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Original Article

Mapping the Perceptions of Bangaloreans towards Flooding and the Influence of Architectural Design on Public Utilities

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Abstract *- Despite its global reputation as a planned city and the 'Silicon Valley' of India (Kar, 2016: 49), the city of Bangalore has in recent years experienced increasing disruptions caused by rainfall-induced flooding and inadequate urban planning to address this challenge. This research explores the perceptions of Bangaloreans regarding flooding and the role of architectural design in shaping public utilities and infrastructure. Through the use of an online questionnaire, which collected responses through a snowballing process, this paper examines the interpretation of residents for the causes of flooding and their assessment of the performance of public utilities, specifically focusing on waste management, road infrastructure, and water supply. The findings showcase that flooding is mainly a man-made problem, caused by poor drainage systems, inefficient governance and inadequate planning. Further, the findings exhibit widespread disappointment with the public utilities, which are worsened with rapid urbanisation; industrial growth, and the absence of coordination amongst governing bodies. The results portray the need to prioritise sustainable growth, equality and equity, and effective inter-agency collaboration for Bangalore's sustainable urban growth. Therefore, despite the responses being limited with respect to geographic scope and sample diversity, the key research findings align with the broader literature, hence portraying the need for citizen-centred and resilient urban planning.*

Keywords - *Urban flooding, Architectural design, Public utilities, Urban planning, Citizen perception.*

1. Introduction

In 2024, the chairman of DLF Emeritus, one of the most powerful men in the space of real estate and architecture in his speech stated, 'India's urban planning should shift from a myopic to surplus mindset' (Haidar, 2024), highlighting his concern over issues such as adverse air quality, traffic congestion and the gap between population growth and urban planning in India. It requires a holistic integration of multiple aspects, such as architecture, engineering, social and political aspects, which together make it an extremely important expertise with strong political undertakings in which the general public is involved. Urban planning has become a crucial element of sustainable development, encompassing essential elements like street design, drainage systems, transport services, etc, while taking into consideration variables such as migration, population dynamics, residential capacity and workplace distribution. It is made of seven major components – namely land use regulation, strategic planning, master planning, urban revitalisation, economic development, environmental planning, and infrastructural development (Sailus, 2024). These components play an essential role in ensuring efficient resource allocation, sustainable urban expansion, improved transit systems, economic opportunities and improved living conditions, making cities resilient to population growth, migration patterns and environmental challenges.

Rapid urbanisation and unstructured urban planning has sparked problems like recurrent flooding, strain on public utilities, and traffic congestion for residents across most Indian cities. With cities like Bangalore, Mumbai, Kolkata, Delhi, etc, experiencing rapid urbanisation and challenges such as global warming and flooding, it has become even more essential to explore how architectural design and urban planning can mitigate such issues. Bangalore, once known as the 'Garden City' of India and now known as the 'Silicon Valley' of India, has fallen prey to rapid urbanisation that has led to major challenges in urban planning that specifically concern public utilities and flooding. As urban expert Ravindra K noted, "The city needs new life and new, inclusive public spaces, not sky decks for the rich." (Nair, 2024). This paper aims to focus on understanding how Bangaloreans perceive urban flooding and investigate the

role played by architectural design in shaping the urban landscape and public utilities.

The existing scholarship on urban design and planning highlights significant gaps in understanding public perceptions of the challenges posed by rapid urbanisation in Bangalore, particularly among middle and lower-income groups, whose concerns are often overlooked by authorities. This study seeks to map the public perception and lived experiences related to urban flood risks, the efficiency of current urban infrastructure and the connection between resilience and urban design decisions. Using a semi-structured questionnaire, administered among residents from different socioeconomic backgrounds, this paper seeks to examine the perceptions of Bangaloreans towards the quality of public services and infrastructure in their respective localities. With increasing incidences of flooding in the city and reports of disruptions to public life, this paper also seeks to understanding the effect of urban flooding on the daily lives of residents and explore their awareness citizens about the flood-resistant design elements, and their likelihood to report urban issues such as flooding, drainage and waste management to the authorities. This research aims to bring citizens into the discussions of urban planning and provide insights that can inform more sustainable and inclusive architectural and planning strategies aligned with the needs of all stakeholders in Bangalore's urban landscape.

2. Literature Review

2.1. Urban Planning: Concept, Components, Processes and Impact

"Urban planning refers to a field of practice that helps city leaders to transform a sustainable development vision into reality using space as a key resource for development and engaging a wide variety of stakeholders in the process"(Raven et al., 2018: 142). Urban design and urban planning are overlapping fields since planners often construct designs for streets, parks, buildings and other urban spaces. There are several components of urban planning, namely land use urban planning, strategic urban planning, master planning, economic development, urban revitalization, environmental planning and infrastructure planning (Sailus, 2024). The central focus of strategic urban planning is on putting high-level objectives in place and recognising preferred growth areas for a city or metropolitan region, which aid in establishing overarching goals and frameworks for urban growth, hence guiding the long-term vision of the city. These objectives include facilitating transportation, expanding communal areas, enhancing living standards, and drawing in locals and tourists. Land use planning involves legislation and policy, which incorporates tools such as government laws, regulations, codes, and policies. These tools help deal with the varied aspects of different city operations, such as the kind, location, and quantity of land. Given the concern of limited resource availability, this ensures optimal resource organisation and prevents urban sprawl. Urban revitalization aims to improve places in a condition of decline by integrating methods like repairing roads, constructing parks and public areas, building infrastructure and minimising pollution. Urban revitalization preserves and enhances urban areas through the strengthening of urban areas and improved accessibility. Economic development aims to promote financial prosperity by attracting MNCs and other companies to relocate their offices in identified target growth areas, which helps stimulate the economy and generate employment opportunities. Master planning takes into account factors like road locations, transit, residential and commercial land use and necessary zoning and infrastructure for projects focused on building on undeveloped land or for greenfield development. Environmental planning emphasizes sustainable urban development by addressing concerns like pollution, wetlands, flood zone vulnerability, endangered species and coastline erosion, hence mitigating the adverse effects of urbanisation on the environment. Infrastructure planning deals with community infrastructure, transport systems, and other essential structures and systems that support a city and its citizens. This helps in ensuring the maintenance of core facilities and services to act as the supporting backbone of the city (ibid.).

2.2. Urban Planning in India

The origin of urban planning in India is specifically ancient and medieval India. Ancient Urbanism included the Harappan Civilisation and the Vedic and Post-Vedic periods (Das, 1981). The Harappan Civilization consisted of the development of gridiron street layouts, drainage systems, public baths and granaries, followed by the emphasis on religious, administrative and trading functions in the Vedic and Post-Vedic periods. By the Medieval period, urban design started incorporating forts, palaces and mosques, with a strong Indo-Islamic influence. There was a clear separation between royal zones and public zones, with the entrance of formal gardens and symmetrical layouts. This was followed by the British Colonial Period, wherein the British influenced the creation of civil lines, railway towns and cantonments. In this period, planning was focused on administration and trade, and the indigenous settlements faced neglect. In the post-colonial period, India continued to follow the introverted British "neighbourhood" model, which focused specifically on segregated housing. This development was led by the foundation of organisations like the Delhi Development Authority, Madras Metropolitan Development Authority, Bombay Metropolitan Region Development Authority, etc. These authorities focused on project land use with a long-term function, elimination of slums, city zoning through land use and developing efficient transport and highway systems (ibid.).

