International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 12 | Dec 2022 www.irjet.net p-ISSN: 2395-0072

Understanding citizen perspectives: Approach towards Water-Sensitive Development of Kanpur City

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Abstract - *The community-based approach is an effective way to plan a city's water-sensitive development. The study looks into the community's perception of water management, climate change, and willingness to participate in Kanpur's water-sensitive development. Structured interviews and group discussions were used to collect data from households at random. The study included 117 participants, 37.6 % of whom were females and 62.4 % of whom were males. The average number of people in a household is 4.64. In June, 33.80% of HHs faced water scarcity. 75.64% of the households are willing to reuse recycled treated stormwater for non-potable domestic purposes, and 77.72 % have no objection to reusing treated wastewater for non-potable public purposes. 87.2 % of respondents believe climate change is real, and 54.7 % believe it will significantly impact the upcoming generation. In addition, 73.5 % of respondents agreed to participate in community programmes promoting water-sensitive development and climate change. More awareness and community participation are required to achieve sustainable urban water management.*

Key Words: community; Kanpur; management; perception; water-sensitive urban development

1. INTRODUCTION

Water is a vital component of life on earth. Every living thing and non-living thing is impacted by water, either directly or indirectly. Humans use water for many daily tasks, such as drinking, cooking, agriculture, washing, and cleaning. Reduced availability of water is one of the critical global issues. According to the World Bank, India is among the most water-stressed countries in the world (The World Bank, 2022). With rapid urbanisation, unplanned development, population growth and climate change, there will be immense pressure on urban hydrology. Cities are more likely to experience increased floods, droughts and other natural disasters like cyclones. Goal 6 of the Sustainable Development Goals (SDG) aims to enable universal access to clean drinking water and sanitation facilities, as well as to increase water efficiency, water quality, integrated water resource management, and the restoration of water-related ecosystems (United Nations, 2022). According to R. R. Brown, a sustainable water management approach is needed to develop water-sensitive cities to make cities water and climate change resilient (Brown, Keath, & Wong, 2009). A comprehensive strategy for the utilisation of water resources is necessary for sustainable water management. Cities of many countries like Australia, China, the United States of America (USA), the United Kingdom (U.K), and Japan have adopted a sustainable water management approach per their requirements. India also adopted a similar approach when Delhi Development Authority (DDA) planned the Dwarka sub-city in 1989 as a 'zero-runoff city' but could not implement it. Later National Institute of Urban Affairs (NIUA) prepared the strategic framework for managing urban river stretches under the Ganga river basin as the Urban River Management Plan (URMP) under National Mission for Clean Ganga. The primary goal of the URMP is to create an integrated approach to manage the river and its associated aspects in the city in a sustainably and have a river-centric urban development (NIUA; NMCG, 2020). Kanpur is the first city of the country to have its URMP prepared by Kanpur Municipal Corporation in 2021.

2. LITERATURE REVIEW

2.1 Existing Scenario of Water Management in India

Indian cities have started working on water sensitive urban design in last few years. Bhopal's green-blue smart city plan, Masterplan of New Delhi (2041), and Chennai's water as leverage initiative, are some of the efforts towards developing water-sensitive cities through urban policy and developmental guidelines (Anand & Janakiraman, 2021). After 2014, Government of India launched two flagship programmes – Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and the Smart City Mission, focused on improving quality of life through improving physical infrastructure in urban areas. The thrust areas of AMRUT are water supply and sewerage, stormwater drainage, green spaces and parks, and non-motorised urban transport (Udas-Mankikar & Driver, 2021).

According to Central Water Commission, approximately 820 million people living in 22 river basins across the country have per capita water availability close to or lower than 600 cum (Commission, 2019). 70% of India's surface water is contaminated (Niti Ayog, 2019). Based on the data gathered in the service level benchmarking system implemented by MoUD, it primarily covers 28 cities and analyses that the

average water supply duration was 4.1 hours ranging from 0.1 hours per day to 24 hours per day (CEPT University, 2014). As per CPCB, only 30-40% of India's wastewater is treated potentially, and the rest of the untreated wastewater flows into the groundwater or sea of the river canal (CPCB, 2021). More than 70% of India's annual rainfall occurs during the three months of monsoon, and most of it floods out to sea (Central Water Commission, 2021). As per Central Ground Water Board, the average depth to water level ranges from 2 metres to 10 metres below ground level (Central Ground Water Board, 2016).

