green spaces is crucial to building the strength and growth of a community's green infrastructure in urban planning. Individuals are willing to pay higher rents to reside near clean, green areas (J.-W. Lee et al., 2023). Modern concerns about health, opportunities for physical activity (Younis & Khan, 2016b), and the desire for a safe environment are sometimes constrained by the fear of crime, acting as a barrier to outdoor activities (Marquet et al., 2020a). The intersection of fear and crime can create "hot spots" of insecurity (Nasar', " et al., 1993), affecting both the mental and physical well-being of residents. Fear of crime is regarded as an emotional response triggered by criminal activities in the area (Hale, 1996), and second-hand information can further contribute to apprehension about the neighborhood (Nasar Jack L. & Jones Kym M., 1997). Persistent exposure to violence or crime in an area can lead to depression and anxiety among residents (Jorgensen & Anthopoulou, 2007). Crime and violence in parks discourage regular usage, creating discomfort in developed and underdeveloped areas (Andrews & Gatersleben, 2010). Park properties often suffer from damage, including graffiti on walls, and may witness illegal activities such as begging, drug selling, and drug usage, raising safety concerns among users (Andrews & Gatersleben, 2010). The irregular growth of trees can favor criminals by obstructing clear vision and providing hiding spots (Nasar Jack L & Fisher Bonnie, 1993). Park security necessitates clear visibility (Potgieter et al., 2019), and people are more inclined to visit places where they feel comfortable, with adequate lighting and sunlight, particularly in the morning, to utilize park facilities without fear. Another paper-based survey approach was conducted by Pocewicz et al., 2008, where they found that paper-based surveys have significantly higher responses than internet-based surveys.

Fear in public spaces has negative impacts on an individual. It reduces the level of trust. It has also been highlighted that females and older people are more prone to feel unsafe, and fear of crime is greater for them (Machielse June & Jansson, 2015).

## **2.5.Green Infrastructure in Urban Areas**

Green Infrastructure is also denoted as an interconnected network with green spaces such as parks, green roofs, green pathways, pavements, and forests that enhance the ecosystem and improve the quality of life of the residents of any area (I. Mell et al., 2009). It is recognized for its ability to highlight social, ecological, and economic challenges as it offers suitable solutions for the urban development of a place (CHERCHYK & KHUMAROVA, 2023). Many cities have incorporated green infrastructure into the long-term city plans, as it is important for urban sustainability (Breuste et al., 2015). Spatial planning also influences resilience by encouraging using natural approaches (Pozoukidou, 2020). Green Infrastructure combines concepts such as land conservation, landscape architecture, and economic benefits. It also refers to delivering various eco-system services through a network of natural and semi-natural products (Baró et al., 2015). It affects the quality of life of the people living in urban areas (Gore, 2013). The three main areas of GI can be classified as exploration, expansion, and consolidation. The author explained that exploration started in 1998 when different terminologies were used for it, such as green space management and greenway planning, which researchers used to develop ways of planning a green environment. The second phase moved towards the expansion of the concept by involving government agencies and academic programs to increase awareness of the importance of GI. The third ongoing phase includes GI investment strategies and concepts on how they need to be developed for the future (I. C. Mell, 2017).

It has certain environmental benefits and helps conserve biodiversity by mitigating the heat-island effect and controlling atmospheric pollution (Dobbs et al., 2019). Some social benefits include access to green open spaces for people, which helps improve their mental and social health (Kaczynski & Henderson, 2007). In terms of economy, areas with more green spaces attract investments, as people prefer to live in urban areas with energy-efficient systems and open green areas for better quality of life (Frumkin et al., 2017). However, green infrastructure also faces certain constraints like spatial and maintenance

costs. In populated urban areas, it becomes a challenge to incorporate GI, which gives birth to new ideas and concepts of pocket parks and vertical gardens (Tzoulas et al., 2007). Long-term funding is also required to maintain any green area as skilled labor is required, and constant maintenance of the area is essential to keep it running to keep the skilled labor active (Bolund & Hunhammar, 1999). Awareness strategies in policymaking, like amendments in municipal budgets and guidance in land-use planning, are essential. It has positively impacted the urban eco-system and quality of life in urban areas. If there is any loss of the ecosystem in a city, it has huge drawbacks to the economic conditions. (Gómez-Baggethun & Barton, 2013).

Implementation of policies is also essential to ensure the true essence of GI usage; a systematic arrangement by policymakers, such as the development of standards and zoning regulations into the built environment, has to be ensured (Tzoulas et al., 2007). The implementation strategies do not completely rely on government agencies; they also involve certain non-governmental organizations that help maintain green infrastructure and encourage projects involving GI (NGOs) (Rigolon & Gibson, 2021). Similarly, educational programs and campaigns demonstrating the importance of urban sustainability help increase public participation and awareness (Childers et al., 2015). In the United States, “The Million Trees NYC” initiative was undertaken to improve the air quality, reduce energy consumption, and enhance the quality of life of the residents (Nowak et al., 2016), (Nyelele et al., 2019). Singapore follows sustainability in every aspect of its infrastructure; “The Garden City” vision has transformed the urban infrastructure of the city into a green metropolitan with good air quality and implementation of climate change resilience (H. Han, 2017), (Velegrinis & Weller, 2007). The city of Copenhagen in Denmark took the initiative to make its built environment cloudburst-proof by creating permeable pavements, green roofs, and rain gardens to reduce the risk of floods and stormwater, hence creating a “Climate-Resilient Neighbourhood” (Lerer et al., 2017).

## **2.6. Climate Change**

The global surface temperature has been steadily increasing since 1850, reaching a temperature rise of over 1.1°C by 2020 (Calvin et al., 2023). This increase is largely due to the historical and ongoing emissions of greenhouse gases and the use of unsustainable

energy sources. As human beings, we have played a significant role in climate change, which has affected various parts of the world regarding food and water insecurity, health issues, and increased disasters such as floods and heatwaves (Calvin et al., 2023). Climate change refers to long-term alterations in the distribution of weather patterns, causing ecological disturbances that can reach catastrophic levels (Debangshi, 2021). It has imposed serious concerns about its effects on health and the environment.

Climate change has affected urban settlements by aggravating vulnerabilities in informal settlements, increasing extreme weather events, and threatening urban infrastructure (Norman, 2022). The rise in global temperatures leads to heat islands, severe droughts, floods, and sea-level changes, affecting urban living conditions; urbanization, demographic shifts, economic growth, and lifestyle choices influence greenhouse gas emissions, leading to climate-induced vulnerabilities like water shortages and health impacts in cities (Siddik et al., 2022). Designing resilient human settlements requires integrating climate extremes, economic growth, and livability aspects, emphasizing the need for environmental justice and transparent geospatial design approaches. Climate change devastates informal settlements, exacerbating inequalities and socio-economic conditions (James, 2023). Its impacts on urban settlements have also increased, with extreme weather conditions, heat island effects, rising sea levels, and floods posing significant challenges to sustainable urban development (Norman, 2022).

Water shortages and extreme events of health risks and environmental changes are the result of climate change, and these impacts have been noticed in formal settlements as well (Siddik et al., 2022). Managing the vulnerability created by climate change is essential to ensure long-term stability and prevent people from suffering extreme heat or flooding (Ye & Niyogi, 2022). In an article, Salimi & Al-Ghamdi, (2020) discussed the worst-case scenarios that urban systems may face. It also highlighted the impact of extreme weather conditions on urban infrastructure. The authors claimed that the world began to experience drastic changes during the mid-20th century when the levels of CO<sub>2</sub> began to rise due to the increased use of fossil fuels. The article also pointed out the concerns of climate change impacts in the Middle East, such as the rise in sea level, changes in precipitation patterns, and increased wet-bulb temperature. Studying urban climate and climate change



necessitates precise and comprehensive data and historical records, where simulations pinpointing pedestrian thermal comfort revealed substantial variations, enabling a deeper investigation into the ramifications of climate change (Zou et al., 2023).

Urbanization in Africa has caused urban heat-island effects, which have adversely affected the health of the residents (Li et al., 2022). Meanwhile, data from twenty-eight provinces in China were analyzed to study the effect of changing temperatures on the population due to urbanization. It was revealed that urbanization has significantly impacted temperature, and climate change has affected people living in both urban and resilient environments (Chai et al., 2022). According to Molin Valdés et al. 2013, disasters have doubled in frequency due to climate change in the past thirty years. Understanding the potential climate change impacts on urban areas is crucial, especially in the face of low-risk, high-consequence extreme climate change events that pose severe threats to urban infrastructure and human society. A resilient environment needs to be created, which should include rooftop gardens, resilient economic strategies with early warnings for the people, resilience in urban water usage by creating breaches, dunes, and levees to avoid floods, and rainwater harvesting can also play a key role in mitigation (Debangshi et al., 2022).

## **2.7. Climate Change Perceptions**

Public perceptions about climate change are influenced by various factors, such as an individual's attitude, knowledge, and personal experience. Surveys effectively conduct quantitative research on climate change perceptions (Zorn et al., 2023a). Sociocultural contexts, personal experiences, psychological effects, and witnessing natural disasters all shape a person's perspective on climate change (Zorn et al., 2023a) (Arıkan & Günay, 2021). Studies have shown that people are enthusiastic about mitigating climate change when they witness a disaster like a hurricane (Stuka et al., 2023). In Germany, a survey revealed that some people recognize the effects of climate change on human health and acknowledge that human actions have contributed to its existence. In contrast, others believe that the most affected population is in other parts of the world (Van Baal & Stiel, 2022). Perceptions of climate change vary among people and communities, and this

directly influences the risk assessment and communication needed to adopt preventive measures to fight the challenges posed by climate change.

The Intergovernmental Panel on Climate Change (IPCC) for 2022 has confirmed that there has been an increase in the frequency of temperature rise and changes in precipitation patterns around the world. These changes are expected to continue unless greenhouse gas emissions are significantly reduced. Scientists have developed various adaptation techniques to combat the effects of climate change at a local level. However, people's perception of climate change (also known as Climate Change Perception or CCP) significantly affects the actions taken towards it (Hügel & Davies, 2020). CCP studies have shown that perception is developed when individuals understand and interpret the idea of climate change. This includes assessing the risks and the response to their effects (Zorn et al., 2023b). Early signs of climate change began to appear in 1850 when plants in Concord started to grow three weeks earlier than usual. In three decades, many regions in Europe experienced an extended growing season by eight days, which raises concerns about biodiversity and the potential extinction of various species (van der Linden, 2019).

The issue of global warming has received significant attention from researchers (Papadimitriou, 2004). Some studies have focused on the ability of common sense of human beings regarding climate change, while others have examined the causes and impacts of climate change (Semenza et al., 2008), (J. Crowley, 2000). It has also been highlighted that teachers play a crucial role in shaping students' perceptions regarding climate change, the greenhouse effect, the ozone layer, and steps of adaptation to create a sense of capability to counter future risks in both urban and rural areas (Dal et al., 2014). Environmental issues, unfortunately, have always been kept as the last priority in any list of concerns by official governments (Brechtin & Bhandari, 2011). However, the United Nations (UN) has recently started to take climate change seriously, as many countries have been affected. COP 28 held in December 2023 had a list of adaptation and awareness techniques which included Global Goal on Adaptation (GGA), Nature-Based Solutions (NBS), Finance for Adaptation and National Adaptation Plans (NAPs), but the need for concrete action, sufficient funding, and clear implementation strategies remains critical for effective climate adaptation (UNFCCC, 2023).

## **2.8. Pakistan and its relation with Climate Change:**

Pakistan is one of the developing countries in South Asia. Its geographical location is such that it is highly vulnerable to the impacts of climate change. Other factors include socioeconomic characteristics, agriculture, water resources, and energy (Abbasi & Nawaz, 2020). Pakistan is a country that relies on the agricultural economy, and climate change imposes great challenges in such conditions (Mumtaz, 2021). Pakistan has formulated its climate change policies by establishing the NCCP National Climate Change Policy. The climate change authority consists of scientists, academic researchers, etc., who help formulate adaptation and mitigation policies and design projects for Pakistan as it has to meet certain obligations under climate accords internationally (Mumtaz, 2018).

Rapid growth in population raises concerns about water shortage as the country lies in a region vulnerable to climate change (F. Khan et al., 2015). It is also considered that urban areas are likely to face more floods through intense rainfalls, and industrial areas may face more heat island effects due to the excess of pollution in the atmosphere. In 2001, Rawalpindi/Islamabad, also known as the twin cities, received massive rainfall lasting almost ten hours with 621mm, resulting in Lai Nullah's flooding (M. A. Khan et al., 2016).

The glacial melts also threaten GLOF (glacial lake outburst floods) in the northern region. Water resources are affected in Pakistan due to climate change. Studies show that the agriculture sector is also being affected by it as climate change affects crop yield (Rehman et al., 2021). The main water source originates from a mountain region in Pakistan, and it largely depends on it, which imposes a threat to socio-economic factors and food security if climate change has massive effects. Another adding factor is the rapid increase in population (Archer et al., 2010).

Although Pakistan faces many challenges, it can secure its food and water resources through supply and demand management, where supply management consists of efficient irrigation systems, desalination of ground and seawater, and demand management includes the creation of a resilient environment and adaptation of sustainable agricultural methods (Ahmad et al., 2021). Pakistan is directly affected by climate change around the world. The increasing carbon emissions play a vital role, and the Pakistan government has developed

mitigation policies as they directly affect the population of various areas. Interdisciplinary approaches and vigorous policy frameworks are required to tackle the complex issue of Pakistan's relationship with climate change (Rehman et al., 2021).

# CHAPTER 3: METHODOLOGY

## 3.1. Study Area: Rawalpindi

Rawalpindi, a district in the province of Punjab, is a destination steeped with cultural significance. It has a population of about 6.1 million, according to 2023 census data, and an area of approximately 5,285 square kilometers (Pakistan Bureau of Statistics (PBS), 2017). Rawalpindi is one of the main cities in the Punjab province. It comes in the Potohar/Pothwar plateau and lies between 33.04 to 34.01° N latitudes and 72.38 to 73.37° E longitudes. It is surrounded by important cities, both provincially and nationally. Rawalpindi has had historical significance in the country as it has served as the acting capital for around 10 years while the capital was shifted from Karachi to Islamabad. The district comprises seven tehsils: Murree, Gujar Khan, Kahuta, Taxila, Kallar Sayaddan, Kotli Sattian, and Rawalpindi. Its location along the route across the Khyber Pass towards India makes it a strategic destination that has been visited by notable figures in history, such as Mongol Conquerors and Alexander the Great. The city gained more importance by the late 1800s, and today, it holds major military cantonment areas and the headquarters of the Armed Forces of Pakistan (Sheikh & Pasha, 2007).