Bangalore has encountered four distinct phases of economic growth post-independence which can be directly correlated with the population apexes in 1951 and 1981

(Puttalingaiah, et al., 2020: 70). From a historical perspective, Bangalore's development has exhibited dual characteristics - transitioning from a specialised centre for trade, commerce, and industry to a globally recognised hub for Information technology (IT) and Biotechnology (BT). The city's physical growth has been characterised by two key trends: "leapfrogging" and "infilling". Leapfrogging is a pattern of urban development wherein new settlements or infrastructure rise at a significant distance from existing urban centres, going past intermediate areas that remain underdeveloped. Infilling patterns describe the process of urban development that occurs within existing built-up areas, making use of underutilised or previously undeveloped land areas. It is typically a follow-up of leapfrogging phases, as infrastructure eventually connects the outer developments, hence allowing the intermediate spaces to be easily constructed and developed. The leapfrogging patterns began with the establishment of major institutions such as the Indian Institute of Science, followed by large scale industries including Hindustan Aeronautics Limited (HAL), and Hindustan Machine Tools Ltd, etc. (Sastry, 2008: 4). Subsequent phases witnessed the development of academic institutions like the University of Agricultural Sciences and Bangalore University, culminating in the rise of software industrial complexes near Whitefield, Electronic City, and the Kempegowda International Airport (ibid.).

Despite the economic growth significantly boosting municipal revenues, it has also brought with it a range of environmental and infrastructural challenges. Transportation emissions alone account for 2858 tonnes of pollutants per day which increases the city's environmental burden (Sastry, 2008: 13). Simultaneously, the city faces a critical water supply crisis, with water as a limited resource in core areas like Bangalore Mahanagara Palike (BMP) experiencing restricted access (HT News Desk, 2025). This issue is further exacerbated by a high percentage of unaccounted-for water, along with insufficient sewage and wastewater management. These factors collectively hinder the delivery of safe and sufficient water to the growing population.

Solid waste management also remains a pressing problem. Of the nearly 5000 tonnes of solid waste generated daily, only 30% is managed directly by the BBMP, while the remaining 70% is handled by private contractors; this leads to widespread non-compliance with municipal solid waste management standards (Ramasamy, 2020; Rules, 2000). Such infrastructural challenges are further intensified by increasing demographic pressures. Between 2010 and 2020, Bangalore's population density surged by 47%, primarily driven by the employment opportunities offered in IT and non-IT sectors (ibid.). Initially, in 2001, the population was 2.985 million, which then rose to 7.99 million by 2006 (excluding 110 villages and reached 12.33 million in 2020 (Chanmal, TG, 2016: 559). This population surge highlights the need for robust infrastructure and services for the effective and efficient management of the city. As of January 2025, the Chief Minister presented an outlay of 3.71 lakh crore rupees for the Karnataka State Budget in order to prioritise infrastructural development (Hirehalli, 2025). Additionally, the Karnataka Cabinet gave approval for a 694 crore rupee project for BBMP road development (Express News Service, 2024). It is evident that the city's development has largely been shaped by a series of incremental measures driven by institutional, industrial and technological advancements rather than a cohesive long-term planning strategy. As the city continues to expand, there is an urgent need for a comprehensive urban planning approach that addresses immediate issues and takes into account the future demographic and economic growth.

2.3. Urban Flooding in Bangalore

Bangalore has a semi-arid climate and is placed in the tropics(Tewari et al., 2022). Historically, known to experience moderate rainfall, the region has experienced a significant rise, with annual rainfall increasing from 500 mm to 1350 mm between 1901 and 2000. In 2022, the city received an exceptional amount of 1958.6 mm of rainfall, which was the highest level of rainfall recorded. This indicates an increasing trend in precipitation, possibly intensified due to climate change(ibid.).

The first record of urban flooding in Bangalore dates back to September 28, 1912, in the central business district close to the fort region(Prasad and Narayanan, 2016). Both public and private properties in areas like Siddakatte, Ranasinghpet, and Gundopet were collectively inundated. Upon investigation, it was revealed that the drainage infrastructure in these areas was inadequate, and the municipality was forced to help residents build their homes and provide higher areas for newer settlements and reconstruction. This eventually led to a transformation of Siddakatte lake to accommodate residential requirements(ibid.).

Urban flooding in Bangalore is primarily caused by high-intensity, short-duration (HI-SD) precipitation (Mukhopadhyay and Das, 2023: 1). This occurs when surface runoff surpasses the absorption capacity of the ground and the conveyance ability of storm drainage systems (ibid.). A major contributor to the worsening phenomenon is the exponential urbanisation and change in land use, which has led to an alteration in the city's hydrological patterns. The rapid and massive increase in population and the reclamation of tanks for various developmental activities have led to the loss of wetland connectivity, causing an increase in water runoff, hence overwhelming stormwater systems and leading to more frequent and intense flooding that severely disrupts regular public life (Ramachandra, 2009). Ranging from blocked roads, drains and forced closure of offices and public spaces, the disruptions have also affected access for essential services

2.4. Bangaloreans' Perception of Urban Infrastructure and Services

Annual flooding in low-lying areas of Bangalore has become a recurring problem every monsoon due to the lack of an integrated plan by the Bruhat Bangalore Mahanagara Palike (BBMP). Low-lying areas and floodplains such as Bellandur, Marathahalli, and Whitefield have suffered from the concern of urban flooding for a long time and have faced the problem of wetland blockages. In the August-September 2022 floods, the above area and the IT offices located within were reported to have faced significant hindrances and were forced to temporarily close operations as these areas were submerged underwater. The government was forced to compensate approximately 225 crore rupees in damages to corporate offices, residential owners and public infrastructure (Express News Service, 2022). As a consequence of such floods, many low-income groups were also rendered homeless, eventually leading to an increase in the tally of urban poor citizens. The city's slum settlements do not have a restricted area and have been expanding.

Particular parts of the city, such as Koramangala–Challaghatta valley, Hebbal valley and Vrishabhavathi valley, have been facing crucial encroachment and siltation issues due to inefficient drainage systems. In areas like Bommanahalli, runoff has exceeded drainage capacities by 11 times based on the records published in 2018 (Avinash et al., 2019). Flooding in Bangalore is driven by several interlinked factors, such as the lack of adequate drainage infrastructure, unmonitored urbanisation, an increase in impervious surfaces and climate change. While the city requires approximately 1500 km of stormwater drains, it currently has only 842 kms of stormwater drains (D'Souza, 2023). Compounding this issue is the widespread encroachment of drainage channels and the absence of proper rainwater outlets, both of which have significantly reduced the effectiveness of drainage systems.

The impervious surface in the city has increased by 1028% in the time frame of 1973-2017 which has led to a soaring surface runoff (Ramesh, 2022; Tewari, et al., 2022: 55). Consequently the runoff coefficient has increased from 45% in 1995 to 91% in 2018 (Avinash, et al., 2019). Furthermore, the number of lakes in the city has plummeted from 1452 lakes to just 194 by 2016, out of which only 10% are well maintained (Ramesh, 2022; Tewari et al., 2022). This has led to a drastic reduction in the city's water storage capacity for lakes, from 35 TMC in 1800 to just 5 TMC in 2016 (ibid.). The loss of wetlands has also led to a dramatic decline in groundwater levels, dropping from 35-40 feet to 250-300 feet over the past two decades (Ramachandra, 2009).

Climate change has further intensified the frequency and magnitude of extreme rainfall events. Atmospheric warming has led to higher moisture retention and more intense downpours. Between 2010 and 2021, rainfall levels were 16% higher than the long-period average (Ramesh, 2022; Tewari et al., 2022).