2.2. Water Sensitive Urban Design (WSUD): Australia

Mouritz initially used the term Water Sensitive Urban Design (WSUD) in Australia in 1992, and the corresponding guidelines were published in 1994 (Radcliffe J. C., 2018). The inter-governmental agreement on National Water Initiatives defines WSUD as the integration of urban planning with the management, preservation, and conservation of the urban water cycle, ensuring that urban water management is responsive to natural hydrological and ecological processes (Wong, 2015). WSUD is an integrated approach for sustainable urban development by integrating urban water systems with natural water cycle. It aims at flood control, rainwater harvesting and water pollution control by efficient storm water management and on-site local treatment and re-use of wastewater (Barton & Argue, 2007). WSUD has various economic, social and environmental benefits such as it helps in recharging ground water, minimizes the impact of urban development on environment, ameliorating Urban Heat Islands (UHIs).

2.3 Low Impact Development: USA

Low impact development (LID) refers to a system that mimics natural processes that result in the infiltration, evapotranspiration, or use of rainwater in order to protect water quality and adjacent aquatic ecosystems (United States Environmental Protection Agency, 2021). LID is a land development strategy for managing stormwater on site with decentralised small-scale control measures (Ahiablame, Engel, & Chaubey, 2012). The idea of Green Infrastructure, which integrates water cycle management with landscape architecture and urban ecosystem services, has been added to LID. Nature-based solutions such as green roofs, rain gardens, swales, permeable pavements, wetlands, green spaces, and natural plant corridors are utilised to improve urban amenity and reduce the risk of floods and pollution (Radcliffe J. C., 2019).

2.4 Sponge Cities: China

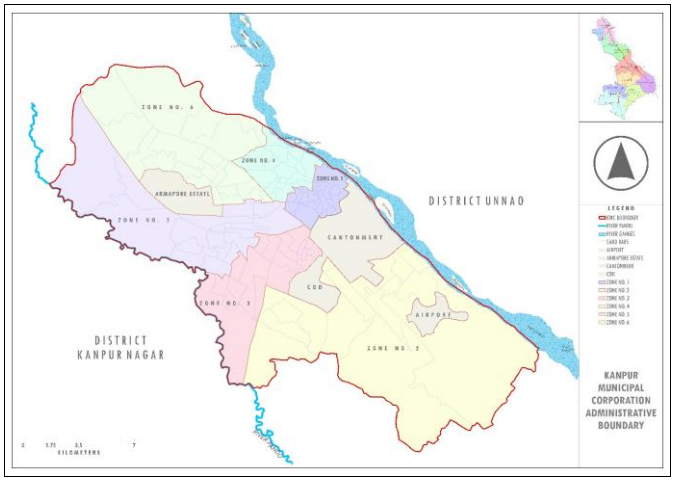
Chinese President Xi Jinping coined the term Sponge Cities at the Central Working Conference of Urbanization in 2013. The main idea of sponge cities was to naturally conserve, purify and infiltrate stormwater for potential reuse (Radcliffe J. C., 2019). The sponge cities project seeks to develop resilience in urban areas by simulating the natural water cycle using permeable surfaces and green-grey-blue infrastructures. Traditional technical solutions cannot handle today's urban drainage and water management problems. In order to recharge groundwater, lower the risk of flooding, and enable the reuse of rainfall and runoff for different residential and urban uses, the city is to be constructed like a sponge that absorbs water (IUCN European Regional Office, 2021). In 2015, China selected 16 cities as pilot cities for the Sponge Cities project to collect and use 70% of stormwater by 2020 and 80% by 2030 in urban areas.