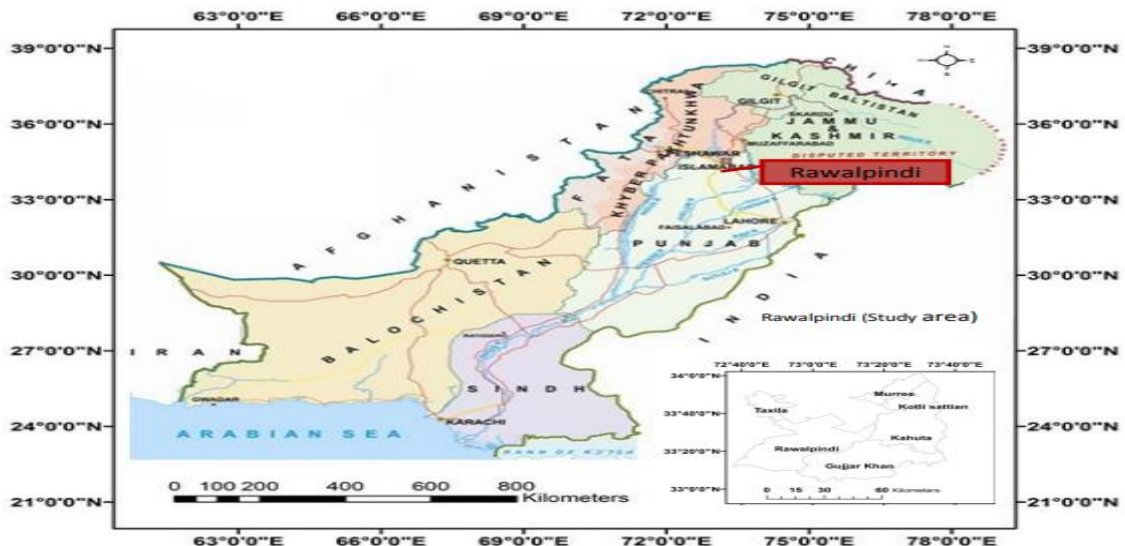


Figure 4: Map of Pakistan showing the location of Rawalpindi (Survey of Pakistan)

Each tehsil is further divided into union councils, of which 55.6% are stated as urban and 44.4% as rural (Census 2017), and the city's population density is approximately 1,158 persons/sq.km (Census 2023) with a population growth rate of 2.1% from 2017 to 2023. The literacy rate of the district is 82.4%, as per the 2017 Census. The district has an over 80% population of park-going people. Over time, Rawalpindi has started to become a hub of commercial opportunities. Due to its proximity to the capital territory, people prefer to live in low-cost housing in Rawalpindi and work in Islamabad.



Figure 5: Rawalpindi City at a glance

### 3.1.1 Field Survey

The study focused on two distinct types of settlements, formal and informal, within various areas of Rawalpindi, Pakistan. Specifically, the formal settlements included Bahria Town Phase 7 and Scheme – III, while the informal settlements comprised Ghareebabad, Satellite Town, and Chaudhry Walayat Colony. The research approach did not directly address questions about the fear of crime. Instead, participants were asked about their perceived safety when visiting nearby parks and other safety-related inquiries, as outlined in Table 1 (Skogan Wesley G. & Maxfield Michael G., 1982). To gain insights into the

state of green infrastructure in these areas, respondents were also prompted to suggest improved security options. However, the population growth and demand for budget-friendly housing, have led to an increase in the number of illegal or informal settlements. These settlements are underdeveloped and lack basic facilities, but people have no choice. Measures must be taken to address the issue of illegal settlements in Rawalpindi and provide better living conditions for the people. Several recorded informal settlements include Gahreabad, Tench Bata, Raja Bazaar, Gulzar-e-Quaid, Rehmanabad (Satellite Town), etc., whereas several formal settlements are Defense Housing Authority (DHA), Chaklala Schemes (I, II, III), Askari Residences (1 – XIV), Bahria Town (Phase 1-8). Different Satellite Town areas have become informal due to saturation, lack of maintenance, and spread of land in areas beyond its boundary.

A field survey was conducted in two formal settlements, Chaklala Scheme III and Bahria Town Phase 7, and in two informal settlements, Satellite Town and Ghareebabad. Chaklala Scheme III and Bahria Town Phase 7 are planned and approved housing societies; their neighborhood is well connected to all the city's main areas. In the case of the two informal settlements, although they are also connected to the main city areas. There are drastic differences between the two settlements.

### *3.1.1. Map of Study Areas:*

A conceptual Model of study area; among the people living in formal and informal settlements in Rawalpindi. A field survey was conducted in two formal settlements; Chaklala Scheme III and Bahria Town Phase 7 and in two informal settlements; Satellite Town and Ghareebabad (as seen from Figure 5).



Figure 6: Informal Settlements: Gharibabad and Satellite Town

Chaklala Scheme III and Bahria Town Phase 7 are planned and approved housing societies; their neighborhood is well connected to all the main areas of the city (as depicted in Figure 6). In the case of the two informal settlements, although they are also connected to the main city areas. There are drastic differences between the two settlements.

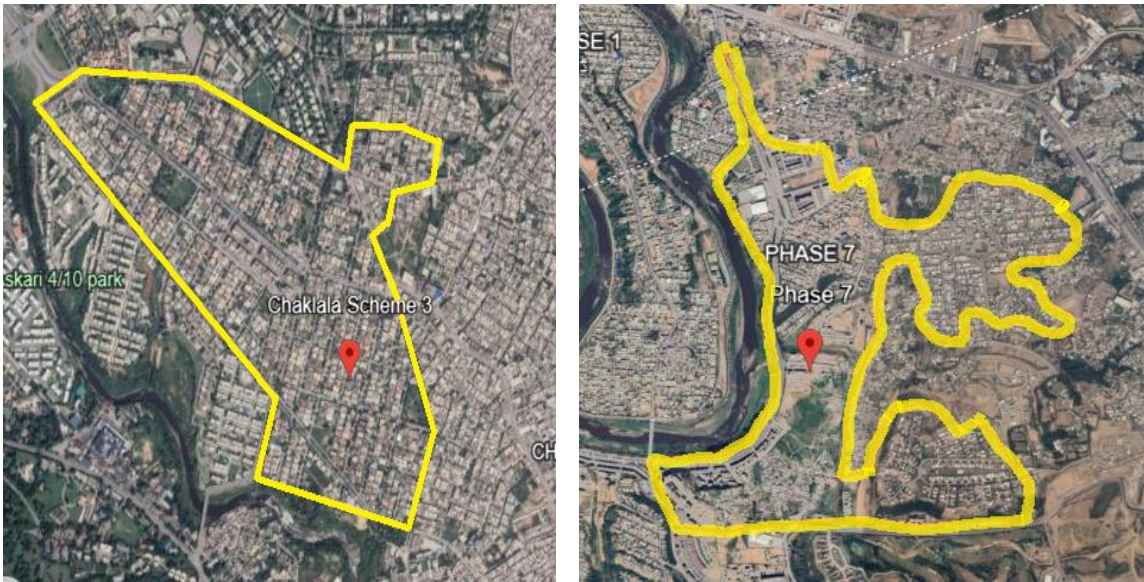


Figure 7: Formal Settlements: Chaklala Scheme 3 and Bahria Town Phase 7

As seen from the figures below, informal settlements are characterized by dinghy streets, open sewerage lines, and above-ground wiring. Figure 7 shows the difference between the



street width in an informal area and a formal area. The picture on the left depicts an informal settlement lacking basic facilities, and one can see many potential hazards to human life.

The open sewerage line threatens children, while the open wiring can be hazardous during the rainy season. On the other hand, in the formal settlement, there is no such hazard present. Figure 8, below shows another major difference between a formal and an informal settlement. The streets in the formal settlement clearly show that the area is planned as the houses are in a straight line and fit like a jigsaw puzzle. In contrast, in informal settlements, due to lack of planning, the houses are spaced and built randomly and with minimal space



Figure 8: formal settlement shows proper planning.

in between them, which causes informal settlements to be hubs of heat generation and be most affected by heat waves.



Figure 9: A view of ghareeb-a-bad from the outskirts of the society

Figure 9 shows a view of informal settlement, i.e. ghareeb-a-bad, from the outskirts of the society. Complete congestion of housing can be seen, and unplanned construction and poor maintenance can be spotted. The construction of houses is congested with poor to no drainage systems installed, especially in society.



Figure 10: Inside the streets of Satellite Town

Images of informal settlement areas of satellite towns can be seen in Figure 9. Unplanned constructed houses with open electrical systems can be seen, and trash and broken roads with water puddles can also be seen. Satellite Town was initially established as a planned residential area for people with moderate income, but it has transitioned from being a formal to informal settlement over the years. Where some streets were comparatively organized than the others over population has lead it to have poor utility services and poor waste management systems due to its unplanned expansion compromising the entire area.



Figure 11: Open Gutters/ Drainage systems in the streets of ghareeb-a-abad

Inner streets of ghareeb-a-bad had open drainage systems, which have been reported to often overflow in the rainy season, causing flash floods and severely affecting houses. People take precautionary measures and maintenance of their damaged property on their own. On the other hand, figure 11 shows the facilities provided to formal settlements such as Bahria town, where security guards are always present, spacious roads, and well-maintained areas provided to the residents. It is densely populated area with lack of infrastructure and other services. Living conditions are overcrowded with limited access to clean water and other healthcare facilities. Materials used in construction of the houses are not enough to protect them from harsh weather. Electricity supply is based on illegal connections causing safety hazard.



Figure 12: Streets of formal settlement (Bahria Town)

Chaklala Scheme III and Bahria Town phase 8 are formal residential areas with organized and well-established layout. These formal settlements have paved roads along with well-maintained parks and green spaces. They are equipped with good infrastructure with effective waste management systems.

### 3.1.2. *Geography*

Rawalpindi is a bustling district located in the heart of Punjab province with a population of approximately 5.5 million people. With a subtropical climate, Rawalpindi experiences rainfall during the monsoon season, which amounts to a total of about 600ml. Unfortunately, the risk of urban floods has increased over the years, with an average of one flood occurring every three years between 1950 and 2021. The last recorded flood was in 2001, which tragically caused many casualties. Despite this, Rawalpindi remains a vibrant and lively district, with plenty to offer to locals and visitors alike (Plaza, 2022). According to the 2022 report, the total population of Rawalpindi city is estimated to be 5.5 million.

Rawalpindi is one of the main cities in the province of Punjab, with an approximate population of 5,405,633. It comes in pothwar plateau. Unfortunately, the risk of urban floods has increased over the years, with an average of one flood occurring every three years between 1950 and 2021. The last recorded flood was in 2001, which tragically caused

many casualties. Despite this, Rawalpindi remains a vibrant and lively district, with plenty to offer to locals and visitors alike (Plaza, 2022). According to the 2022 report, the total population of Rawalpindi city is estimated to be 5.5 million.

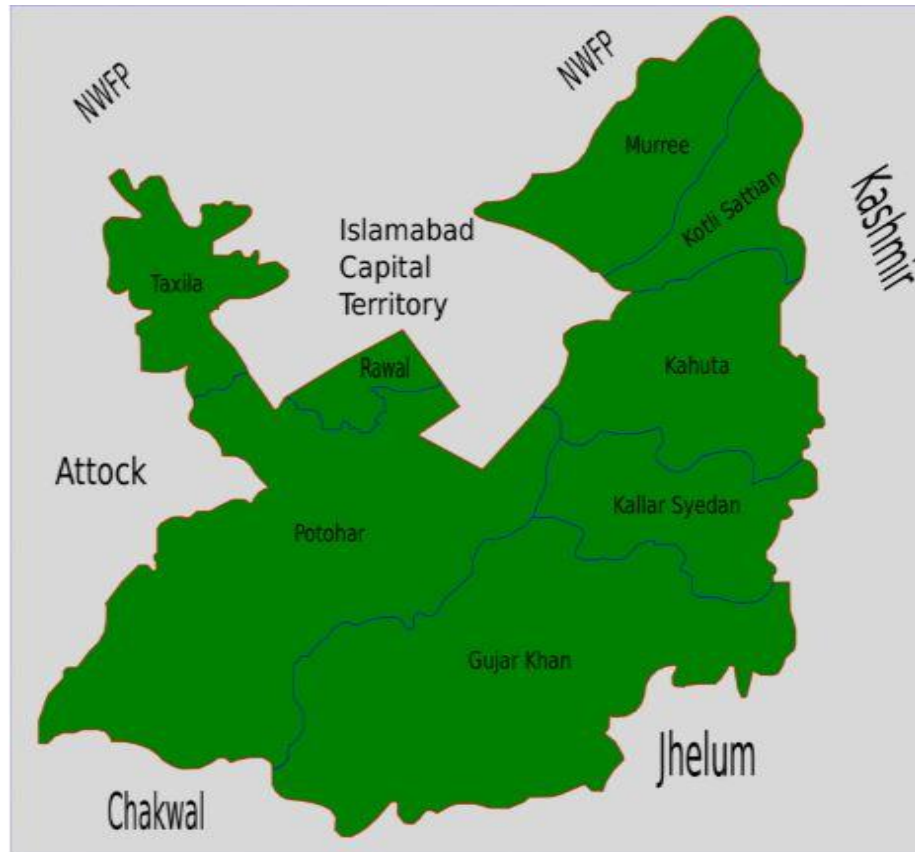


Figure 13: Map of District Rawalpindi

The chief hill station of the Punjab province Murree, an extension of the Margalla Hills, is located around 70 km from Rawalpindi and is a popular tourist destination in both winters and summers (Ahmed, 2018). The Margalla hills make the Rawalpindi region's climate mild by acting as a barrier to the cold winds from the north in the winter (Rizvi et al.; 2019). Taxila is another historically and culturally significant city, home to the Gandhara Civilization and housing various militarily important manufacturing facilities. Another neighboring area is Kahuta, a strategically important location for the country in terms of nuclear programs and atomic research labs (Khan, 2013).

Traditionally, Rawalpindi was dominated by arid agriculture, with most farming being dependent on rainfall and farmers having small land holdings. However, the city has become a hub for employment for the nearby districts due to its proximity to the current capital city, Islamabad, and growing industry setups. Studies on the geological composition of the area suggest the presence of alluvial plains and sedimentary rocks, which aid in groundwater recharge and urban development (Ali et al., 2020). Most of the agricultural land has now been devoured by the rising trend of housing developments, and the city is expanding rapidly, giving rise to informal settlements and peri-urban areas (Khan et al., 2021). This urban development has led to land cover changes and environmental degradation, creating issues such as deforestation, soil erosion, and loss of biodiversity (Hussain et al.; 2020). Sustainable development strategies need to be implemented to curb the effects of this rapid urbanization (Babar et al; 2018).

Various hazards, such as air and water pollution, stemming from this urbanization and industrialization, leading to respiratory diseases, skin allergies, and severe gastrointestinal problems (Khan and Khan, 2017). Solid waste management is also a growing concern, with the population increasing rapidly, which results in increasing garbage generation, overwhelming an already under-capacity waste management and disposal system (Iqbal et al; 2020).

All the aforementioned issues that arise because of urbanization have led to the region being at serious risk of environmental calamities such as urban flooding and heat waves, which emphasize the need for disaster preparedness and risk mitigation strategies (Rafique et al; 2019). The rise of informal settlements puts these marginalized communities at risk floods, heat waves, and possibly increased crime rates (Malik et al; 2018).