These environmental and infrastructural challenges have led to widespread urban flooding, which disrupts traffic and public transportation. Waterlogging has also caused damage to homes and public utilities. The collapse of electric poles, for example, has caused BESCOM substantial losses. Bangalore also encounters flash floods at over 280 locations annually, with water stagnation lasting anywhere from four hours to four days (Prasad and Narayanan, 2016: 1). Such flash floods have been worsened due to impervious surfaces and silting of drainage areas. The combination of increased impervious surfaces and the silting of drains has only worsened the severity of flash floods.. In response, the government allocated 45 million rupees for flood management and deployed 12 specialised quads (each with 20 personnel) for rain and flood relief operations. Additionally, under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), which was launched in December 2005, a multi-year budget was set aside for improving urban infrastructure in the city (Gupta and Nair, 2011: 1640). Citizens have also recommended further interventions, such as establishing flood alarm systems, developing a real-time monitoring system for rapid identification of vulnerable underpasses, and appointing a dedicated Bangalore Development Minister to oversee urban resilience initiatives.

2.5. Public Engagement and Participation in Urban Planning

Participatory urbanisation refers to a model of urban development that actively involves citizens' decision-making processes, enabling them to express their needs and aspirations (Lee, 2025). Such an approach aims to align urban growth with the community's present circumstances and fosters a sense of collective ownership. In recent years, participatory urban planning has gained prominence, with planners increasingly recognizing the value of engaging citizens. In cities like Bengaluru, citizen feedback has played a vital role in shaping urban policies.

In 2020, the Karnataka government launched the "Brand Bengaluru" digital platform, aimed at creating a comprehensive master plan for the city's development (Economic Times, 2023). This initiative sought to empower citizens by allowing them to contribute ideas and suggestions, thereby ensuring that the city's growth reflects the collective vision of its residents. With support from C. N. Ashwath Narayan, the state's Urban Development Minister, the government adopted a multi-modal approach, involving local communities and industry professionals in workshops and interactive sessions to gather more targeted feedback. The suggestions collected through this platform were intended to guide the city's future as a smart, sustainable

one; most importantly, this strategy aimed to reduce citizen apathy by promoting transparency and trust in governance.

Another notable initiative was the *Janaagraha* campaign, which ran from 2001 to 2003. It sought to bridge the gap between citizens and urban planning by enhancing transparency and accountability. Residents were encouraged to contribute to 'ward visions' and prioritise local infrastructure and service improvements. Public meetings were held across 65 wards, which included elected representatives, municipal officials and community members. Over 100,000 engaged in the planning activities in the two years, reflecting a growing interest in urban governance (Maiti and De Faria, 2017: 30). However, the initiative had limited outreach to marginalized communities. Although this was partially addressed later, the absence of institutional backing meant that many recommendations lacked long-term impact, as citizens lost motivation to participate.

The 'Next' Bengaluru initiative, implemented in 2013 as a collaboration between the MOD Institute and the "Next" NGO drew inspiration from Germany's "Next Hamburg" project started in 2009 (Maiti and De Faria, 2017: 27). It provided both digital and in-person platforms for citizens to share ideas and suggestions for the city's progress and future vision. Field trips and grassroots engagement made the initiative accessible to a broader demographic. This blend of online and offline engagement was well received, with many citizens showing interest in bottom-up planning. However, despite its promise, the initiative's impact was short-lived due to the absence of a clear implementation mechanism. The ideas generated failed to translate into tangible infrastructure or policy changes.

Despite multiple such successful or partially successful attempts at public engagement, the city continues to face barriers to effective public participation. There is a significant lack of trust in authorities, which has increased a sense of public apathy. Citizens, especially in the lower-middle or middle class category, have often been reported to argue that their concerns are not considered to be significant, with minimal output and action.

Over the years, the city has experienced the absence of a steady government; with frequent changes in political regimes, the average residents have developed a sense of apathy towards most public engagements. The fragmentation of the governmental structure with an overlap of roles played by several different agencies, such as *Bruhat Bengaluru Mahanagara Palike*, Bangalore Development Authority and Bangalore Water Supply and Sewerage Board, creates a dilemma which leads to project delays and further disappointment (Tewari et al., 2022). Citizens are often left concerned about clear points of contact due to bureaucratic inefficiencies and delayed paperwork, which hampers the effective governance of Bengaluru. Lastly, the limited awareness about channels for public participation creates more barriers to this communication and public participation. Citizens often find government platforms to be user-friendly, with complex mechanisms, and are more likely to avoid direct interactions.

Furthermore, even though technology has been facing a soaring rise, the rural and slum areas of Bengaluru are still alienated from the digital scope and face a significant gap in digital literacy. Therefore, they do not have the opportunity to access the city's online governance processes. The municipal bodies fail to publicise opportunities for citizens in an engaging manner, which leads to a lack of awareness and a lack of participation. To effectively make use of participatory urbanisation, the authorities of Bangalore should implement a structured plan to involve average citizens, especially among the rural population.

3. Materials and Methods

3.1. Research Questions

1. How do people living in different parts of Bangalore rate the quality of public services and infrastructure in their localities?
2. Has urban flooding affected the daily lives of Bangalore residents, and what do they believe are the main causes?
3. Are people aware of flood-resistant design elements, and how likely are they to report urban issues like flooding, drainage, and waste management to authorities?

3.2. Research Method

In order to assess the perceptions of local Bangaloreans towards urban flooding and the influence of architectural design on public utilities, the study adopts a quantitative research design. For these purposes, a semi-structured survey was distributed among Bangalorean residents living across different locations and belonging to varied socio-economic backgrounds.

3.3. Research Design

The survey consisted of both open-ended and Likert scale-based questions, which aimed to explore the following factors: people's perception, response and willingness to contribute.

3.4. Sampling Strategy

In order to outline average Bangaloreans' perception towards the urban design and management of the city, the sample for this study included respondents from diverse socio-economic and regional locations. A non-probability sampling strategy, involving a snowball sampling framework, was used. This approach helped in the recruitment of participants from personal and social networks since the research survey was distributed to the students, staff, and parents of my school in Whitefield and was further

distributed by them to other localities. This helped in reaching a broader demographic, enhancing the spatial and socio-economic representativeness of the data.

The survey was distributed digitally, which ensured that the responses captured respondents from diverse socio-economic and spatial backgrounds. Participation in the survey was voluntary, and all responses were collected following ethical standards. Hence, the respondents' consent was obtained before participation. The collected data was analysed through descriptive statistics; through the means of bar charts, pie charts, percentages, etc, and through inferential statistical tests, which included T-tests and ANOVA tests.

4. Results and Discussion

4.1. Research Findings

For the survey, a total of 59 respondents are not from Karnataka, whereas only 11 are originally based in Karnataka. The graph below shows the distribution of residents in the area. Although the original plan was to get an equal area distribution, due to lack of access the sample found over-representation from people from the Eastern part of the city, which was also useful as it provided a greater focus to areas like Whitefield, Sarjapur Road, Electronic City, Dommasandra, etc which have been reported as experiencing the worst cases of flooding and disruption of regular life.