2.5 Water Management: Singapore

Singapore created a strategy to improve water security and self-sufficiency in 2011. The Public Utilities Board (PUB) oversees the water cycle in the country. Singapore has four water sources: imported Malaysian water, desalination, water recycling (NEWater), and catchment water (Radcliffe J. C., 2019). PUB focuses on institutional efficacy, building an enabling environment, such as political will, regulatory framework, and staff, and efficient supply and demand management of water, wastewater, and stormwater. By using economic tools to ensure efficient use of its limited water resources, adopting cutting-edge technological advancements to produce new water sources, improving storage capacities through proper catchment management, and engaging in water conservation practices, Singapore has reached a level of sustainable water management (Tortajada, 2006).

3. MATERIALS AND METHODS

3.1 Study Area



Map 1: Kanpur Municipal Corporation-Administrative Boundaries

Kanpur is the industrial centre of Uttar Pradesh and the country's 12th largest metropolitan agglomeration. Kanpur, located on the Ganga's banks, is well connected to major

cities around the country by NH-2 on the Delhi-Agra-Prayagraj-Kolkata route and NH-25 on the Lucknow-Jhansi-Shivpuri route. It is one of the oldest industrial townships in North India and one of the fastest developing cities in terms of industrial growth. According to the 2011 census, the population of the Kanpur Municipal Corporation (KMC) region was 27,65,348 people, spread throughout an area of 260 square kilometres. It is administratively organized into six administrative zones and 110 wards, with an average ward population of 18,000 to 26,500. (shown in map 1).

There has been uncontrolled development in the city along with steady population growth over the years. Between 1991 and 2001, population growth increased from the preceding decade's average annual growth rate of 2.6 % to an average annual growth rate of 3.5 % (1981-91). Given that Kanpur is a prosperous industrial city, increased migration from neighbouring areas will only add to the existing problems of water management.

The temperature ranges from 2 °C to 48 °C, and the climate is tropical in nature of the city. The months of July and August often see the heaviest rainfall during the rainy season, which lasts from June through September. During the monsoon season, almost 89 % of the yearly rainfall is recorded (June to September). The region receives between 450 and 750 mm of rain annually. In the district, there are about 40 rainy days each year (Kanpur Nagar Nigam, 2013). According to the State of Groundwater report from 2021, Kanpur's groundwater is depleting at a rate of 0.5 to 1.0 mtr per year. The ground water level ranges from 13.36 metres to 37.80 metres below ground level in Kanpur (Sinha, 2021).

3.2 Methodology

Individual stakeholders, citizens, and other organisations are necessary participants in the water-sensitive development of the city. Their awareness of water management problems and willingness to participate to the community good are crucial factors of sustainable water management. The study attempts to comprehend citizens' perspectives on the city's water-sensitive development to provide an integrated strategy for managing water supply, stormwater, and wastewater. For this objective, a questionnaire survey has been developed to reach out to large and diverse groups of city residents from various age groups, socioeconomic classes, and different locations within the city.

The questionnaire was prepared in two languages, i.e. Hindi and English and then disseminated. The aim of the questionnaire was given: The survey aims to understand and quantify community knowledge, behaviour and actions associated with stormwater/urban water management. The questionnaire was divided into two sections with total of 17 questions:

i. Personal information and Socio-Economic Status – Questions 1-6

ii. Towards Water-Sensitive Community – Questions 7-17

A total of 117 respondents took part in the survey, distributed randomly to persons in the city's six administrative zones on important roundabouts, neighbourhood streets, open parks, Ganga ghat, shopping malls, and local vegetable markets.

4. RESULTS AND DISCUSSIONS

4.1 Socio-Economic Characteristics of Households

To analyse respondents' attitudes, perceptions, awareness, and desire to participate in the city's water management, socio-economic parameters including gender, age, the number of people living in the household, average yearly income, housing typology, and home ownership were looked into. The respondents fit the following profile:

- Gender: 37.6 % of females and 62.4 % of males participated in the survey.
- Age Distribution: Out of 117 respondents, 50.4 % of respondents were from the age group 18-35 years, 30.8 respondents from 35-60 years, and 18.8 % were from above 60 years.
- Household Size: 4.64 persons per household was the average household size of 117 respondents.
- Annual household income: 4.27 % of households have income below Rs 1 lakh p.a., 23.93 % of households have payment of Rs 1-3 lakhs p.a., 25.64 % of households have income Rs 3-6 lakhs p.a., 23.93 % participants have an income of Rs 6-12 lakhs p.a., 8.55 % households earns between Rs 12-18 lakhs p.a., and 3.42 % households earn above Rs 18 lakhs p.a.
- Housing typology: 5.98 % of respondents were living in apartments, 23.08 % had detached houses, 34.19 % of respondents were living in the semi-detached dwelling, and 36.75 respondents had row houses.
- Tenure status: 80.34 % of respondents owned the house, and 19.66 % lived on rent.