### *3.1.3. Climate Change in Rawalpindi*

Climate change is one of the world's biggest concerns today; it poses various challenges to many countries, especially developing countries like Pakistan. The country, which encompasses different landscapes from coastal regions to desert areas and highly fertile vegetation land, is the fifth country in the world to be most affected by climate change (Malik et al., 2024). About 173 extreme weather conditions have occurred in the

last two decades. The country is facing major climate-related issues and water resources due to changes in monsoon patterns and melting glaciers (Maqbool, 2022). Pakistan has witnessed extreme weather conditions in recent years, from heat waves to cold waves and elongated summer months. Climate change has affected the city of Rawalpindi immensely, with extreme weather events such as changes in precipitation and rising temperatures (Abbas et al., 2014). This phenomenon has environmental, social, and economic implications.

According to research, precipitation has increased in Pakistan in the range of +57% - +71%, and it has been recommended that the entire country build more dams and water storage reservoirs (Ghumman et al., 2013). A temperature rise is one of the prominent features of climate change, and research depicts that the average temperature in the world will rise from 4-12 °F, reflecting that heat waves will occur more often and last longer (Malik et al., 2024). Climate change has also worsened the water scarcity issues in the Rawalpindi region, as it alters the water cycle through an increase in evaporation and changes the amount of rainfall. It has also resulted in melting glaciers in the Himalayas, raising the sea level with dangerous variations in river runoff water and groundwater (Maqbool, 2022). Many health-related issues have arisen, and displacement and migration are taking place due to vulnerable climatic conditions. The economic impacts of the loss of agricultural produce have been immense and have resulted in the decline of tourism in Rawalpindi.

### **3.2. Sampling, questionnaire design, and data collection**

As done by (Zhang & Tan, 2019), data collection was done at the household level, and several factors were collected through door-to-door questionnaire surveys in the selected formal and informal settlements of Rawalpindi. The chosen locations were highly populated with people of different incomes and backgrounds. Some old areas become informal settlements due to overpopulation and lack of planning implementation (Salas, 1970). Most of the neighborhoods did have parks near them. The survey was conducted in December 2022. The demographic and physical functionality data were analyzed using IBM SPSS version 26.0 to calculate the sample's descriptive statistics. Data collection and data analysis were performed sequentially (Van Puyvelde et al., 2023). Although a target

of 400 sample size was set due to major difficulties and the non-cooperation of people from different areas, it wasn't achieved. For an adequate comparison, a total of 360 samples were collected: 151 from formal settlements and 206 from informal settlements.

The questionnaire assessed Accessibility and Proximity to Parks, Social Aspects and Crime History, Security Personnel and Surveillance, and Perception of Safety and Crime. The fieldwork was conducted in December 2022, and three undergraduate students from the National University of Sciences and Technology (NUST) Islamabad were trained for data collection. The team was experienced in conducting surveys, and they explained the survey details. The team was trained to translate the questionnaire into Urdu wherever required.

### **3.3. Data analysis**

The following two data analysis tools were applied to learn about institutional challenges and risk perceptions in a multi-hazard environment.

### **3.4. Selection of indicators**

The research was based on different indicators that revealed people's perceptions of crime, climate change, and accessibility to their nearest parks. An extensive literature review was conducted to figure out the relevant indicators for quantifying the components. In this paper, five indicators are reviewed and studied to determine the perception of crime among the people living in the surveyed areas.

The most social-able method was adopted to conduct surveys, i.e., face-to-face (Sheskin Ira M., 1985). Data analysis was done by adding the surveyed information to IBM SPSS (Mak & Jim, 2019). The significance of the data was analyzed. The frequency of crime perceptions was also indicated. Any area with criminal activity should be indicated as it aids in more crime in the specific area or gives a margin to criminals to perform more such activities (S. Lee, 2022). Lighting streets and parks have been essential since the 18th and 19th centuries as increased reduced criminal activity or fear of crime (S. Lee, 2022).



### **3.5. Sample Characteristics:**

Across the different locations of formal and informal settlements that were surveyed, the participants ranged from different educational levels. Some were highly educated and worked in better environments, while others were less educated, i.e., primary and secondary. There seemed to be a relation between education level and the fact that they were living in formal or informal society. The level of crime perception among informal settlements was higher than in formal settlements. This also varies due to the level of security provided by the housing society or the government in the local parks

## CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents the findings from the questionnaire surveys and discusses the results. SPSS software was utilized to analyze the results, which included chi-square tests, T-tests, and graphical representations such as graphs and pie charts. It is further divided into Socio-Economic Factors affecting Park Usage, Park Characteristics, Park Safety Factors, Fear of Crime, and Climate Change.

### 4.1. Socio-economic factors

The survey used socioeconomic indicators such as gender, education, household income, and occupation. Education includes primary, secondary, high school, college and university. Household income was classified into five different classes representing low to high-income classes of society. Occupation was divided into five classes: student, housewife (if female), retired, or others. In formal settlements, the number of male respondents was 116, and female respondents were 35, whereas there were 162 and 47 male and female respondents in informal settlements.

Table 1: Analysis of Socioeconomic indicators: number of children, young and elderly in the house (separately), household income, occupation, and education.

Indicators	Classification	Formal (N=151)		Informal (N=209)	
		Frequency	Percentage	Frequency	Percentage
Gender	Male	116	76.8	162	77.5
	Female	35	23.2	47	22.5
Number of Children	No children in the house	9	6.0	18	8.6
	1-5 children in the house	137	90.7	171	81.8
	6-7 children in the house	3	2.0	7	3.3
	more than 7 children	2	1.3	13	6.2
Number of Young People in the House	No young people	2	1.3	2	1.0
	1-5 young people	141	93.4	178	85.2

	6-7 young people	5	3.3	19	9.1
	more than 7 young people	3	2.0	10	4.8
Number of Elderly in the House?	No Elderly in the house	53	35.1	55	26.3
	1-2 elderly people	93	61.6	143	68.4
	more than 2 elderly people	5	3.3	11	5.3
Household Income	Below 35000		-	27	12.9
	35000 – 50000	5	92	92	44.0
	50000 – 70000		-	58	27.8
	70000 – 80000	66	32	32	15.3
	Above 100000	80	53.0		
Occupation	Student	69	45.7	54	25.8
	Housewife	20	13.2	38	18.2
	Retried	9	6.0	15	7.2
	Others	53	35.1	102	48.8
Education	Primary	10	6.6	31	14.8
	Secondary	5	3.3	21	10.0
	Matric	20	13.2	61	29.2
	College	39	25.8	34	16.3
	University	77	51.0	61	29.2
	Illiterate		-	1	0.5

There appears to be a noticeable contrast in the average characteristics of formal and informal settlements. In informal settlements, there seems to be a higher number of children than in formal settlements. On the other hand, the number of young and elderly individuals appears to be slightly higher in formal settlements. Additionally, the average household income in formal settlements is 4.73, while in informal settlements, it is 2.34. This represents a significant difference in the income rates between the two types of settlements.

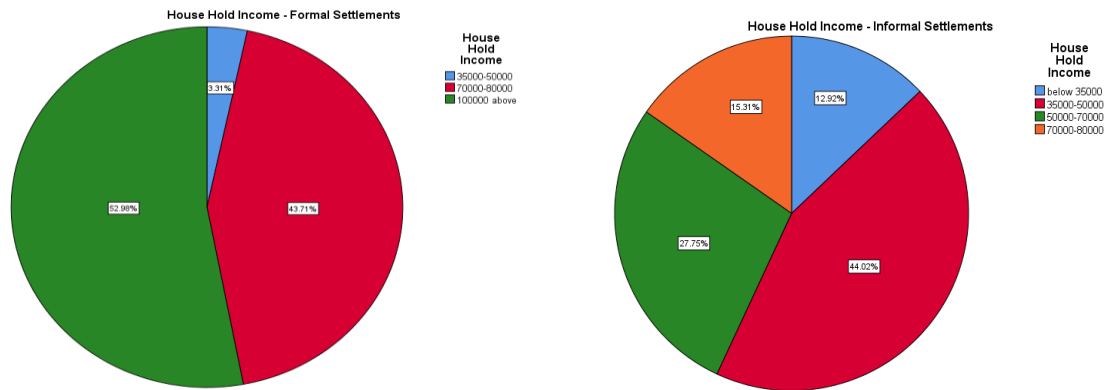


Figure 14: Difference between household incomes in formal and informal settlements

The figures above illustrate a comprehensive depiction of household income distribution within formal and informal settlements, providing valuable insights into how these income disparities influence residents' behavior, particularly concerning park visitation patterns.

The data reveals a notable concentration of households within specific income brackets in informal settlements. For instance, a significant proportion, accounting for 44%, falls within the income range of 35,000 to 50,000 (PKR). Furthermore, approximately 27% of households report incomes ranging from 50,000 to 70,000 (PKR), indicating a substantial segment of the population in this moderate-income bracket. Conversely, around 12% of households earn below the average income threshold of 35,000 (PKR), a figure of particular significance given Pakistan's government-set minimum wage of 32,000 (PKR) per month. Moreover, a noteworthy 15% of households in informal settlements boast incomes surpassing 70,000 (PKR), underscoring the presence of a relatively affluent subset within these communities.

In contrast, the income distribution in formal settlements presents a different profile. Here, a smaller proportion, specifically 3.31%, falls within the 35,000 to 50,000 (PKR) income bracket, reflecting a comparatively lower prevalence of moderate-income households. Instead, a significant majority, comprising 43.71%, reports incomes ranging from 70,000 to 80,000 (PKR), indicating a higher concentration of households with relatively higher incomes. Moreover, an even more substantial segment, accounting for

52.98%, boasts incomes exceeding 100,000 (PKR), highlighting the predominance of affluent households within formal settlements.

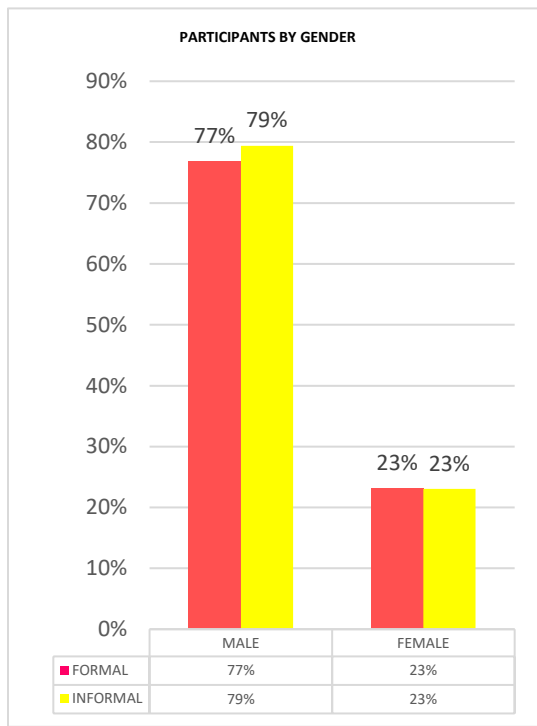


Figure 15: Participants by Gender

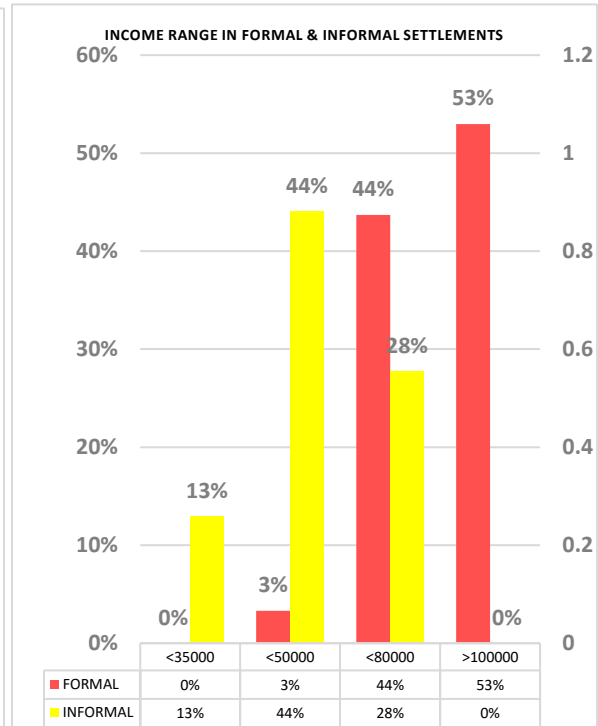


Figure 16: Income range in both settlements

The figures above illustrate the number of participants/respondents to the questionnaire by gender. In formal settlements, 77% of respondents were male, while 23% were female. In informal settlements, 79% of respondents were male, and 21% were female. The income range of respondents in formal and informal settlements reveals significant differences in their economic statuses. In formal settlements, no respondents reported earning less than 3,500 PKR, while 13% of respondents in informal settlements did. For income levels below 50,000 PKR, only 3% of respondents from formal settlements fell into this category, compared to 44% in informal settlements. Among those earning less than 80,000 PKR, 44% were from formal settlements, whereas 28% were from informal settlements. A notable disparity is observed in higher income brackets, with 53% of respondents from formal settlements earning more than 100,000 PKR, while no respondents from informal settlements reported incomes above this threshold. These

results suggest that formal settlements generally have higher income levels than informal settlements, indicating a significant economic divide between the two groups.

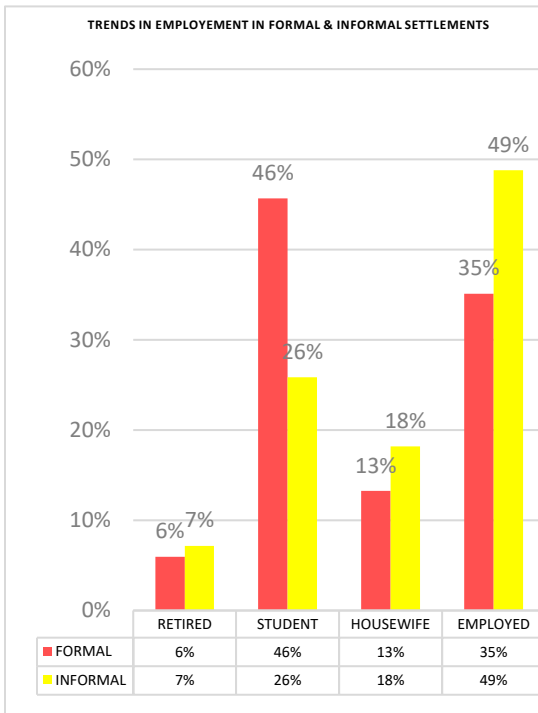


Figure 17 Trends in Employment

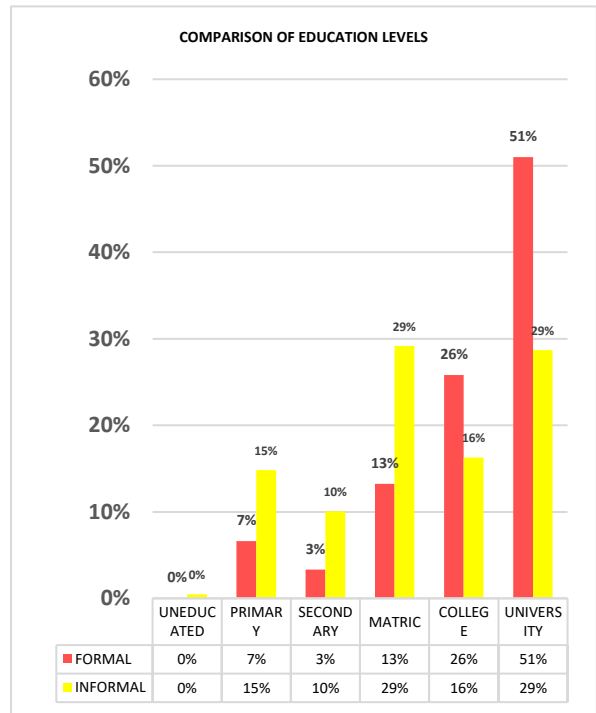


Figure 18: Comparison of Education Levels

The employment status of respondents in formal and informal settlements shows distinct patterns. In formal settlements, 6% of respondents are retired, compared to 7% in informal settlements. Students make up 46% of respondents in formal settlements, while 26% of respondents in informal settlements are students. The category of homemakers comprises 13% of respondents in formal settlements and 18% in informal settlements. Employment is reported by 35% of respondents in formal settlements, but a higher 49% of respondents in informal settlements are employed. These results indicate that formal settlements have a higher proportion of students and a lower proportion of employed individuals than informal settlements.