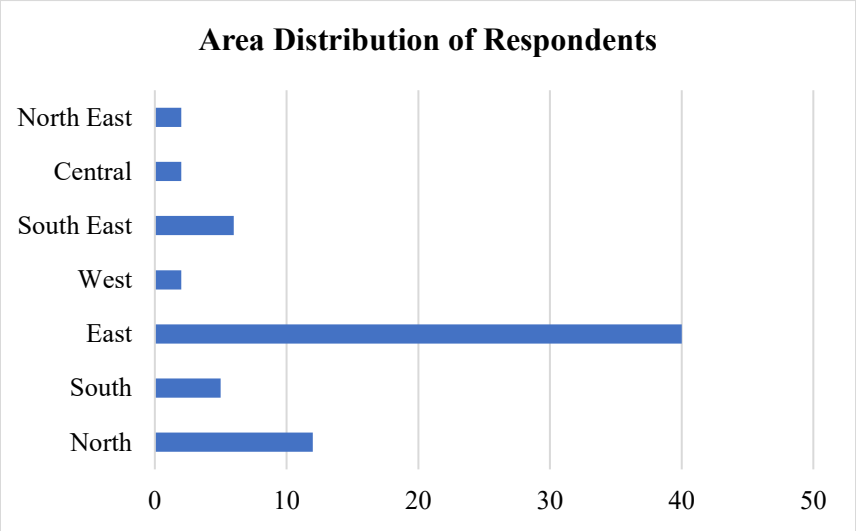


Fig. 1 Bar graph on area distribution of the Surveyed Population

The following graph shows a fairly even distribution of residents across various durations. The mix of newer and long-term residents helps in giving a balanced perspective on flooding and design-based issues for the city since it allows for a long-term evaluation of the prolonged concerns.

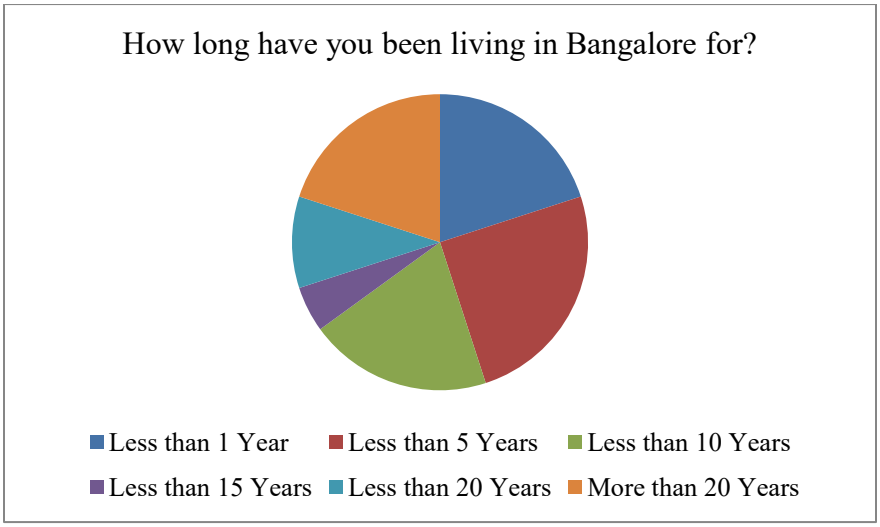


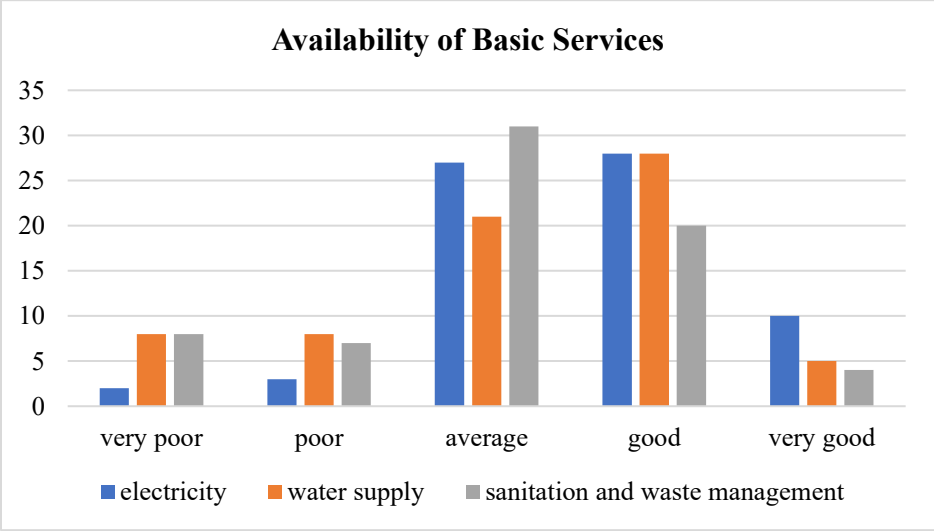
Fig. 2 Pie chart of duration of residence in Bangalore for respondents

Beyond the area distribution, Table 1 below shows the demographic profile of the respondents.

Table 1. Nature of respondents

Category		Number of Respondents	Percentage of Sample (%)
Occupational Status	Salaried Private Sector	20	28.6 %
	Salaried Public Sector	8	11.4 %
	Self Employed	11	15.7 %
	Not Employed	1	1.4 %
	Housewife	5	7.1 %
	Retired	10	14.3 %
	Student	15	21.4 %
Family Income	Below Rs. 3 lakhs per annum	14	20 %
	Rs. 3-5 lakhs per annum	2	2.9 %
	Rs. 5-10 lakhs per annum	8	11.4 %
	Rs. 10-15 lakhs per annum	9	12.9 %
	Rs. 15-20 lakhs per annum	8	11.4 %
	Rs. 20 lakhs per annum	29	41.4 %
Gender	Female	30	42.9 %
	Male	39	55.7 %
	Prefer not to say	1	1.4 %

As table 1 illustrates, the majority of the respondents are from a relatively well-educated background, with 31.4% being graduates and 32.9% having completed post-graduation and above, and are likely to be aware of urban planning, architectural design and infrastructure-related issues. In terms of occupational groups, salaried private sector employees are highest in the sample (28.6%), followed by students (21.4%), followed by self-employed respondents (15.7%), followed by retired respondents (14.3%), followed by salaried public sector employees (11.4%), followed by housewives (7.1%), and lastly unemployed respondents (1.4%).