4.2 Months of Water Scarcity

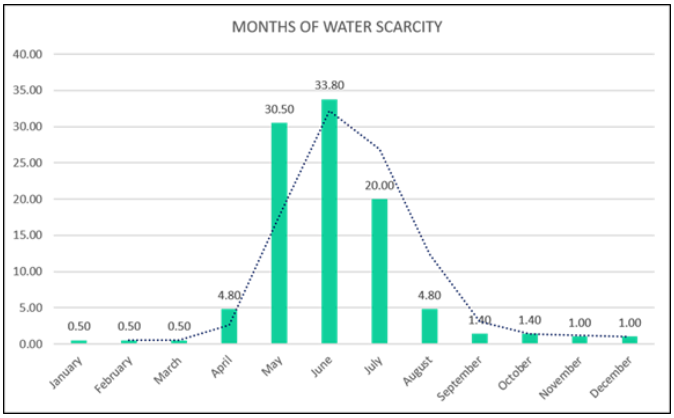


Figure 1: Months of water scarcity

According to the findings, people experience water scarcity from April to August. Out of the 117 HHs who provided feedback, 33.80% HHs reported a water shortage in June, followed by 30.50% in May, 20% in July, and 4.80% in April and August.

Out of 117 respondents, 71 (55.56 %) reported experiencing water logging or flooding in the area on rainy days, 37 (27.35 %) said having no such problem, and 9 (7.69 %) were unaware of the issue.

The average weighted mean of the responses was calculated in order to understand the citizen's viewpoint on the significance of stormwater management. On a 5-point Likert scale, the respondents were asked to rate the significance of stormwater management. With a score of 3.18, the average weighted mean indicates that city residents believe it is important to manage stormwater to decrease instances of water logging.

Table 1: Community perception on reusing treated stormwater/wastewater for domestic and public purpose

Reuse Recycled Treated Stormwater for Domestic use				
	Washing Clothes	Gardening	Flushing Toilet	Cleaning (mopping floor)
Yes	55.56 %	87.18 %	88.89 %	70.94 %
No	27.35 %	4.27 %	3.42 %	17.09 %
Don't Know	17.09 %	8.55 %	7.69 %	11.97 %
Reuse Recycled Treated Stormwater/Wastewater for Public purpose				
	Watering Public Gardens/Lawns	Cleaning (floor mopping)	Flushing toilets (public amenities)	Other municipal uses
Yes	75.20 %	78.60 %	79.50 %	77.60 %
No	8.50 %	6.80 %	6.80 %	6.90 %
Don't Know	16.20 %	14.50 %	13.70 %	15.50 %

4.3 Status of Roof Top Rainwater Harvesting and Storm Water Management

Rooftop Rain Water Harvesting is one of the best options for boosting groundwater recharge/storage in a city like Kanpur, where natural recharge is severely reduced due to increased urban activity, and limited land is available for implementing any other artificial recharge approach. The question Do you have Rooftop Rain Water Harvesting in practice? was posed to respondents to understand the state of rainwater harvesting in the city. Only 11.97% of respondents said yes, compared to 88.03% who said no.

4.4 Reuse recycled treated Stormwater/Wastewater

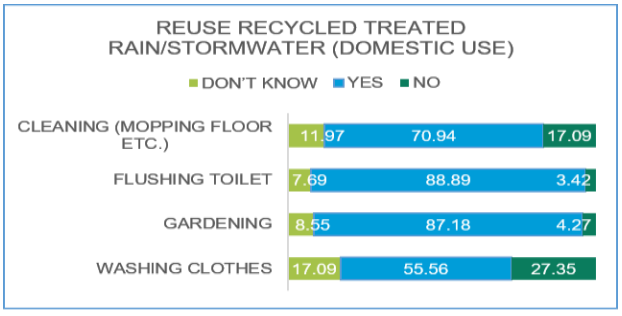


Figure 2: Community perception on reusing stormwater for non-potable domestic use

In order to understand community attitude toward reusing treated stormwater for non-potable domestic use, the survey presented the respondents' four end purposes shown in table 1. According to the findings, respondents were open to using treated stormwater for non-potable uses. As a result, it was determined that washing clothes were the least preferred use, and 88.89 % of respondents were willing to use treated stormwater for toilet flushing and 87.18 % for gardening/washing lawns (shown in fugure-2).