This could suggest that formal settlements might have a larger proportion of younger individuals still in education or possibly more economically stable residents who have retired. In contrast, informal settlements appear to have a higher percentage of employed individuals, potentially reflecting a different economic dynamic or workforce

participation rate. The comparison of education levels between respondents from formal and informal settlements reveals distinct educational patterns. Neither group reported any respondents as uneducated. In formal settlements, 7% of respondents had primary education, while 15% of respondents in informal settlements had primary education. For secondary education, 3% of formal settlement respondents, compared to 10% of informal settlement respondents, had attained this level. 13% of respondents in formal settlements and 29% in informal settlements achieved the matric level of education. At the college level, 26% of respondents in formal settlements had this level of education, whereas 16% in informal settlements did. Finally, university education was attained by 51% of respondents in formal settlements compared to 29% in informal settlements.

These results suggest that formal settlements generally have a higher proportion of respondents with higher education levels than informal settlements. The significant difference in university education—51% in formal versus 29% in informal settlements—indicates that formal settlements might have better access to higher education opportunities or higher educational attainment overall. Conversely, informal settlements show a higher proportion of respondents with secondary education and metric-level qualifications, reflecting different educational access and attainment between the two types of settlements.

The disparities in income distribution between formal and informal settlements play a pivotal role in shaping residents' park-going behavior. For instance, the higher concentration of moderate to high-income households in formal settlements may correlate with increased park utilization, driven by factors such as greater disposable income for recreational activities and potentially better-maintained parks within these areas. Residents of informal settlements, particularly those with lower incomes, may face barriers to park access, including limited financial resources and inadequate park infrastructure.

Overall, the detailed analysis of household income distribution provided by the figures above serve as a valuable foundation for understanding the socioeconomic dynamics influencing park visitation patterns in both formal and informal settlements. These insights are essential for informing targeted interventions aimed at promoting

equitable access to green spaces and enhancing the quality of life for residents across diverse urban landscapes.

Table 2: Regression Analysis of some socio-economic factors

Dependent Variable	Independent variables/Questions	(Formal and Informal)		
		Significance	ANOVA dF = 359	Beta standardized
How often do you go to the park?	Gender	.143	F= 6.85, p-value= 0.000	-.076
	Number of Children	.148		-.077
	Number of Young People in the House	.287		-.056
	Number of Elderly in the House?	.001*		.165
	Household Income	.000*		.215
	Occupation	.793		-.013
	Education	.026*		.121

Table 3: Regression Analysis of distance and park visitation frequency

Dependent Variable	Independent variables/Questions	(Formal and Informal)		
		Significance	ANOVA dF = 359	Beta standardized
How often do you go to the park?	DISTANCE (from your house to the park)	.000	F= 30.781, p-value= 0.000	.281

#### 4.2. Park Characteristics

Different studies reveal that high physical activity levels are directly related to park proximity (Rung et al., 2011). It is also said that the built environment greatly influences visitor activity; it can limit and increase activity (McCormack et al., 2010). Physical activities are encouraged with more parks in the community. Still, park



characteristics such as its design, structure, and facilities play an important role in the social interaction and activities carried out by the visitors (Hayward D. Geoffrey & Weitzer William H., 1984). Any scientific research is incomplete without statistical testing. A Pearson’s chi-square test is conducted to test the hypothesis, whether there is any relationship between two or more groups, such as population, and the observed data distribution is similar to the expected distribution (Nihan, 2020).

The formula for Chi-Square test:

$$X^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i} \quad (4.1)$$

Systematic analysis of the public’s image and use of urban parks is an important foundation for present and future planning. However, one must also recognize that cities are facing significant budgetary pressures, which may cause people to lose sight of rational planning. Natural areas in the urban landscape are obviously viewed as amenities. Still, their future will be shaped by financial and political decisions, which may have little to do with scenic beauty. Therefore, our choices concerning our urban parks must be seen in that context.

Table 4: Statistical test of Park Characteristics in formal and informal settlements

Categories	Questions	Classes	Chi Sq. Formal & Informal	P value														
Recreational Facilities	Are there any recreational facilities for the park users?	Yes	9.510	0.002*														
		No				Are there any play areas for children in the park?	Yes	4.972	0.026*	No	Food and Amenities:	Does the park have food stalls?	Yes	36.234	0.000*	No		Are there any benches in the park?
	Are there any play areas for children in the park?	Yes	4.972	0.026*														
		No			Food and Amenities:	Does the park have food stalls?	Yes	36.234	0.000*	No		Are there any benches in the park?	Yes	0.524	0.469	No		
Food and Amenities:	Does the park have food stalls?	Yes	36.234	0.000*														
		No				Are there any benches in the park?	Yes	0.524	0.469	No								
	Are there any benches in the park?	Yes	0.524	0.469														
		No																

Safety and Emergency Services:	Are there any trained professionals to provide initial aid at once?	Yes	11.396	0.001*
		No		
	Do you think that adequate lighting is available for visitors at night?	Yes	11.116	0.001*
		No		
Socialization and Community	Do you visit the park to socialize?	Yes	3.002	0.223
		No		
	To what extent do you agree more people should visit parks to encourage socialization?	Strongly Disagree	1.799	0.773
		Disagree		
		Neutral		
		Agree		
		Strongly Agree		
Mental Health and Well-being	To what extent do you agree that the parks in your community have positive effects on your mental health?	Strongly Disagree	0.916	0.822
		Disagree		
		Neutral		
		Agree		
		Strongly Agree		
Visitor Behavior	How do you rate behaviour of park visitors?	Very Friendly	27.872	0.000*
		Friendly		
		Neutral		
		Impolite		
		Disrespectful		

#### 4.2.1. Recreational Facilities

Recreational facilities and play areas for children are important features of parks. They significantly impact the number of daily and monthly park users. It has been observed that there is a significant relationship between the type of settlement - both formal and informal settlements and recreational facilities, with both values being below 0.05.

#### *4.2.2. Food and Amenities*

In addition, the availability of food and amenities is another crucial factor for parks. Providing healthy food and products for park users is a growing trend worldwide to make parks more sustainable.

#### *4.2.3. Safety and Emergency Services*

Safety and emergency services are crucial for the protection and well-being of park users. First aid should be provided by trained professionals who can offer initial assistance in case of an emergency. Basic first aid training is mandatory for all areas to ensure user safety. The availability of trained professionals for first aid should be considered in relation to the type of settlement in the park. In addition, a well-lit park environment is essential, especially in the evening and night, to ensure clear visibility for users. This not only enhances the user experience but also serves as a safety measure. The value of this factor is 0.001 and is also significant in relation to the type of settlement in the park.

#### *4.2.4. Socialization and Community*

Socialization in any community is important and helps foster positive relationships. When asked whether they visited their neighborhood parks to socialize, it was clear that not many people preferred to do so. Instead, they visited the parks for entertainment and well-being, with minimal interaction with others. Since most people did not visit parks to socialize, they did not encourage socialization. Although some people believed that socialization should be encouraged, they were in the minority. Most people prefer to mind their own business and keep their interactions private. The chi-square values and p-values were not significant.

#### *4.2.5. Mental Health and Well-being*

The chi-square value and p-value were not significant in both formal and informal settlements combined. The chi-square value was 0.916, whereas the p-value turned out to be 0.822.

#### 4.2.6. Visitor Behavior

The p-value indicates significant findings, as the majority of park visitors exhibit friendly behavior, with very few displaying impolite and disrespectful tendencies based on survey responses. This is also visually represented in the pie chart below, which shows that 45.56% were rated as friendly, 33.33% as neutral, 10.56% as very friendly, 9.61% as impolite, and 1.94% as disrespectful.

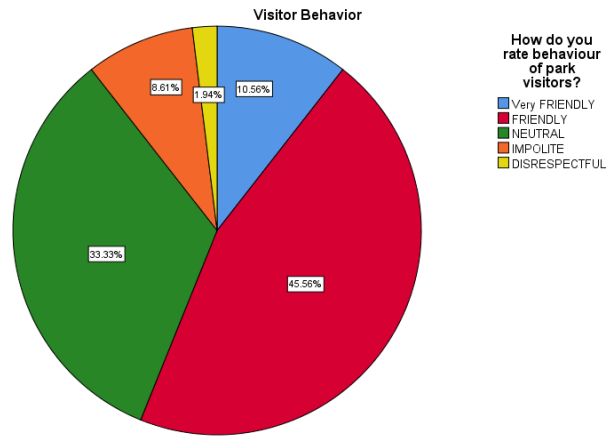


Figure 19: Visitor behavior (formal and informal settlements combined)

The average distance from respondents' homes to the nearest park was also analyzed. It was found that 46% of people from formal settlements have a park within less than 1 km of their homes. In contrast, only 15% of respondents from informal settlements have a park within that same distance. Most people from informal settlements (54%) have parks located within 2-5 km from their homes, while 32% have parks more than 5 km away. Visitors of formal settlements, Bahria Town and Chaklala Scheme III have more parks near them whereas the ones living in informal areas such as Ghareeb-a-abad and Satellite Town have parks at a certain distance to their houses, which influences the park visitation of the residents.

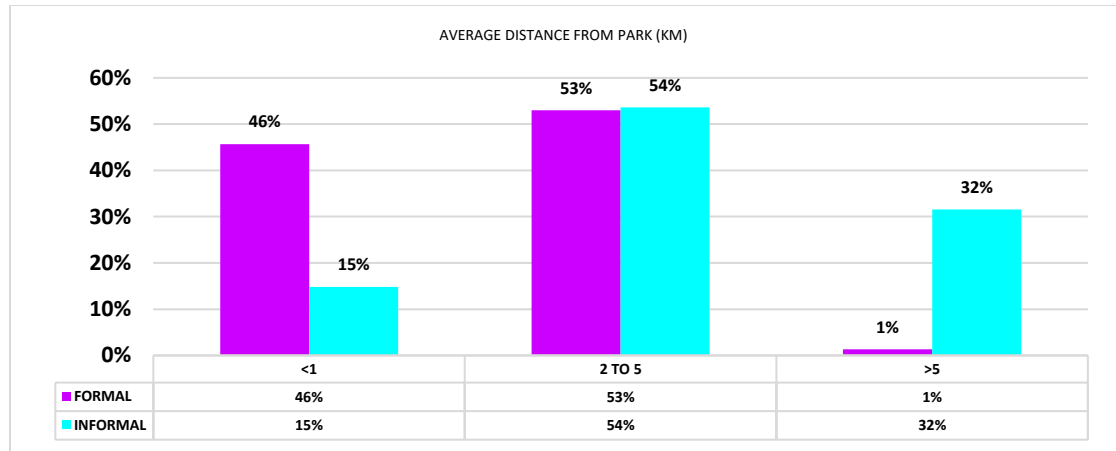


Figure 20: Average distance from the park (KM)

A t-test was conducted to compare the means of formal and informal settlements to determine people from which settlements tend to go more to the parks. The table below shows the results where the f value is 44.822 with a significance of 0.00. The mean value in formal settlements is 2.741, and 1.847 in informal settlements, showing that people living in formal settlements go to parks more often than in informal settlements.

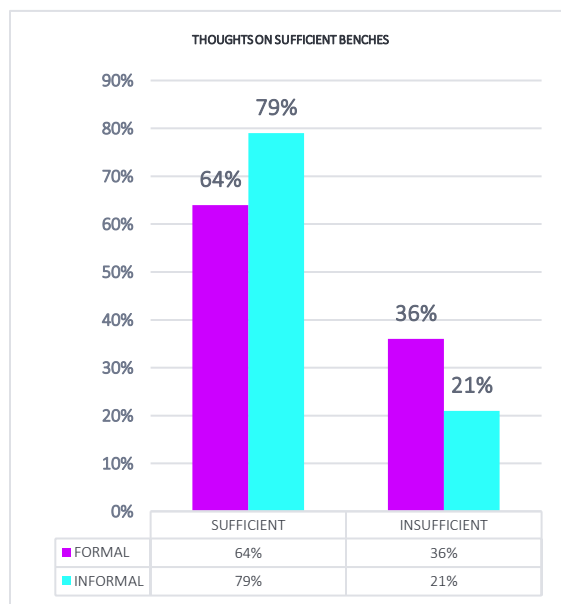


Figure 21: Thoughts on sufficient benches

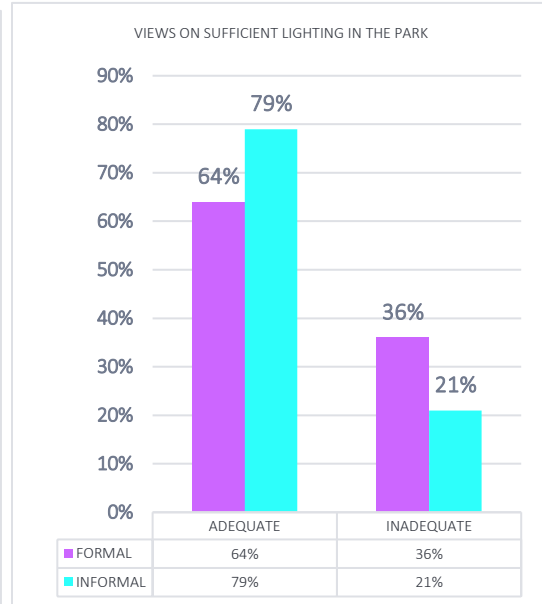


Figure 22: Views on sufficient lighting

Figure 21 illustrates the availability of sufficient benches in parks visited by respondents from both formal and informal settlements. According to the data, 64% of

respondents from formal settlements reported that the parks they visit have adequate benches, while a higher percentage, 79%, of respondents from informal settlements reported the same. This suggests that parks in informal settlements may prioritize providing seating facilities more than those in formal settlements, or it could indicate that the need for seating is more keenly felt and thus reported by respondents in informal settlements. On the other hand, 36% of respondents from formal settlements and 21% from informal settlements reported insufficient benches. This disparity could reflect differences in park maintenance, usage, or design priorities between the two settlement types.

Figure 22 shows the availability of sufficient lighting for night users in parks. The data reveals that 64% of respondents from formal settlements and 79% from informal settlements stated that the parks they visit have adequate lighting at night. This higher percentage from informal settlements may indicate that lighting is a critical concern for safety and usability, prompting more attention to this feature in parks within informal settlements. Whereas, 36% of respondents from formal settlements and 21% from informal settlements reported insufficient lighting in their parks. The lower percentage of inadequate lighting reports from informal settlements suggests that despite other challenges, these areas might receive more focus on basic amenities like lighting, which is essential for safety and extended use of the parks during evening hours.