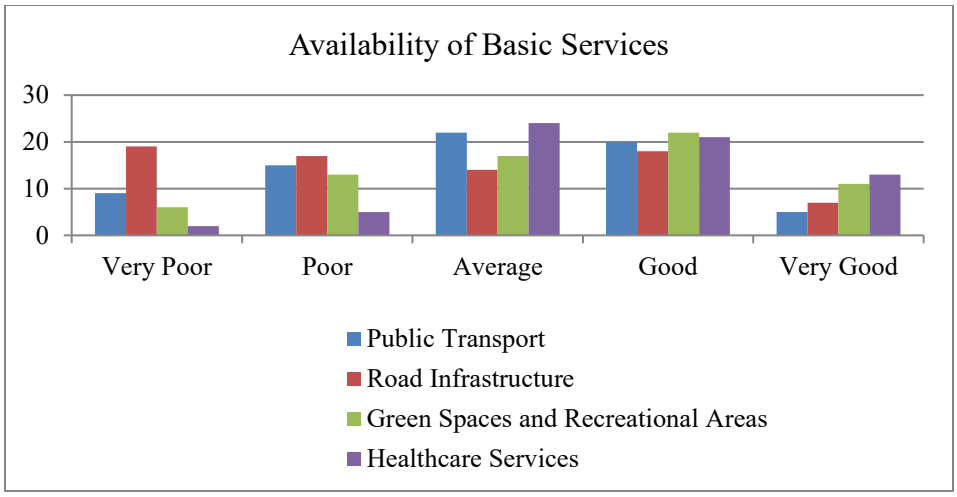
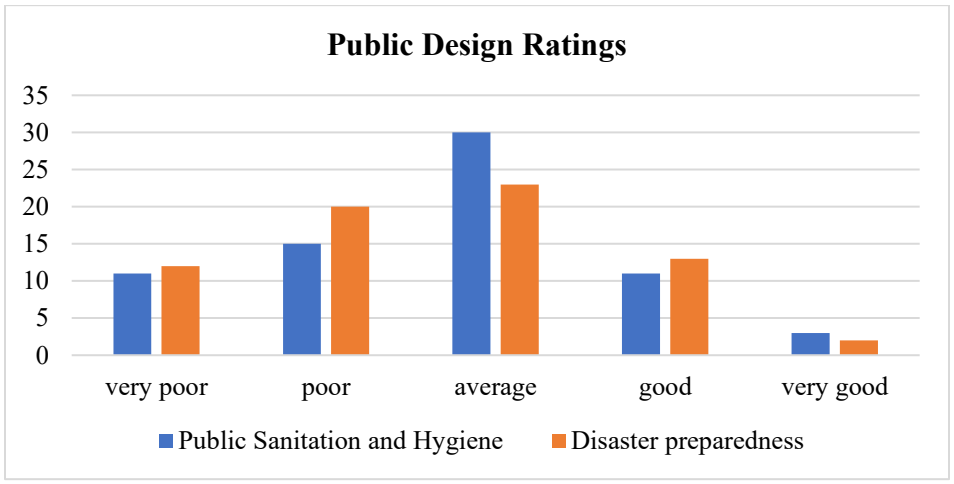
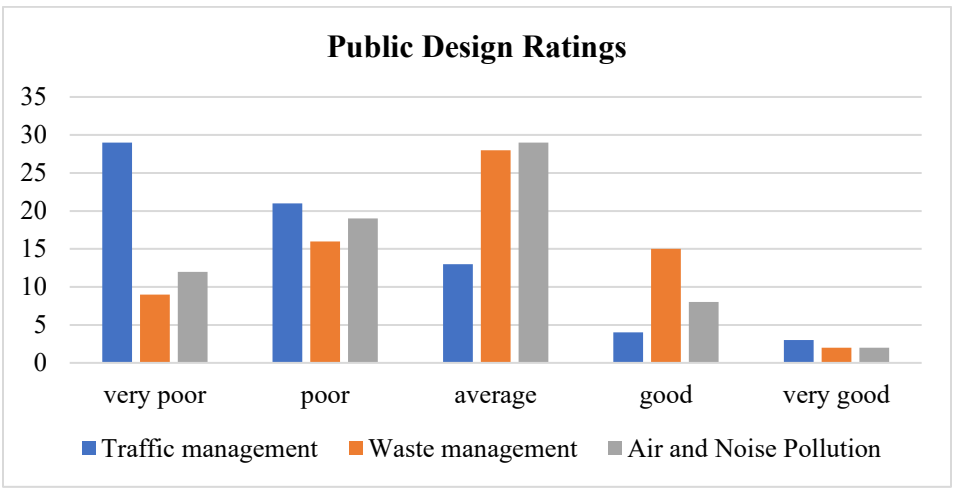


Fig. 3 Rating for availability of basic services

Figure 3 represents the quality and availability of basic and essential services in Bangalore. Out of all the services, healthcare services and electricity supply are the two best-performing services with the highest ratings in the 'Good' and 'Very Good' categories. Green Spaces and water supply are noticeably rated Average, which conveys that there is some room for improvement. Road infrastructure has the lowest ratings, with a significant percentage of respondents rating it as 'Very Poor' or 'Poor', which conveys the infrastructural neglect in Bangalore.





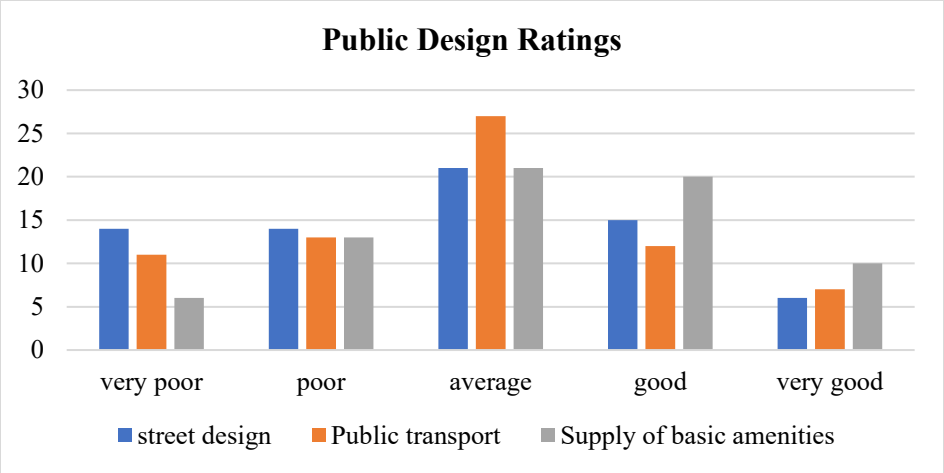


Fig. 4 Public Design Ratings of Various Public Utilities and Urban Design

Figure 4 shows the respondents' perceptions about public design in Bangalore. Traffic management has received the worst feedback, with a great majority of respondents rating it as 'Very poor' or 'poor'. Air and noise pollution, waste management and public transport also portray fairly poor ratings, with a high percentage of respondents voting for 'Average' or 'poor'. Supply of basic amenities has the highest number of respondents voting for it in the 'Good' or 'Very Good' category, even though the 'Average' category continues to be the most significant.

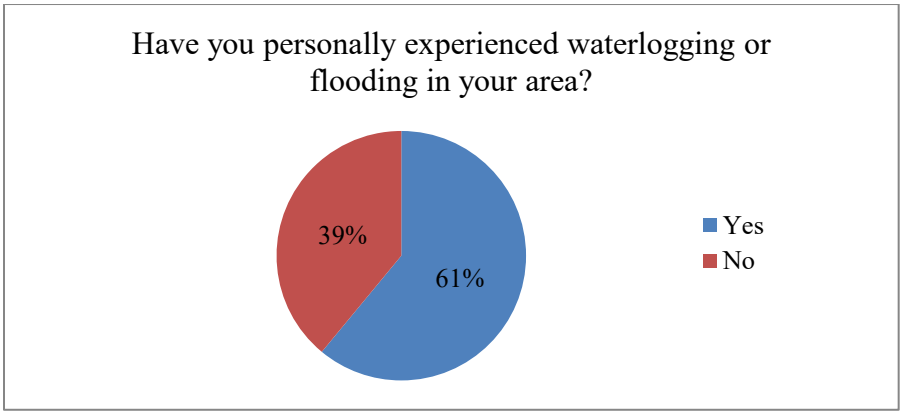


Fig. 5 Pie chart representation of the number of people who have experienced waterlogging in their area