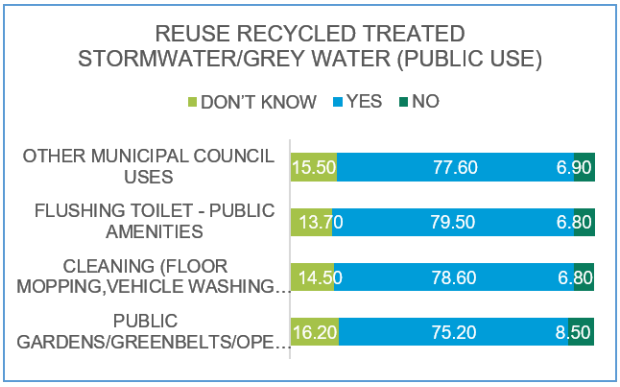


Figure 3: Community perception on reusing treated stormwater/wastewater for non-potable public use

75.20 % of respondents approved the reuse of treated wastewater for non-potable public uses, such as watering greenbelts and public gardens. 78.60 % of respondents agreed to reuse it for routine cleaning tasks like mopping floors, 77.60 % agreed to reuse it for municipal applications like dust suppressants, and 79.50 % agreed to reuse it for the public amenities (flushing public restrooms).

4.5 Source of Information and Community Awareness on Environment related issues

74.35% respondents get information related to environmental issues from newspaper/magazine, 65.81% get informed from social media, 49.57% of respondents get informed from TV/radio, 8.54% of respondents get informed from friends and family, and 5.98% respondents use books and other sources for getting information related to environmental issues.

Respondents were asked to mark the government programmes they are aware of in a multiple-choice question to gauge their awareness of water management. The National Mission for Clean Ganga (NMCG), the Swachh Bharat Mission (SBM), the Jal Jeevan Mission, and the Smart City Mission are five government programmes that synergise urban water management and were offered as options. According to the results, 96.58 % of respondents knew about SBM, 78.63 % knew about the Smart City mission, 76.06 % knew about NMCG, 39.30 % knew about AMRUT, and 36.75 % knew about Jal Jeevan Mission.

4.5 Climate Change and Community Participation

A total of 87.2 % of respondents agreed that climate change is real, whereas only 12% were unsure and 0.9% believed it to be untrue. The results of the study show that 54.7 % of respondents think that climate change will have a significant impact on the near future, 27.4 % opted it will have a fair amount of an impact, 12.8 % made a point of saying it will have a little impact, and 5.1 % claimed it will have no impact.

73.5 % of participants were willing to participate in community awareness programmes relevant to water-sensitive city planning and climate change awareness, 16.2 % were unsure, and 10.3 % refused to participate in such community awareness programmes.

5. CONCLUSION

The study looked at how community views influence city planning for water-sensitive development. Their perspectives on water scarcity, stormwater management and rainwater harvesting, utilizing recycled stormwater and wastewater, understanding of relevant environmental issues, and climate change were analyzed using descriptive analysis, as was their involvement in the study.

According to the findings, the average household size is 4.64 people per household. June is the city's most water-stressed month. There is an opportunity to collect rainwater from residential rooftops, recycle it, and reuse it for domestic purposes, as 76% of respondents agreed to use recycled rainwater/stormwater for non-potable domestic use. Treated/recycled stormwater and wastewater can be used for non-potable public use. On various platforms such as Social Media/Newspapers, and TV/Radio, there is the potential to raise public awareness about water sensitivity and climate change. Even NGOs and schools can organise multiple awareness programmes at the local level, as 74% of respondents are interested in participating in community awareness programmes.

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