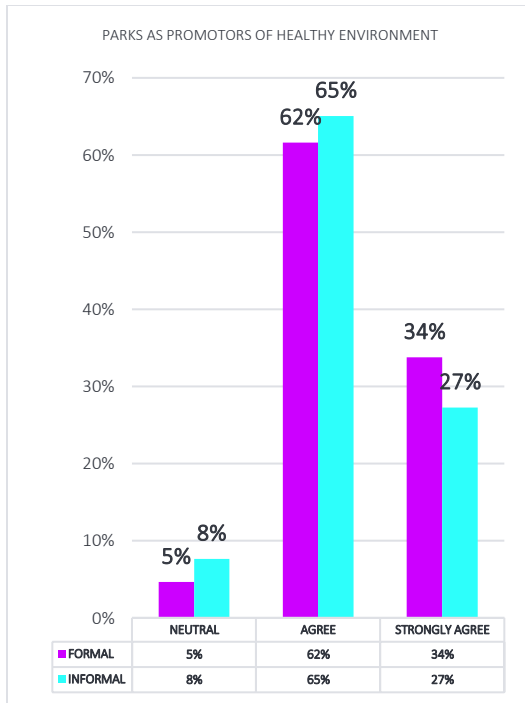


Figure 23: healthy environment

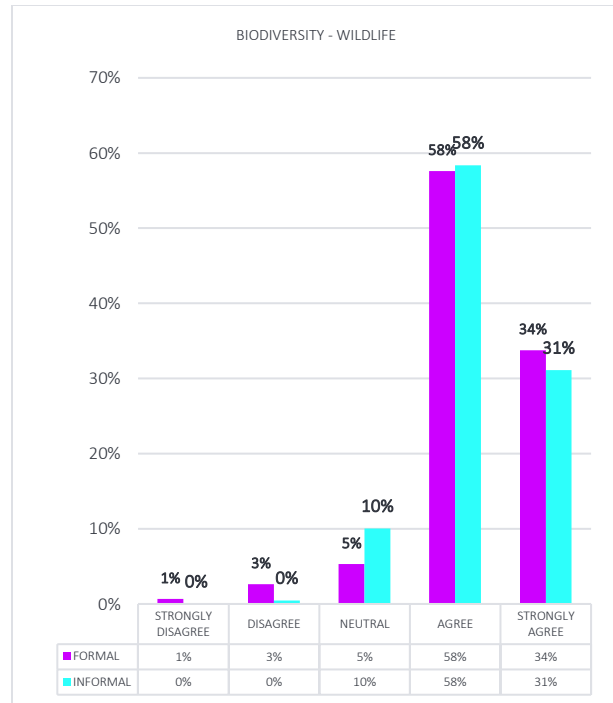


Figure 24: Parks promoting biodiversity

The above figure 23 reveals people's perceptions of parks in promoting a healthy environment. According to the data, 65% of respondents from formal settlements and 62% from informal settlements agree that parks contribute to a healthy environment. A small portion, 8% from formal and 5% from informal settlements have a neutral view on this matter. Additionally, a significant proportion strongly agrees with the statement, with 27% from formal settlements and 34% from informal settlements. This indicates a strong overall belief among the respondents that parks play a crucial role in fostering a healthy environment, with a slightly higher conviction observed in informal settlements. Whereas, figure 24 explores the perception of respondents regarding the role of parks in promoting biodiversity. The data shows that 58% of respondents from formal and informal settlements agree that more parks in an area contribute to greater biodiversity within the community. This consensus reflects a widespread understanding of the ecological benefits of parks, such as providing habitats for various species, supporting plant diversity, and maintaining ecological balance. The equal percentage across both settlement types suggests a common recognition of the importance of parks for biodiversity, regardless of the respondents' living conditions.

### 4.3. Park Safety Factors

Park safety is one of the most significant factors affecting park usage. Important considerations include proximity to the park, accessibility for pedestrians, traffic conditions for those commuting by car, and personal safety (McCormack et al., 2010).

Table 5: Categories influencing crime perception in Formal and Informal Settlements

Categories	Questions	Classes	Formal %age (N=151)	Informal %age (N=209)	Chi Sq. Formal & Informal	P - Value
Accessibility and Proximity to Parks	Distance (from your house to the park)	less than 1 KM	45.7	14.8	72.547	0.000
		2-5 KM	53.0	53.6		
		more than 5 KM	1.3	31.6		
	Are there any parks near your house?	Yes	98.7	92.3	7.397	0.007
		No	1.3	7.7		
	Do you walk to the park?	Yes	92.7	73.7	21.206	0.000
		No	7.3	26.3		
	How often do you go to the park?	Daily	45.7	16.3	52.709	0.000
		Weekly	39.1	40.7		
		Bi-Weekly	6.6	9.6		
Monthly		4.0	22.5			
Yearly		2.6	8.1			
Never		2.0	2.9			
Security Personnel and Surveillance	Is there any security guard(s) in this park?	Yes	80.1	80.4	0.003	0.953
		No	19.9	19.6		
	Are there any checkpoints installed to enter the park?	Yes	2.6	30.1	43.750	0.000
		No	97.4	69.9		
	Are Security Guards present at every gate and checkpoint?	Yes	1.3	28.2	45.092	0.000
		No	98.7	71.8		
	Are there any surveillance cameras installed in the park for protection and security purposes?	Yes	1.3	47.8	93.439	0.000
		No	98.7	52.2		
Proximity to law enforcement	How far is the nearest Police station from this park?	less than 1 KM	22.5	6.2	47.009	0.000
		2-5 KM	74.2	67.0		



		6-10 KM	3.3	26.8		
Perception of Safety and Crime	How would you rate the safety at all hours to go to the park?	Not Safe at All Hours	.7	1.0	6.073	0.194
		Not Safe at some hours	13.2	22.5		
		Moderate	19.9	16.7		
		Safe at most hours of the day	57.6	49.3		
		Safe at all hours	8.6	10.5		
	How do you rate the safety of your route from home to the park is safe?	Not Safe at all	10.6	.5	2.904	0.574
		Sometimes Safe	37.1	12.4		
		Moderate	39.7	31.1		
		Safe at most hours of the day	12.6	45.5		
		Very Safe	10.6	10.5		
	Do you think that adequate lighting is available for visitors at night?	Yes	63.6	79.4	11.116	0.001
		No	36.4	20.6		
	To what extent do you agree more people should visit parks to encourage socialization?	Strongly Disagree	3.3	3.8	1.799	0.773
		Disagree	7.3	11.0		
		Neutral	13.2	14.4		
Agree		64.9	59.8			
Strongly Agree		11.3	11.0			
Social Aspects and Crime History	Is there any history of crime in this park?	Yes	1.3	7.7	7.397	0.007
		No	98.7	92.3		
	Is there any history of crimes related to gender in this park?	Yes	1.3	3.3	1.474	0.225
		No	98.7	96.7		
	Do you know the people who frequently meet you in the park?	Yes	27.8	34.9	2.041	0.153
		No	72.2	65.1		

The table above captures a comparative analysis of lifestyle, usage, and perceptions relating to neighborhood parks among residents of formal and informal settlements. This table delineates the demographic distribution across multiple categories within each

settlement type, based on a series of survey questions. Respondents were presented with questions and asked to respond with a simple "Yes" or "No," or to provide their input on a scale-based metric. The data presents intriguing insights into the behaviors and attitudes of the two different residential communities concerning their interaction with and around local parks.

#### *4.3.1. Accessibility and Proximity to Parks/ Park Proximity and Usage*

The table illustrates significant disparities in park access between formal and informal settlements. Within formal settlements, an equal number 74 out of 151 residents live within 1KM and between 2-5KM of a park. Conversely, a mere 35 out of 209 residents in informal settlements report having a park within a walking distance of less than 1 km. A considerable majority, over 150 out of 209, travel distances ranging from 2-5KM or even further, exceeding 5KM, to reach a park. The frequency of park visits also reflects a pronounced contrast; 69 out of 151 residents visit parks daily in formal settlements, while only 34 out of 209 do the same in informal settlements.

#### *4.3.2. Security Personnel and Surveillance*

It is noted that parks frequented by residents of informal settlements are more likely to be under higher security surveillance. This observation suggests a proactive approach to park safety in areas where residents from informal settlements tend to visit.

#### *4.3.3. Proximity to law enforcement*

Regarding law enforcement proximity, both formal and informal settlement dwellers seem to have relatively ample access, with only 61 residents across both types visiting parks 6-10 KM away from the nearest police station. The graphical explanation and demonstration below also support the statement.

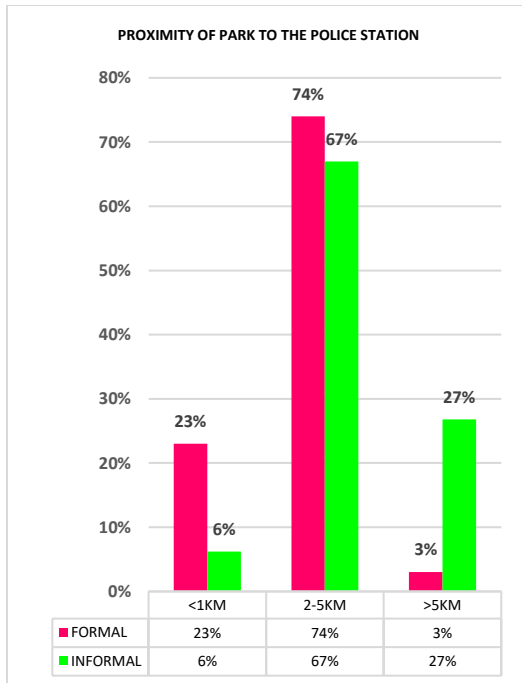


Figure 25 park to police station

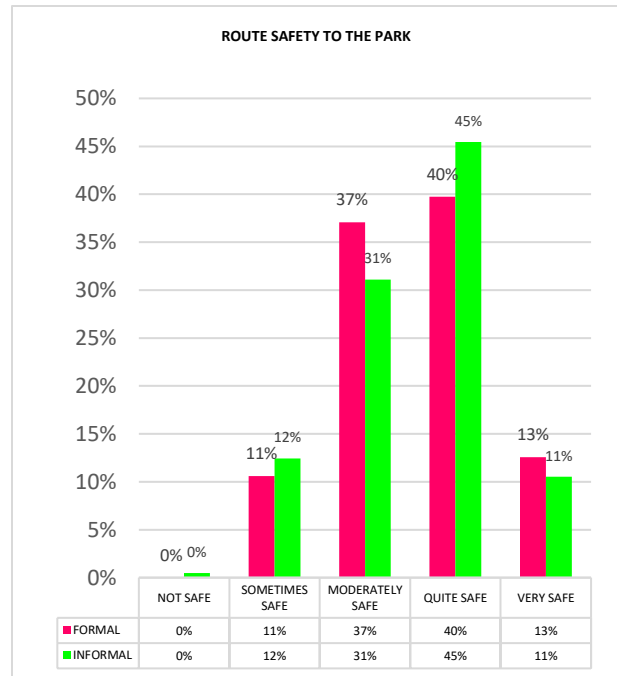


Figure 26: Route safety

To further analyze park safety factors, the proximity of parks to police stations was compared (figure 25) in both formal and informal settlements. Among the respondents, 74% reported that the police station is within 2-5 km of the park they use, while 23% reported that it is less than 1 km away.

#### 4.3.4. Safety Perceptions and Social Interaction / Perception of Safety and Crime

Safety perceptions vary notably between the two communities. Residents of informal settlements report feeling unsafe during certain hours on their route to the parks more frequently than those from the formal settlements. However, it is common for most residents from both demographics to consider the safety level as "safe at most hours of the day." A minority, 13 from formal and 22 from informal settlements, feel the route from their house to the park is "safe at all hours." The perception of route safety was also analyzed in figure 26. Most people from both settlements reported finding their routes moderately safe or quite safe, with no one claiming the route from their house to the park to be unsafe. Specifically, 37% of respondents from formal settlements found their route moderately safe, compared to 31% from informal settlements. Additionally, 40% of

respondents from formal settlements found their route quite safe, compared to 45% from informal settlements. Lastly, 13% of respondents from formal settlements found their route very safe, compared to 11% from informal settlements.

#### 4.3.5. *Social Aspects and Crime History*

The history of crime in parks and the history of crime related to gender is very low for both settlements. The only crimes faced were street crimes, such as pickpocketing and mobile snatching. A moderate number of people in both settlements appear to know the people they frequently meet in the park. People prefer to focus on their respective activities. The incidence of crime within parks has been notably low for both settlement types, with only minor occurrences of street crimes, such as pickpocketing and phone snatching, reported in the study.

Table 6: Regression analysis of safety at all hours to go to the park and park visitation frequency

Dependent Variable	Independent variables/Questions	(Formal and Informal)		
		Significance	ANOVA dF = 359	Beta standardized
How often do you go to the park?	How would you rate the safety at all hours to go to park?	.000	F= 31.258, p-value= 0.000	5.591

Regression analysis was conducted to determine the significance of two factors: "How often do you go to the park?" and "How would you rate the safety of the park at all hours?" The analysis revealed a significance level of 0.00, which is below the threshold of 0.05, thereby demonstrating that the perceived safety of the route to the park directly impacts the frequency of park visitation. The F-value obtained from the analysis was 31.258, and the p-value was 0.00. These results underscore route safety's critical role in influencing how often people visit parks.

#### 4.4. Fear of Crime Model

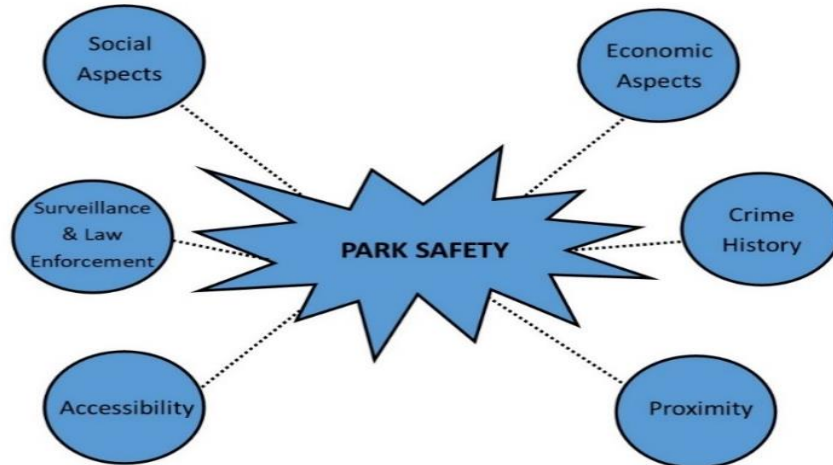


Figure 27: Fear of Crime Model

This survey included visitor's spatial perception of the environment, where a fear of crime model is adapted, depicting the various aspects directly affecting people's perception of crime and safety. This conceptual model addresses park features and each factor contributes to the fear of crime model. Accessibility and proximity to services and amenities, levels of surveillance and law enforcement presence, history of crime, economic conditions, and social aspects are all integral components that can shape the fear of crime in a given community. While each factor may individually contribute to feelings of safety or fear, they create a comprehensive framework for understanding fear of crime models. Here is how they each fit into the model:

##### 4.4.1. Accessibility and Proximity

Easy access to services, amenities, and law enforcement can lead to a greater sense of security. If people feel that help or escape is easily accessible, their fear of crime may be lower. 2.