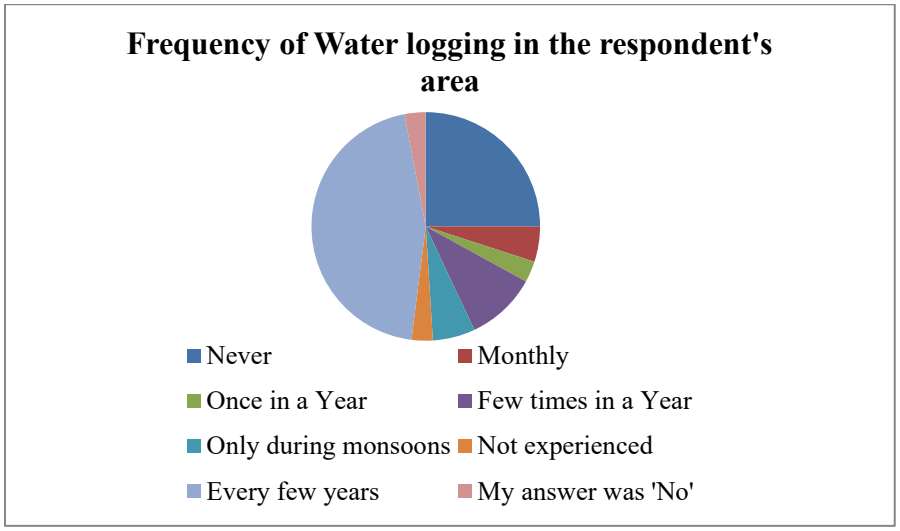


Fig. 6 Pie chart representation of the frequency of waterlogging in the respondents' areas

Figure 5 conveys that the majority of respondents have encountered waterlogging in their area, with 61.4% respondents voting yes. This conveys that waterlogging is a persistent and serious issue in Bangalore's architectural design. Graph 6 shows the frequency of waterlogging in the respondents' areas. The majority of respondents (47.1%) reported that they encounter waterlogging only in monsoons, whereas about 27.1% of respondents never encountered flooding. This shows that waterlogging is a seasonal problem in Bangalore. A small percentage of 2.9% of respondents encounter waterlogging monthly, which conveys that some areas have extremely poor and inefficient urban planning.

4.2. Data Analysis

To further interpret the above findings, a one-way ANOVA test was conducted to understand the relationship between personal income level and the rating of street design in Bangalore. The independent variable here is the personal income level, while the dependent variable is the public rating for street design.

Table 2. Relation between Income level and citizens' perception of public street design of Bangalore

	n	Mean	Std. Deviation
Below Rs. 3 lakhs per annum	14	2.64	1.22
Rs. 15-20 lakhs per annum	8	2.75	0.89
above Rs. 20 lakhs per annum	29	2.34	1.26
Rs. 10-15 lakhs per annum	9	3.11	1.05
Rs. 3-5 lakhs per annum	2	4	1.41
Rs. 5-10 lakhs per annum	8	4	0.76
Total	70	2.79	1.24

Table 3. ANOVA results for personal income level and street design rating

	Sum of Squares	df	Mean Square	F	p
Personal Income Level	21.63	5	4.33	3.29	.01
Residual	84.15	64	1.31		
Total	105.79	69			

The overall mean rating across all the income levels for street design is 2.79. The lowest rating is for the above Rs. 20 Lakhs income group (a rating of 2.34 out of 5), and the highest rating is by the Rs. 3-5 lakhs and Rs. 5-10 lakhs income group (a rating of 4.00 out of 5).

The p-value is 0.01 and the F value is 3.29, hence proving that personal income levels have a statistically significant relationship with the perception and rating of street design. It is interesting to see that the lower income groups have given a higher rating than the higher income groups, which conveys the greater expectations of the higher income groups. On the other hand, the lower-income groups have lower expectations or a stronger presence in the recently redeveloped localities of Bangalore, hence they may have witnessed an improvement in street design.

4.2.1. Relationship between Personal Income and Willingness to Pay for a Resistant Locality

A one-way ANOVA test was used to examine the relationship between personal income level and willingness to pay for a flood-resistant locality. The null and alternative hypotheses in this case are:

H_0- There is no statistically significant difference between the personal income level of respondents with respect to their willingness to pay for a flood-resistant locality.

H_1- There is a statistically significant difference between the personal income level of respondents with respect to their willingness to pay for a flood-resistant locality.

Table 4. Descriptive statistics for personal income level and willingness to pay for flood-resistant localities

	n	Mean	Std. Deviation
Below Rs. 3 lakhs per annum	14	1.93	0.83
Rs. 15-20 lakhs per annum	8	1.5	0.76
above Rs. 20 lakhs per annum	29	1.41	0.63
Rs. 10-15 lakhs per annum	9	1.11	0.33
Rs. 3-5 lakhs per annum	2	3	0
Rs. 5-10 lakhs per annum	8	1.75	0.89
Total	70	1.57	0.75

Table 5. ANOVA results for personal income level and willingness to pay for flood-resistant localities

	Sum of Squares	df	Mean Square	F	p
Personal Income Level	8.79	5	1.76	3.71	.005
Residual	30.35	64	0.47		
Total	39.14	69			

The overall mean for the willingness to pay for a flood-resistant locality across all income groups is 1.57. The lowest rating is given by the income group of Rs. 10-15 lakhs with an average score of 1.11, and the highest rating is given by the income group of Rs. 3-5 lakhs per annum with an average score of 3.00. The p-value is 0.005 and the F value is 3.71, which proves the alternative hypothesis and conveys that personal income level and the willingness to pay have a statistically significant relationship. This portrays that income levels play a significant role in the assessment of the safety-related features in housing. Since the lower-income group has an average score of 3.00, this indicates that they are more likely to invest in safer flood-resistant housing due to budget concerns. The relatively high within-group variance, with a residual sum of squares of 30.35, highlights that not everyone within the income group feels the same. However, the between-group variance value is 8.79, which shows that it is large enough to produce a statistically significant F-value.

4.2.2. Relation between Personal Income and Disaster Preparedness

In order to understand the relationship between personal income and the public's perception of disaster preparedness, a one-way ANOVA was conducted. The independent variable, personal income level, is divided into 5 income categories.

Table 6. Descriptive statistics for personal income level and disaster preparedness

	n	Mean	Std. Deviation
Below Rs. 3 lakhs per annum	14	2.71	0.83
Rs. 15-20 lakhs per annum	8	2.75	0.71
above Rs. 20 lakhs per annum	29	2.07	0.92
Rs. 10-15 lakhs per annum	9	3	1
Rs. 3-5 lakhs per annum	2	4	1.41
Rs. 5-10 lakhs per annum	8	3.5	1.31
Total	70	2.61	1.07

Table 7. ANOVA results for personal income level and disaster preparedness

	Sum of Squares	df	Mean Square	F	p
Personal Income Level	20.37	5	4.07	4.48	.001
Residual	58.22	64	0.91		
Total	78.59	69			

The overall mean for all the groups was 2.61 on the Likert scale. The highest mean rating value was from the Rs. 5-10 lakhs group with a rating of 4.13, and the lowest rating was from the Below Rs. 3 lakhs group with a rating of 2.36. With a p-value of 0.001, this test shows that there is a statistically significant difference between the Personal Income group level and the rating for disaster preparedness under public design in Bangalore.

4.2.3. Perception on Public Sanitation and Hygiene

In order to understand the relationship between personal income and the public's perception of public sanitation and hygiene, a one-way ANOVA was conducted. Following the same income level as above, the hypothesis for this test is:

H_0- There is no significant difference in perceptions of public sanitation and hygiene across the six income levels.

H_1- There is a significant difference in perceptions of public sanitation and hygiene across the six income levels.