#### *4.4.2. Surveillance and Law Enforcement Presence*

Surveillance, whether through CCTV, neighborhood watch programs, or police patrols, can deter criminal activity. The visible presence of security measures can significantly reduce the fear of crime. A visible and responsive law enforcement presence is often reassuring to the public. When residents know that police are close by or that the response time is swift, it can alleviate their anxiety about criminal activity.

#### *4.4.3. Crime History*

The past occurrence of crimes in an area can affect the current fear of crime. A history of high crime rates can lead to increased fear among residents, whereas a reputation for being a low-crime area can instill a sense of safety.

#### *4.4.4. Economic Aspects*

Socio-economic factors, such as poverty and unemployment, are closely correlated with crime rates and, by extension, fear of crime. People living in economically deprived areas may feel more vulnerable to crime.

#### *4.4.5. Social Aspects*

A strong sense of community and social cohesion can reduce fear of crime. When residents know their neighbors and participate in community activities, they often feel safer and more secure.

#### *4.4.6. T-test of park usability*

T-test was conducted to analyze the relationship between the frequency of people going to park in formal and informal settlements (Sakip et al., 2016). The results show that there is a direct relationship between “type of settlement” and “how often do you go to the park?” as the result is significant ( $<0.005$ ). It also shows that people in informal settlements visit parks more often than the ones living in formal settlements.

Table 7: T-test of “How often do you go to the park?” And “type of settlement”

	Type of Settlement	N	Mean	Std. Deviation	F	Sig.
<b>How often do you go to the park?</b>	Formal	151	2.741	1.344	44.822	0.000 <sup>b</sup>
	Informal	209	1.847	1.106		

The table above explains the relationship between socio-economic characteristics of households and the frequency of visits to local parks. Through a particular dissection of data, one can discern a compelling pattern: the presence of elderly members within a household exhibits a positive correlation with the frequency of visits to nearby parks. This trend may be attributed to the elderly's need for tranquil and accessible spaces for leisure and mobility.

Moreover, the financial fabric of a household also interweaves with park visitations. A notable observation is that households with higher incomes tend to reside closer to parks, particularly in formal settlements. This proximity does not occur by happenstance it is a measured choice, affording residents the luxury of convenience when engaging with these verdant spaces. Accessibility, thus, emerges as a linchpin in the complex mechanism of park utilization.

Furthermore, education casts a long shadow over park interaction. An educated populace is known to emphasize the benefits of physical exercise and the sanctity of mental well-being, manifesting in a pronounced predilection for visiting parks or embracing open green spaces.

The cadence of park visitation ties into a broader narrative concerning crime perception within a community. "How often do you go to the park?" a seemingly innocuous query may, in fact, be an indirect barometer of an individual's sense of safety. The response to this question sheds light on the perceived security of park environs; a habitual park-goer likely equates the frequency of their visits with a reassuring perception of safety.

#### 4.5. Climate Change:

The table presented below offers a detailed breakdown of responses concerning various aspects of Climate Change. This information has been meticulously organized into five distinct categories: Knowledge and Awareness of Climate Change, Mitigation through Parks and Green Spaces, Impact of Climate Change on Specific Regions, Urban Flooding Preparedness, and Information Sources & Government Communication.

Table 8: Climate Change and its different aspects (frequency and percentage evaluated)

Categories	Indicators	Classification	Formal (N=151)		Informal (N=209)	
			Freq.	%	Freq.	%
<b>Knowledge and Awareness of Climate Change</b>	Do you know about climate change?	Yes	142	94.0	186	89.0
		No	9	6.0	23	11.0
Mitigation through Parks and Green Spaces	To what extent do you agree that by developing parks we can help to mitigate climate change?	Strongly Disagree	1	0.7	-	-
		Disagree	1	0.7	3	1.4
		Neutral	7	4.6	15	7.2
		Agree	118	78.1	139	66.5
		Strongly Agree	24	15.9	52	24.9
	To what extent you agree that presence of more trees make the environment clean?	Strongly Disagree	-	-	-	-
		Disagree	-	-	1	.5
		Neutral	11	7.3	8	3.8
		Agree	67	44.4	84	40.2
		Strongly Agree	73	48.3	116	55.5
	To what level do you agree that these parks are a source of mitigation of heat waves?	Strongly Disagree	1	.7	4	1.9
		Disagree	2	1.3	6	2.9
		Neutral	14	9.3	15	7.2
		Agree	94	62.3	134	64.1
		Strongly Agree	40	26.5	50	23.9
To what extent do you agree that presence of parks in your area has helped to mitigate challenges of climate change?	Strongly Disagree	-	-	1	.5	
	Disagree	3	2.0	8	3.8	



		Neutral	8	5.3	32	15.3
		Agree	109	72.2	122	58.4
		Strongly Agree	31	20.5	46	22.0
	Do you recommend more green spaces in your residential area?	Yes	125	82.8	206	98.6
		No	26	17.2	3	1.4
Impact of Climate Change on Specific Regions	To what extent do you agree people of your residential area are more prone to be directly affected by climate change?	Strongly Disagree	18	11.9	2	1.0
		Disagree	38	25.2	9	4.3
		Neutral	24	15.9	32	15.3
		Agree	40	26.5	80	38.3
		Strongly Agree	31	20.5	86	41.1
	How much do you agree that climate change has affected Pakistan severely?	Strongly Disagree	-	-	1	.5
		Disagree	2	1.3	9	4.3
		Neutral	7	4.6	12	5.7
		Agree	104	68.9	103	49.3
		Strongly Agree	38	25.2	84	40.2
Urban Flooding Preparedness	How would you rate the preparedness of people in your residential area to counter urban flooding?	Not Prepared at all	8	5.3	67	32.1
		Slightly Prepared	26	17.2	30	14.4
		Moderate	73	48.3	59	28.2
		Prepared	43	28.5	52	24.9
		Highly Prepared	1	.7	1	.5
	How prepared are you to face urban floods in your residential area?	Not Prepared at all	9	6.0	65	31.1
		Slightly Prepared	22	14.6	25	12.0
		Moderate	80	53.0	61	29.2
		Prepared	39	25.8	56	26.8
		Highly Prepared	1	.7	2	1.0
Information Sources and Government Communication:	Which media platform do you prefer to use in order to get information regarding the precautionary measures?	Television	71	47.0	113	54.1
		Smartphones/Social Media	78	51.7	92	44.0
		Print Media	2	1.3	4	1.9

	To what extent do you think the government authorities timely inform the people to be prepared?	Strongly Disagree	21	13.9	55	26.3
		Disagree	72	47.7	72	34.4
		Neutral	31	20.5	22	10.5
		Agree	26	17.2	51	24.4
		Strongly Agree	1	.7	9	4.3

#### 4.5.1. Knowledge and awareness of climate change

The data indicates varying levels of climate change knowledge and awareness among residents, contingent upon their geographic location. In formal residential areas, a high percentage, representing 94% of inhabitants report a comprehensive understanding of climate change issues. In contrast, the awareness level in informal settlements declines to 84%. A possible explanation for this disparity is the difference in literacy rates between these areas. Often, inhabitants of informal areas may lack formal education or have completed only primary schooling. Consequently, this educational gap likely contributes to the lower awareness rates observed in informal settlements as compared to their formal counterparts.

#### 4.5.2. Mitigation through Parks and Green Spaces

The sentiments regarding climate change mitigation, specifically through the enhancement and proliferation of parks and green spaces, are also explored within the table. This segment encompasses five queries, including attitudes toward park development as a mitigation strategy, the perceived impact of tree-planting on environmental cleanliness, the efficacy of parks in alleviating heat wave effects, and recommendations for increasing green spaces within residential vicinities. An overwhelming majority of settlement types endorse the development of parks as a strategy to combat climate change, with 78.1% of formal settlements and 66.5% of informal settlements agreeing. The belief in the positive environmental impact of tree planting is unanimous among survey participants; not a single respondent denounces that additional trees contribute to a healthier environment. In fact, 44.4% of the formal settlement residents 'agree' while an even higher proportion, 48.3%, 'strongly agree' with this notion. This sentiment is similarly popular in informal settlements,

where 40.2% 'agree' and a significant 55.5% 'strongly agree' with the premise. Furthermore, a significant number of participants recognize the importance of parks in mitigating the harshness of heat waves. Specifically, 62.3% of formal and 64.1% of informal settlement respondents affirm this role of parks. Lastly, a large fraction of the population expresses the desire for more green spaces in residential areas; 82.8% from formal settlements and a remarkable 98.6% from informal settlements express this preference for increased green spaces within their residential areas.

#### *4.5.3. Impact of Climate Change on Specific Regions*

This category delves into the perceptions of how climate change impacts specific geographical areas. Notably, respondents from both formal and informal settlements recognize that climate change does not affect every region uniformly; certain areas are more susceptible to its repercussions. Survey data illuminates public perception regarding the differential impact of climate change across various regions. In formal settlements, around one-quarter of the population does not see climate change as a direct threat to their region. At the same time, a roughly similar proportion, 26.5%, agrees, and 20.5% strongly concurs that their locality is susceptible to the consequences of climate change. Strikingly, in informal settlements, the level of concern is markedly higher, with 38.3% agreeing and 41.1% strongly agreeing with the notion of direct impact. The results underline the gravity of climate change in Pakistan, reflecting a significant acknowledgment among dwellers that the country is facing severe climatic effects; this is affirmed by 68.9% of participants in formal settlements and an aggregate of 89.5% (both agree and strongly agree categories added) in informal settlements. This insight is critical for planning localized adaptation strategies that address the unique challenges of different regions.

#### *4.5.4. Urban Flooding Preparedness*

The data examining urban flooding preparedness sheds light on the residents' readiness to face flooding events, which are expected to increase in frequency and intensity due to climate change. This survey segment evaluates the perceived readiness among communities for urban flooding, a phenomenon exacerbated by climate change. Almost half of the residents in formal settlements rate their area's urban flooding preparedness as

moderate, at 48.3%. Conversely, the informal settlements report relatively lower confidence levels, with 28.2% considering their preparation as moderate, accompanied by a combined 24.9% who deem themselves more adequately prepared.

Personal preparedness for such events draws a similar picture; 53% of formal settlement respondents feel moderately ready, whereas in less structured communities, 29.2% feel moderately ready, with an additional 26.8% feeling prepared for urban flooding challenges. This points to a pressing need for improved infrastructure and emergency response mechanisms, especially in less formalized urban sectors, which are often more prone to the adverse outcomes of flooding due to inadequate drainage systems.

#### 4.5.5. Information Sources and Government Communication

The availability and quality of information and the effectiveness of government communication on climate change are crucial variables that influence public awareness and action. This segment of the survey highlights that the primary sources of climate change information for residents are divergent based on residential type. The survey assesses the dissemination channels of climate change information, revealing distinct preferences among the residents based on settlement type. Television and social media have emerged as dominant information sources for formal and informal settlements, with print media trailing behind. Notably, 47.7% of the population in formal areas reports a lack of timely

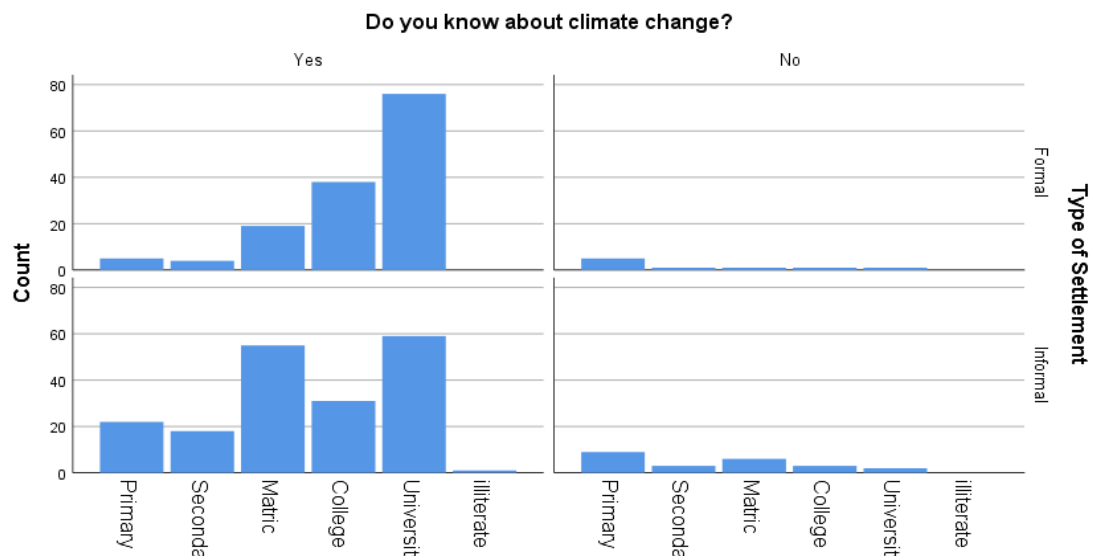


Figure 28: Comparison between Type of Settlement and “Do you know about CC?”

government communication regarding disaster preparedness, and 20.5% hold neutral views. Concern in informal settlements is expressed differently, with 34.4% disagreeing that government authorities provide timely hazard warnings, whereas 24.4% agree with the promptness of such communications. This disparity in responses showcases the necessity for authorities to enhance their communication strategies to ensure adequate and timely dissemination of vital information to all sections of society.

Climate change is a pressing global issue that affects individuals, communities, and nations. It is crucial for individuals, especially those living in vulnerable regions and populations, to be aware of climate change and its potential impacts. Figure 28 above indicates that residents of both formal and informal settlements are aware of climate change. This awareness is particularly noteworthy in formal settlements, where only 1% claim to be unaware of climate change. The level of education also appears to play a role in climate change awareness. Based on the data collected, it can be inferred that education level significantly impacts climate change awareness. Furthermore, most people in both formal and informal settlements were found to be literate. This finding suggests that education plays a critical role in shaping individuals' knowledge and understanding of climate change. However, it is important to note that the literacy rate may be low in some cases, especially in underdeveloped regions. This is where local-based knowledge, commonly known as indigenous knowledge, becomes important. Indigenous knowledge has been used by local communities in developing countries to adapt to the impacts of climate change.

In regions with low literacy rates, indigenous knowledge plays a pivotal role and is highly valued for implementing adaptation strategies to climate change. The impact of climate change extends to essential aspects of daily life such as food, water, and energy, particularly affecting developing countries with limited resources and knowledge to cope with its challenges. Consequently, local knowledge becomes paramount as communities adapt to uncertain calamities, including climate change-induced ones (Mustonen et al., 2022). An additional study examines indigenous knowledge in Tanzania, which assists farmers in adapting to climate change impacts (Theodory, 2021).

In conclusion, indigenous knowledge and education are instrumental in understanding climate change adaptation, and integrating indigenous knowledge into existing frameworks can serve as a critical component for effective adaptation. However, farmers question the long-term efficacy of indigenous knowledge due to the unpredictable nature of weather patterns resulting from rapid climate change. Previous research has shown that combining indigenous knowledge with scientific expertise enhances farmers' resilience and adaptive capacity in the face of a changing climate. Given the increasing unpredictability of climate change impacts, accurate weather forecasts are increasingly important. Recognizing the value of indigenous knowledge in adapting to new weather patterns is essential for navigating the uncertainties posed by climate change (Makate, 2019).

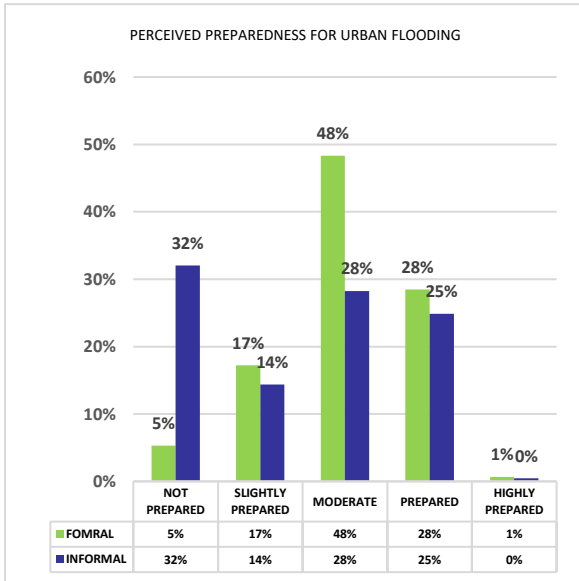


Figure 29: perceived preparedness

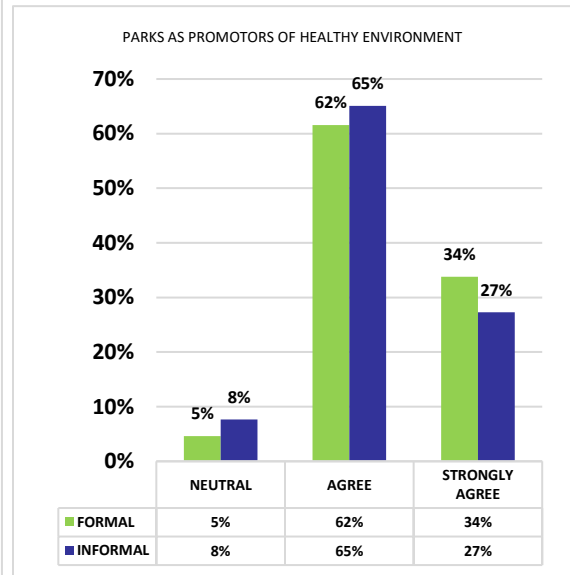


Figure 30: Parks as healthy environment

To analyze the residents' perception of preparedness for urban floods in both formal and informal settlements, a comparison was made (figure 29). The results indicate that most people feel moderately prepared for urban flooding. However, there is a notable disparity between the two types of settlements. In informal settlements, 32% of residents reported being unprepared, while only 5% of residents in formal settlements felt the same way. In formal settlements, 17% of residents and 14% of residents in informal settlements

are slightly prepared. About 28% of residents in formal settlements and 25% in informal settlements reported being prepared. Lastly, 1% of residents in formal settlements are highly prepared, whereas no residents in informal settlements reported being highly prepared.

Parks promote a healthy environment, as shown in figure 30. Among the respondents, 5% from formal settlements and 8% from informal settlements felt neutral about this statement. A majority, 62% from formal settlements and 65% from informal settlements agreed that parks promote a healthy environment. Where 34% of respondents from formal settlements and 27% from informal settlements strongly agreed with this statement.

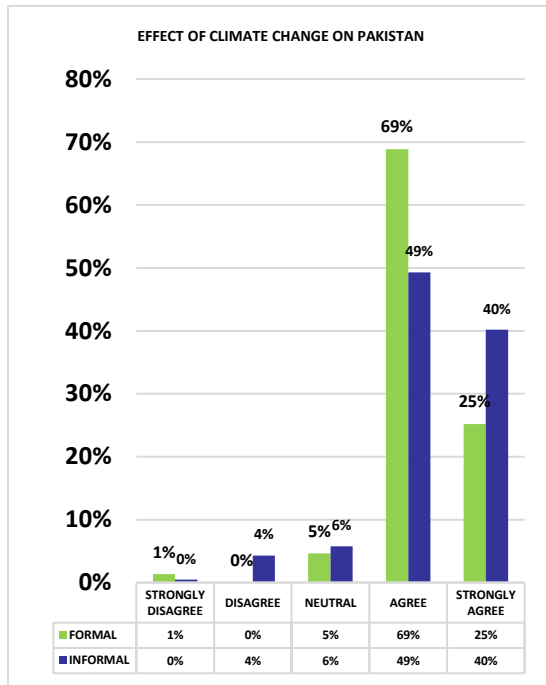


Figure 31: CC impacts on Pakistan

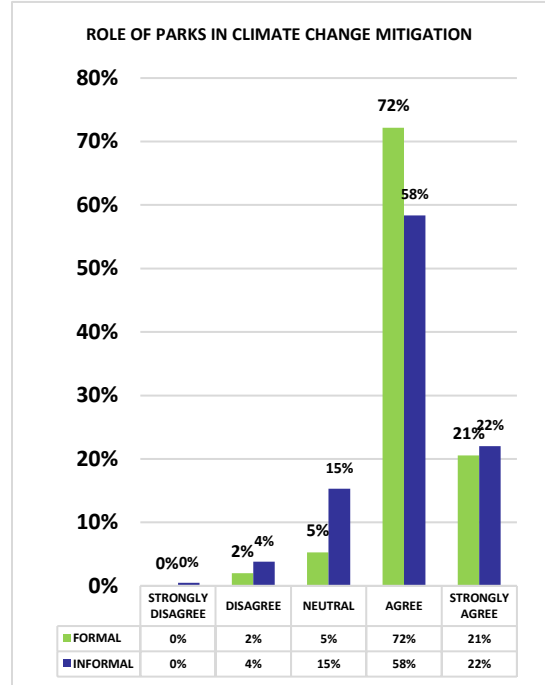


Figure 32 Role of parks in CCM

The responses were categorized accordingly to analyze people's perceptions regarding the effects of climate change on Pakistan. 1% of respondents strongly disagreed in formal settlements, while none from informal settlements did. None of the respondents from formal settlements disagreed, whereas 4% from informal settlements did. Additionally, 5% of respondents from formal settlements were neutral, compared to 6% in informal settlements. A significant majority, 69% of respondents from formal settlements,

agreed with the statement, compared to 49% from informal settlements. Finally, 25% of respondents from formal settlements strongly agreed, while 40% from informal settlements strongly agreed. To determine the role of parks in climate change mitigation, respondents' perceptions were analyzed. None of the respondents in either formal or informal settlements strongly disagreed. In formal settlements, 2% disagreed, while 4% in informal settlements did.

Additionally, 5% of respondents from formal settlements were neutral, compared to 15% from informal settlements. A majority of 72% in formal settlements agreed that parks play a role in climate change mitigation, compared to 58% in informal settlements. Finally, 21% of respondents from formal settlements strongly agreed, while 22% from informal settlements strongly agreed.

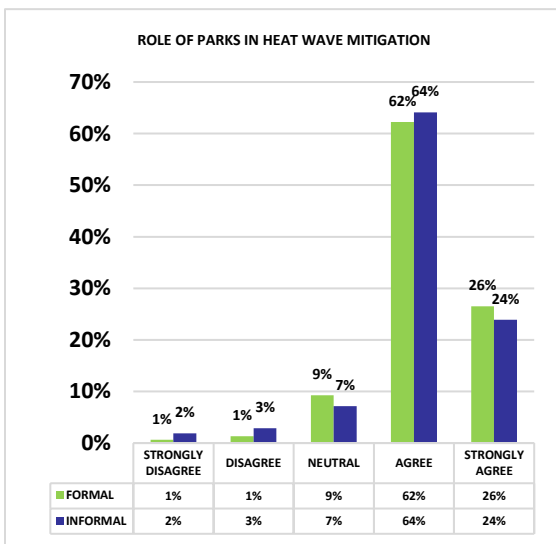


Figure 33: Heat Wave Mitigation

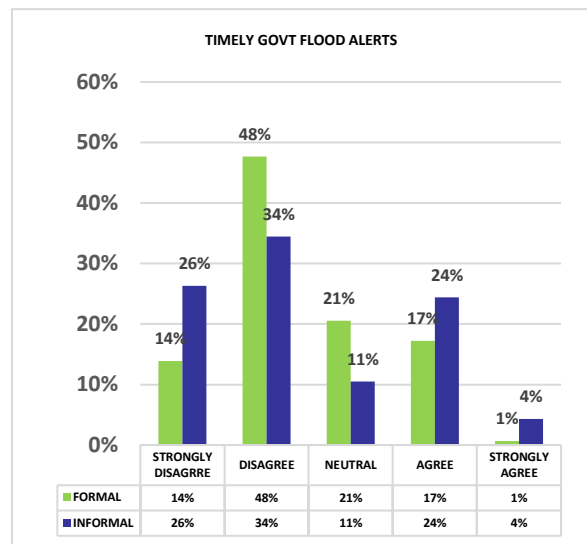


Figure 34: Timely government alerts

Figure 33 shows the perception of people in both formal and informal settlements regarding the role of parks in heat wave mitigation. 1% of respondents strongly disagreed with formal settlements, compared to 2% in informal settlements. 1% of respondents from formal settlements disagreed, compared to 3% from informal settlements. Neutral responses were given by 9% of respondents from formal settlements and 7% from informal settlements. A majority, 62% from formal and 64% from informal settlements, agreed that



parks help mitigate heat waves. Finally, 26% of respondents from formal settlements strongly agreed, while 24% from informal settlements strongly agreed.

Figure 34 shows the importance of government alerts for disasters, as these alerts indicate that government authorities are prepared to take necessary actions in advance. However, people generally disagree that the government sends timely alerts about disasters. Specifically, 14% of respondents from formal and 26% from informal settlements strongly disagreed that alerts are sent on time. In formal settlements, 48% of respondents and 34% from informal settlements disagreed with this notion. In contrast, 21% of respondents from formal settlements and 11% from informal settlements were neutral. Meanwhile, 17% of respondents from formal and 24% from informal settlements agreed that timely alerts are provided. 1% of respondents from formal settlements and 4% from informal settlements strongly agreed that the government sends alerts on time.

## CHAPTER 5: DISCUSSION

A comprehensive questionnaire was developed, and data was collected through household surveys conducted at four locations in Rawalpindi. The collected data, totaling 360 samples due to challenges in certain residential areas, comprising 151 from formal settlements and 209 from informal settlements, was analyzed using SPSS software. Regression analysis was employed to determine any significant relationships between the selected variables and their impact on park usage. Descriptive statistics, chi-square tests, and T-tests were also conducted to identify significant differences between variables. The study identifies socio-economic factors influencing park usage, such as household income, occupation, education, household demographics, and gender.

Research revealed an analysis of park characteristics, showing disparities in amenities between informal and formal settlements. Furthermore, the study sheds light on park safety factors and fear of crime, indicating lower fear levels in parks near police stations. To reduce fear of crime, a holistic approach that considers all the different components is used to formulate policies and interventions to improve the quality of life of different communities (Hodgkinson et al., 2017), (Winkel, 1986), (Clarke & Cornish, 1985).

Results show that people prefer their individual activities, and many do not like to engage in social interactions, which gives room for improvement in community bonding and community engagement activities. This can be done by promoting inclusivity in parks and providing a welcoming environment that facilitates positive social interactions. Park managers should be hired to maintain a well-managed park, and they can help cater to the diverse needs and preferences of residents from different backgrounds. Policymakers and park managers can create inclusive, accessible park spaces that enhance the well-being and quality of life of residents in urban communities. Recreational activities, cultural events, and community gatherings should be promoted. Community involvement and participatory decision-making processes are essential for ensuring that parks reflect residents' unique ideas, identities, and aspirations. Engaging community members in upcoming planning events and enhancement of the park cultivates a sense of ownership and better park

maintenance. Additionally, leveraging technology and data-driven approaches can enhance park management efficiency and effectiveness, enabling real-time monitoring of park usage patterns, safety concerns, and community feedback.

Then, fear of crime was analyzed. Fear of crime within communities is a multifaceted phenomenon shaped by numerous interconnected factors, each playing a distinct role in influencing individuals' perceptions of safety and security. Accessibility and proximity to parks play a pivotal role in mitigating the fear of crime by providing residents with a sense of security and reassurance. When individuals feel that help or escape is readily available, their fear of crime diminishes. Furthermore, the historical occurrence of crimes within an area can significantly influence residents' perceptions of safety. Communities with a known history of high crime rates may experience heightened levels of fear among residents, whereas those with reputations for being low-crime areas may instill a sense of safety and security. Economic factors, such as poverty and unemployment, are closely intertwined with crime rates and, by extension, fear of crime. Individuals living in economically disadvantaged areas feel more vulnerable to crime, exacerbating their fear and anxiety about safety within their community.

Moreover, the social fabric of a community plays a crucial role in shaping residents' perceptions of safety. Strong social ties and a sense of community cohesion can mitigate the fear of crime by adopting trust, communication, and mutual support among residents. When individuals know their neighbors and participate in community activities, they often feel safer and more secure, creating a positive feedback loop that strengthens community resilience against crime. The relationship between socio-economic characteristics and park visitation patterns further explains the difficult interplay between fear of crime and community dynamics.

Household composition, income levels, and educational level emerge as significant determinants of park utilization, with elderly members and higher-income households exhibiting higher frequencies of park visits. The observed correlation between education and park interaction underscores the importance of promoting physical activity and mental well-being among educated populations, highlighting the role of parks as vital community

assets that contribute to overall well-being. Additionally, the frequency of park visitation serves as an indirect indicator of individuals' perceptions of safety within park environments. The survey results show that by incorporating spatial perceptions into fear of crime models, researchers can gain valuable insights into the factors shaping residents' sense of safety and security. This inclusive approach ensures a more representative understanding of community dynamics, particularly in contexts where literacy is unevenly distributed across demographic groups.

The analysis provides valuable insights into the complex dynamics of climate change awareness, attitudes, and preparedness among residents of formal and informal settlements. The underlying socio-economic, environmental, and governance factors that shape responses to climate change, policymakers and practitioners can develop holistic and context-specific strategies that promote sustainable development, enhance community resilience, and build a more equitable and resilient future for all have been addressed. Climate change represents one of our most pressing global challenges, with far-reaching implications for individuals, communities, and ecosystems worldwide. The data presented in the table offers a detailed understanding of various dimensions of climate change awareness, attitudes toward mitigation strategies, perceptions of climate change impacts, urban flooding preparedness, and government communication among residents of formal and informal settlements. This analysis provides valuable insights into the complex interplay of socio-economic, environmental, and governance factors that shape responses to climate change at the local level.