Table 8. Descriptive statistics for personal income level and rating for public sanitation and hygiene

	n	Mean	Std. Deviation
Below Rs. 3 lakhs per annum	14	2.36	0.93
Rs. 15-20 lakhs per annum	8	2.88	0.35
above Rs. 20 lakhs per annum	29	2.41	0.98
Rs. 10-15 lakhs per annum	9	2.67	1.12
Rs. 3-5 lakhs per annum	2	3.5	0.71
Rs. 5-10 lakhs per annum	8	4.13	0.83
Total	70	2.71	1.05

Table 9. ANOVA results for personal income level and rating for public sanitation and hygiene

	Sum of Squares	df	Mean Square	F	p
Personal Income Level	21.79	5	4.36	5.12	.001
Residual	54.5	64	0.85		
Total	76.29	69			

The highest value of mean rating was for the Rs. 5-10 lakhs group (a rating of 4.13), and the lowest value of mean rating was for the Below Rs. 3 lakhs group (a rating of 2.36).

Since the p-value is 0.001, the null hypothesis is nullified and the alternative hypothesis is established.

The value for Eta Squared (η^2) is 0.29, indicating that 28.56% of the variance is caused by personal income differences. This value is greater than 0.14, which, according to Cohen's guidelines (1988), indicates that income levels

have a strong prediction of public sanitation perception. With alternative hypotheses being established, this test indicates that income level significantly influences citizens' evaluation of sanitation and hygiene infrastructure in Bangalore. The middle-income group of Rs. 5-10 lakhs reported the highest ratings, while the lower and higher income groups gave relatively lower ratings. This indicates the inequality in neighbourhood conditions and different expectation standards among the income groups. This highlights the significance of ensuring equitable and inclusive urban planning that focuses on public hygiene and infrastructure across all socio-economic classes.

4.2.4. Education, Income, Tenure in Bangalore, and Public Design Perceptions

The purpose of this Repeated Measures ANOVA was to assess how demographic variables influence the public's perception of public design in Bangalore. The demographic variables include educational qualification, personal income level and number of years of residence in Bangalore. The dependent variable was the average rating of basic services, which was rated on a 5- point Likert scale (1- Very poor, 5- Very good).

Table 10. Descriptive statistics for education qualification, personal income level, number of years in Bangalore and average for public design rating

	n	Mean	Std. Deviation
What is your educational qualification?	70	5.1	1.53
Personal Income Level	70	4.17	1.96
How long have you been living in Bangalore?	70	3.26	1.85
Average for public design	70	2.69	0.83

Table 11. Repeated measures ANOVA results for education qualification, personal income level, number of years in Bangalore and average for public design rating

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	234.1	3	78.03	35.56	<.001	0.34
Error	454.19	207	2.19			

The value of F(3,207) is 35.56, and the value of p is < 0.001. This shows that there is a statistically significant difference among the four variables being compared and portrays that the mean values for minimum 1 variable are significantly different from the others in how they relate to the perception of basic services in the city.

The Eta Squared (η^2) is 0.34, which conveys that 34% of the variance in the dependent variable can be attributed to the difference between the levels of educational qualification, income level and duration of residence in Bangalore. This conveys a large effect size, suggesting that the difference between the groups is statistically significant.

Based on these findings, the null hypothesis can be rejected, which assumes no significant differences between demographic factors and the perception of public design, and suggests that demographic traits influence the evaluation of public design quality for residents. Thus, there is a need for multifaceted urban planning strategies that consider these demographic variables when designing spaces. Tailoring design to these variables may enhance its effectiveness and increase levels of public satisfaction.

A similar Repeated Measures ANOVA test was conducted to examine how demographic factors influence residents' perceptions of the quality of basic services available in Bangalore.

Table 12. Descriptive statistics for education qualification, personal income level, number of years in Bangalore and average for basic amenities rating

	n	Mean	Std. Deviation
What is your educational qualification?	70	5.1	1.53
Personal Income Level	70	4.17	1.96
How long have you been living in Bangalore?	70	3.26	1.85
Average of basic services	70	3.19	0.8

Table 13. Repeated measures ANOVA results for education qualification, personal income level, number of years in Bangalore and average for basic amenities rating

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	169.74	3	56.58	25.72	<.001	0.27
Error	455.31	207	2.2			

The value of F(3,207) is 25.72, and the value of p is < 0.001. This shows that there is a statistically significant difference among the four variables being compared. The Eta Squared (η^2) = 0.27 conveys that 27.16% of the variance in the dependent variable can be attributed to the difference in demographic factors. Such a difference can be explained in terms of differences in socioeconomic access to infrastructure, awareness of systemic inefficiencies, and lived experience with urban flooding and resilience measures.

4.2.5. Personal Income vs Average Rating for Public Design

In order to assess the relationship between personal income levels and public perception of public design, a one-way ANOVA was conducted. The independent variable here was the personal income level, and the dependent variable was the Average rating of public design(this included factors such as street design, public transport, supply of basic amenities, traffic management, waste management, air and noise pollution, public sanitation and hygiene and disaster preparedness). The independent variable had six groups. The dependent variable was assessed on a 5-point Likert scale (1- Very Poor, 5- Very Good).

H_0= = There is no relationship between the average public design ratings by the participants of the survey and the income level of the participants.

H_1= There is a statistically significant relationship between the average public design ratings by participants of the survey and the income level of the participants.

Table 14. Descriptive statistics for personal income level and average rating for public design

	n	Mean	Std. Deviation
Below Rs. 3 lakhs per annum	14	2.69	0.64
Rs. 15-20 lakhs per annum	8	2.69	0.43
above Rs. 20 lakhs per annum	29	2.31	0.72
Rs. 10-15 lakhs per annum	9	2.89	0.89
Rs. 3-5 lakhs per annum	2	3.56	0.44
Rs. 5-10 lakhs per annum	8	3.67	0.9
Total	70	2.69	0.83

Table 15. ANOVA results for personal income level vs average public design rating

	Sum of Squares	df	Mean Square	F	p
Personal Income Level	13.77	5	2.75	5.25	<.001
Residual	33.59	64	0.52		
Total	47.36	69			

The overall mean rating across all income groups was 2.69. The highest mean score was reported by the income group of Rs. 5-10 lakhs per annum with a score of 3.67, the lowest rating was reported by the Above 20 lakhs per annum group with a score of 2.31.

The one-way ANOVA test showed a statistically significant difference between the perceptions of public design across income groups. The p value was < 0.001 and F(5, 64)= 5.25. Since the p-value is < 0.05, it is significant and proves the relationship between the two variables.

The eta squared (η^2) value was 0.29, hence indicating that 29% of the variance in the perception of public design quality can be explained through the income level differences. The result rejects the null hypothesis and supports the alternate hypothesis about there being a statistically significant difference between the perceptions of public design across income groups. The lower middle-income class reported greater satisfaction with public design, which could be due to greater dependence on public infrastructure. On the contrary, the higher income class reported lower satisfaction, which could be due to higher expectations of the infrastructure.

4.2.6. Impact of Age on Perceptions of Basic Service Quality in Bangalore

Public perception towards urban design and, more importantly, the quality of basic services is often significantly conditioned by age, as younger generations, with greater awareness, are more likely to demand better services, whereas the older generations are largely recorded as being more forgiving of provisions. To further test this view, a one-way ANOVA was conducted, with age as the independent variable comprising five age distributions and quality of basic services as the dependent variable, assessed on a 5-point Likert Scale (1- Very poor, 5- Very Good).

Table 16. Descriptive statistics for age and perceived quality of basic services in Bangalore

	n	Mean	Std. Deviation
Between 41 and 50 years	14	2.74	0.59
Above 50 years	24	3.04	0.71
Less than 18	8	3.66	0.59
Between 31 and 40 years	9	3.29	1.12
Between 18 and 30 years	15	3.55	0.77
Total	70	3.19	0.8

Table 17. ANOVA results for age and perceived quality of basic services in Bangalore

	Sum of Squares	df	Mean Square	F	p
Age	7.17	4	1.79	3.15	.02
Residual	37.03	65	0.57		
Total	44.2	69			

The overall mean rating across all the age groups was 3.19. The mean score was the highest for the Less than 18 group (with a rating of 3.66) and the lowest for the age group of 41-50 (with a rating of 2.74). The one-way ANOVA results were statistically significant with a p-value of 0.02 and $F(4, 65)= 3.15$. This portrays that the age of an individual has a noteworthy effect on the ratings by residents for basic public services. The eta squared (η^2) value was 0.16, indicating that approximately 16% of the difference in the quality of basic services could be explained by age differences.

4.3. Discussion

The above section clearly illustrates the prominent issues faced by Bangaloreans in terms of road infrastructure and mobility, flooding, water infrastructure and civic participation. With rapid urbanisation, these issues have a severe and disproportionate impact on the geographically and economically vulnerable sections of society. The findings above clearly illustrate that flooding is not just a natural disaster but an urban planning failure for the city.

Floods, particularly flash floods, have become a recurring issue in Bangalore. Survey results reflect these concerns, with respondents identifying poor drainage systems (64.3%), encroachment of lakes and wetlands (57.1%), and rapid urbanisation (64.1%) as the primary causes of floodings. These findings are consistent with existing scholarship.

A 2019 study reported that 408 square kilometre out of Bangalore's total 741 square kilometre is now covered by impervious surfaces, making a 1028% increase since 1973 (Ramesh, 2022; Tewari, et al., 2022: 55). This has significantly impaired natural drainage systems, especially in low-lying areas such as Bellandur, Marathahalli and Whitefield, which lie on the floodplains and have been particularly vulnerable to urban flooding.

This trend was evident in this study as well, with 40 out of 70 respondents from these areas identifying it as a major concern. The existing scholarship notes that the lake numbers in the city have drastically declined from 1452 to just 194 by 2016 (Ramesh, 2022; Tewari et al., 2022), highlighting the extent of encroachment and disappearance of natural water bodies that once acted as flood buffers.

Citizens overwhelmingly reported that the most urgent steps to reduce urban flooding should include improving drainage management, enforcing stricter regulations on illegal encroachments, and increasing the levels of rainwater harvesting, along with improved waste management. Moreover, 88% of the respondents viewed flood-resistant features as essential, underscoring a public demand for resilient urban planning, an aspect often overlooked by existing policies.

Poor road infrastructure and ineffective traffic management emerged as two of the lowest-rated parameters in both the literature and primary data. Existing research highlights widespread public dissatisfaction with the government's focus on marquee projects, such as proposals to build South Asia's tallest skydeck, while neglecting pressing everyday urban issues (Nair, 2024). Residents believed that core concerns such as public transportation, mobility, green space access and flooding require greater attention. The survey findings support this sentiment: traffic management received the lowest scores, with 29 respondents reporting it as "very poor" and 21 rating it as "poor". Additionally, 68.6% of respondents reported commuting difficulties and 35.7% experienced work disruptions due to waterlogging. This, along with rapid urbanisation has also worsened air and noise pollution, as 29 respondents rated pollution levels as "average" and 31 rated them as "poor" or "very poor".

Waste management received moderately low ratings, with 28 respondents rating it as "average" and 24 as either "poor" or "very poor." The data suggests that municipal solid waste management remains inadequate. The relatively moderate dissatisfaction in the responses may be due to the sample's concentration in affluent neighbourhoods with better-managed societies.

Similarly, existing scholarship highlights irregular water supply in Bangalore, particularly affecting low-income groups facing unreliable access to groundwater and rising water costs(HT News Desk, 2025). Only 38.6% of the city is presently covered by a sewage network, leading to untreated sewage entering stormwater drains. This study illustrates similar disparities; respondents from higher-income areas like Indiranagar and Koramangala seemed satisfied, while respondents from lower-income areas rated the water infrastructure supply as "poor" or "very poor". Despite government efforts such as the Cauvery Water Supply Scheme, the issue persists, likely due to population growth and groundwater depletion.

In contrast, electricity supply and basic amenities (e.g., roads, street lighting) were rated relatively better. While scholarship notes that damages, such as potholes and fallen electric poles, have led to significant financial losses for BESCOM (Prasad and Narayanan, 2016: 1), 42.8% of survey respondents rated electricity infrastructure as "good" or "very good," and 30% rated it "average."

Despite things like *Brand Bengaluru* and the earlier *Janaagraha* campaign aimed to empower residents and involve them in urban planning, our findings reflect low levels of civic engagement. For example, 58.6% respondents had never reported issues related to flooding; only 7.4% saw any action taken. Similar trends were observed across other issues - for waste management, 55.7% never reported issues

and only 11.4% reported and saw action taken; only 1.4 % respondents reported illegal encroachment, and 7.1% respondents reported problems related to drainage infrastructure. These patterns contrast sharply with perceptions of civic responsibility, where 70% respondents rated the role of citizens in urban waste management as important. This gap between belief and action may reflect apathy, a lack of trust in authorities, or perceptions of government inaction. The literature also notes the city's historically low voter turnout, especially from lower-income groups, who often feel neglected. Respondents of this study echoed similar views, citing illegal encroachments as a result of "corrupt politicians" and calling for "good administration and leadership.

5. Conclusion

This research paper offers an in-depth exploration of citizens' perceptions regarding the architectural design and public utilities in Bangalore. One of the study's main limitations is the relatively small sample size and the limited geographic distribution of respondents, with a majority concentrated in East Bangalore. As a result, the perspectives of residents from other significant areas such as Electronic City, Yelahanka, Hebbal, and Magadi Road remain underrepresented. Additionally, the inclusion of qualitative interviews could have given deeper insights into the perceptions, hence enhancing the findings.

The sampling strategy used for the survey was a non-probability convenience sampling strategy, chosen to ensure access to respondents who were both willing to participate and had experience with the city's urban infrastructure. While this limits the generalisability of the findings, the findings nevertheless remain valid, as they align closely with existing literature, particularly on issues such as flooding, waste management and road infrastructure. The study successfully captures patterns of awareness, attitudinal trends, and shared concerns among residents on issues such as flooding, waste management, road infrastructure and urban planning. The findings reveal that urban design in Bangalore significantly influences the quality of life. Flooding is widely perceived not as a natural calamity, but as a consequence of poor urban planning, with clear spillover effects on daily mobility and residential life. Road infrastructure and traffic management have been a concerning issue due to the growing overpopulation and the exponential industrial growth in the city. Lastly, waste management and water infrastructure have received criticism due to inefficient waste handling, unequal water supply and limited sewage coverage across the city. The study also underscores the lack of coordination among key governmental bodies like the *Bruhat Bengaluru Mahanagara Palike,* the Karnataka Urban Development Department and the Bangalore Development Authority, which has contributed to the persistence of urban challenges. Low levels of citizen engagement and a widespread mistrust of authorities further hinder effective civic participation. In conclusion, the findings point towards an urgent need for resilient, inclusive, and citizen-responsive urban planning strategies that can address these deep-rooted infrastructural and governance challenges in Bangalore.

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