Significant disparities were observed in climate change awareness between residents of formal and informal settlements. While a high percentage of inhabitants in formal residential areas demonstrate a comprehensive understanding of climate change issues, awareness levels in informal settlements appear to be lower. This discrepancy can be attributed, in part, to differences in educational attainment and literacy rates between these areas. Higher levels of education are often associated with greater awareness and understanding of environmental issues, underscoring the critical role of education in shaping individuals' perceptions of climate change. Moreover, residents from both settlement types overwhelmingly support the development of parks and green spaces as a

key strategy for mitigating the effects of climate change. The positive attitudes toward tree-planting initiatives and the perceived role of parks in alleviating heat waves highlight the potential of green infrastructure to enhance community resilience and improve overall well-being. The data also presents the importance of considering local contexts and community preferences in the design and implementation of green infrastructure projects, ensuring that interventions are tailored to meet residents' specific needs and priorities.

Furthermore, the analysis reveals residents' perceptions of the differential impact of climate change across specific regions, with a greater level of concern observed in informal settlements. This insight shows the importance of localized adaptation strategies that address the unique vulnerabilities and challenges different communities face. Policymakers and practicing individuals can build targeted interventions for community resilience and promote sustainability. The data also sheds light on urban flooding preparedness, highlighting varying levels of confidence among residents in formal and informal settlements. While residents in formal settlements tend to perceive higher levels of preparedness, there is a clear need for improved infrastructure and emergency response mechanisms, particularly in informal urban sectors that are more susceptible to the adverse effects of flooding. Enhancing urban resilience to climate-related hazards requires investments in robust infrastructure, early warning systems, and community-based adaptation initiatives that empower local residents to participate actively in disaster risk reduction efforts.

The crucial role of information delivery systems and government communication in raising awareness and fostering community resilience to climate change was also investigated. While television and social media emerge as dominant information sources, there is a need for more effective government communication strategies, particularly in ensuring the timely broadcasting of hazard warnings and disaster preparedness information to all segments of society. By strengthening communication channels and engaging with local communities in a participatory and inclusive manner, governments can enhance public awareness and build trust, facilitating collective action and build a more sustainable and resilient future for all.

## **CHAPTER 6: CONCLUSIONS AND FUTURE RECOMMENDATION**

This study examines various aspects of park usage among households, drawing comparisons between formal and informal settlements in Rawalpindi. These aspects encompass socio-economic factors, park characteristics, park safety factors, fear of crime, and the impact of climate change. The study also tries to investigate the effects of climate change on residential areas, highlighting the contrasting preparedness between formal and informal settlements. Formal settlements exhibit better green space coverage and receive prompt assistance from management during disasters, while informal settlements often rely on indigenous knowledge and self-protection measures with limited external support.

This study provides valuable insights into the complex dynamics shaping residents' behaviors and park visitation patterns. A notable contrast emerges between the demographic compositions of these two types of settlements, with formal areas exhibiting a higher proportion of young and elderly individuals, while informal settlements seem to have a greater concentration of children. This demographic variation suggests potential differences in family structures, lifestyles, and community dynamics between the two settlement types. Moreover, the average household income in formal settlements significantly exceeds that of informal settlements, indicating substantial income disparities.

Addressing these socio-economic disparities is crucial for promoting equitable access to green spaces and enhancing the quality of life for residents across diverse urban landscapes. By implementing targeted interventions that address the specific needs and challenges of different settlement types, policymakers can foster inclusive and vibrant communities where all residents have equal opportunities to enjoy the benefits of public parks and recreational amenities.

**Park Characteristics:** The presence of recreational facilities emerges as a significant determinant of park usage, with a notable correlation observed between the availability of such amenities and the type of settlement, whether formal or informal. This highlights the importance of strategic investment in recreational infrastructure to enhance park

accessibility and attractiveness across diverse communities. The findings emphasize the importance of promoting friendly behavior among park visitors while addressing instances of impolite or disrespectful conduct to uphold the integrity of public spaces. In conclusion, understanding the multifaceted factors influencing park usage and visitor behavior is essential for fostering inclusive, safe, and vibrant park environments. By leveraging these insights, park managers and planners can design interventions that cater to the diverse needs and preferences of park-goers, ultimately enhancing the quality of life and well-being of communities across urban landscapes.

**Park Safety Factors:** The comprehensive analysis of lifestyle, park usage, and perceptions among residents of formal and informal settlements yields valuable insights into the complex dynamics shaping their interactions with neighborhood parks. These insights highlight the multifaceted nature of factors influencing park accessibility, safety perceptions, and social dynamics within urban communities. Furthermore, the observed differences in security and surveillance levels between parks frequented by residents of formal and informal settlements emphasize the importance of proactive safety measures in vulnerable areas. By enhancing security protocols and implementing surveillance systems, park managers can create safer environments that promote community well-being and encourage park utilization among residents from all settlement types. Despite variations in safety perceptions, the overall incidence of park-related crime appears to be low for both formal and informal settlements, with minor occurrences of street crimes reported in the study. However, addressing residents' concerns about safety during certain hours and along specific routes to parks is crucial for fostering a sense of security and promoting park utilization among all community members.

Harnessing the power of digital tools and smart technologies, park managers can optimize resource allocation, improve service delivery, and tailor park amenities to meet park users' evolving needs and preferences. Hence, creating inclusive, vibrant, and accessible park spaces requires a holistic and collaborative approach that encompasses physical infrastructure, safety measures, programming, community engagement, and technological innovation by embracing these principles and working together with local stakeholders, policymakers, and park users. We can build parks that serve as thriving

community hubs, enriching the quality of life and fostering a sense of belonging for all residents, regardless of their settlement type or background.

Fear of Crime: Accessibility and proximity to essential services and amenities, the presence of surveillance and law enforcement measures, crime history, economic conditions, and social cohesion all contribute to the complex tapestry of the fear of crime model. Together, these elements form a comprehensive framework that underpins residents' sense of safety within their community, reflecting the broader socio-economic and cultural context in which they live.

In conclusion, addressing the underlying determinants of fear of crime and promoting inclusive, vibrant, and accessible park environments are essential for fostering safer, healthier, and more resilient communities by adopting holistic approaches to urban planning and public safety, policymakers can create environments that prioritize the well-being and security of all residents, thereby enhancing the overall quality of life and sense of belonging within communities.

Climate change: The comprehensive analysis presented herein provides invaluable insights into the intricate dynamics of climate change awareness, attitudes toward mitigation strategies, perceptions of climate change impacts, urban flooding preparedness, and government communication among residents of formal and informal settlements. These findings underscore the multifaceted nature of the climate change challenge and highlight the need for holistic and context-specific approaches to adaptation and mitigation efforts. Moreover, the data emphasizes the critical role of education in shaping individuals' perceptions of climate change and underscores the importance of targeted awareness campaigns and capacity-building initiatives, particularly in underprivileged communities with lower levels of literacy and access to information. Furthermore, the overwhelming support for developing parks and green spaces as climate change mitigation measures underscores the potential of nature-based solutions to enhance resilience, mitigate environmental risks, and improve overall quality of life. By integrating green infrastructure into urban planning and design, policymakers can create more livable, sustainable, and resilient cities that benefit both people and the planet.



The comprehensive analysis presented herein provides valuable insights into the intricate dynamics of climate change awareness, attitudes toward mitigation strategies, and perceptions of climate change impacts, urban flooding preparedness, and government communication among residents of formal and informal settlements. These findings underscore the multifaceted nature of the climate change challenge and highlight the need for holistic and context-specific approaches to adaptation and mitigation efforts. Notably, disparities in climate change awareness between formal and informal settlement residents present the role of education in shaping perceptions, with higher levels of education associated with greater awareness. Overwhelming support for park development as a mitigation strategy highlights the potential of green infrastructure to enhance resilience and well-being. At the same time, the differential impact of climate change across regions necessitates localized adaptation strategies tailored to community needs. Moreover, urban flooding preparedness reveals disparities in confidence levels, emphasizing the need for improved infrastructure, particularly in informal settlements. Effective government communication is crucial for raising awareness and fostering community resilience. Still, there is a pressing need for more inclusive and accessible communication strategies that reach all segments of society, including marginalized and vulnerable populations. By integrating these insights into policy and planning initiatives, policymakers can develop robust strategies that promote sustainability, enhance resilience, and improve the quality of life for all residents, contributing to a more equitable and resilient future.

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# APPENDIX A: SURVEY QUESTIONNAIRE

## ASSESSMENT OF PARKS/PARK USAGE IN FORMAL AND INFORMAL

### SETTLEMENTS OF RAWALPINDI, PAKISTAN

CONSENT FORM: You are invited to participate in a research survey about the assessment of green areas in your neighbourhood. Your participation will take approximately 7 minutes. This is regarding MS research work on the importance and need of green infrastructure. This survey is designed to ascertain the impacts of green places on the residents. Taking part in this survey is voluntary and the data collected will be kept confidential and research purposes only. If you have any questions or want a copy of a summary of the results of this survey, you can contact on the email address given below.

RIDA TARIQ ridatarq.urp20nit@student.nust.edu.pk; THESIS SUPERVISOR: DR. IRFAN AHMAD RANA (HOD – U&RP) iarana@nit.nust.edu.pk

<b>1. <u>Basic Information</u></b>			FORMAL	INFORMAL	
MALE <input type="checkbox"/>	FEMALE <input type="checkbox"/>	OTHERS <input type="checkbox"/>	1.5. HOUSEHOLD INCOME: _____		
1.1. EDUCATION:		1.6. OCCUPATION:			
PRIMARY <input type="checkbox"/>	SECONDARY <input type="checkbox"/>	MATRIC <input type="checkbox"/>	STUDENT <input type="checkbox"/>	HOUSEWIFE <input type="checkbox"/>	
COLLEGE <input type="checkbox"/>	UNIVERSITY <input type="checkbox"/>		OTHERS: _____	RETIRED <input type="checkbox"/>	
NUMBER OF CHILDREN IN THE HOUSE:					
NUMBER OF YOUNG PEOPLE IN THE HOUSE:					
NUMBER OF ELDERLY IN THE HOUSE:					
<b>2. <u>GREEN ROOFS:</u></b>					
2.1. How is the drainage system of your neighbourhood?	VERY	BAD	NEUTRAL	GOOD	VERY GOOD
	BAD				
2.2. After rainfalls, are the sideways and footpaths clear or there is some drainage issue in your neighbourhood?	CLEAR <input type="checkbox"/>			ISSUE <input type="checkbox"/>	



2.3. Do you purchase water (household usage) from outside?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.3.1. If yes, then how? _____ (litres/tanks)					
2.4. Do you use rain barrels to store water?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.5. Do you have built rainwater tanks in your house?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.6. Do you have underground water tanks?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.7. Would you prefer to have green roofs?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.8. Do you have a garden on your roof?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
2.9. Do you have kitchen garden in your house?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
<b>3. <u>PARKS</u></b>					
3.1. Are there any parks near your house?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.2. DISTANCE (from your house to the park):	_____ KILOMETERS / _____ MINUTES				
3.3. Do you walk to the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.4. Do you have to use crossroads with high traffic to reach this park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.5. Does the park near your house hold any historic value?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.6. Is there any entrance fee for this park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.6.1. If so, then how much? _____ Rs					
3.7. Is first aid readily available in the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.8. How often do you go to the park?	DAILY	WEEKLY	BI-WEEKLY	MONTHLY	NEVER

3.9. Is the park accessible to people of all age groups and genders?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.10. Is the park easily accessible to people with disabilities?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.11. Would you agree that the walkways (from your house to the park) are safe?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.12. Are there any recreational facilities for the park users?	YES <input type="checkbox"/>	NO <input type="checkbox"/>	e.g. _____		
3.13. Does the park have food stalls?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.14. How would you rate the healthiness of food available in the park?	Not Healthy at all	Slightly Healthy	Moderate	Healthy Food	Very Healthy Food
3.15. Are there any trained professionals to provide initial aid at once?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.16. Do you think that adequate lighting is available for visitors at night?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.17. Do you visit the park to socialize?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.18. To what extent do you agree more people should visit parks to encourage socialization?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
3.19. To what extent do you agree that the parks in your community have positive effects on your mental health?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
3.20. How do you rate behaviour of park visitors?	Very FRIENDLY	FRIENDLY	NEUTRAL	IMPOLITE	DISRESPECTFUL
3.21. Are there any benches in the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.22. Are there sufficient number of benches available for park visitors?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			

3.23. Are there any play areas for children in the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.24. Are there any grounds for outdoor sports for girls in the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.25. Are there any grounds for outdoor sports for boys in the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
3.26. To what extent do you agree your activities in the park are affected by traffic noise?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
3.27. Will more parks in this community help to accommodate more wildlife?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
3.28. How much do you agree these parks play any role in creating a healthy environment for the society?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
<b>4. <u>Crime &amp; Security</u></b>					
4.1. Is there any security guard(s) in this park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
4.2. Are there any checkpoints installed to enter the park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
4.3. Are Security Guards present at every gate and check point?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
4.4. Are there any surveillance cameras installed in the park for protection and security purpose?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			
4.5. How far is the nearest Police station from this park?	_____ KM	_____ MINS			
4.6. How would you rate the safety at all hours to go to park?	Not Safe at all Hours	Not Safe at some hours	Moderate	Safe at most hours of the day	Safe at all hours
4.7. Do you know the people who frequently meet you in park?	YES <input type="checkbox"/>	NO <input type="checkbox"/>			

4.8. How do you rate the safety of your route from home to park is safe?	Not Safe at all	Sometimes Safe	Moderate	Safe at most hours of the day	Very Safe
4.9. Is there any history of crime in this park? 4.9.1. If so then, what kind of crime? _____	YES <input type="checkbox"/> NO <input type="checkbox"/>				
4.10. Is there any history of crimes related to gender in this park?	YES <input type="checkbox"/> NO <input type="checkbox"/>				
<b>5. <u>Climate change</u></b>					
5.1. Do you know about climate change?	YES <input type="checkbox"/> NO <input type="checkbox"/>				
5.2. To what extent do you agree that by developing parks we can help to mitigate climate change?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.3. To what extent you agree that presence of more trees make the environment clean?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.4. How much do you agree that climate change has affected Pakistan severely?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.5. To what extent do you agree that presence of parks in your area has helped to mitigate challenges of climate change?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.6. To what extent do you agree people of your residential area are more prone to be directly affected by climate change?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.7. To what level do you agree that these parks are a source of mitigation of heat waves?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE
5.8. Do you recommend more green spaces in your residential area?	YES <input type="checkbox"/> NO <input type="checkbox"/>				

5.9. How would you rate the preparedness of people in your residential area to counter urban flooding?	Not Prepared at all (NO KNOWLEDGE)	Slightly Prepared (Minimum KNOWLEDGE)	Moderate	Prepared	Highly Prepared
5.10. How prepared are you to face urban floods in your residential area?	Not Prepared at all (NO KNOWLEDGE)	Slightly Prepared (Minimum KNOWLEDGE)	Moderate	Prepared	Highly Prepared
5.10.1. If so, then how? What are the precautionary measures you usually take? _____					
5.11. Which media platform do you prefer to use in order to get information regarding the precautionary measures?	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <input type="checkbox"/> Television         </div> <div style="text-align: center;"> <input type="checkbox"/> Smartphones/Social Media         </div> <div style="text-align: center;"> <input type="checkbox"/> Print Media         </div> </div>				
5.12. To what extent do you think the government authorities timely inform the people to be prepared?	STRONGLY DISAGREE	DISAGREE	NEUTRAL	AGREE	STRONGLY AGREE

**6. CHALLENGES:**

**7. SUGGESTIONS:**