International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 09 September 2023
DOI: 10.47191/ijcsrr/V6-i9-28, Impact Factor: 6.789
IJCSRR @ 2023

Sectoral Approach for Solid Waste Management and Water Management

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ABSTRACT: Rapid urbanization, poor solid waste management and inadequate maintenance of water can lead to flooding, water scarcity, water pollution, adverse health effects and rehabilitation costs that may overwhelm the resilience of cities. Cities face significant difficulties as a result of these megatrends, as the cost of inactivity is considerable. A capacity building programme was conducted with a purpose to be a strategic step in building the capacity of Urban Local Bodies (ULBs). The objective of the study was to assess the impact of the capacity building programme conducted for urban local body officials on solid waste and water management. The study focuses on the practices being followed by the urban local bodies in Ganga basin states in terms of solid waste and water management. It further highlights the gaps which must be addressed in relation to the aforementioned topics.

KEY WORDS: Ganga Basin, Impact Assessment, Solid Waste Management, Urban Local Body, Water Management.

INTRODUCTION

For the majority of human history, most of the people have lived in tiny settlements all over the globe. Over the last few hundred years, the world's population has increased dramatically, and our economies have gotten more industrialized, resulting in a major increase in the number of people moving to cities (National Geographic Science, 2022). Cities now house around 55 % of the world's population, or 4.2 billion people. This pattern is likely to persist as it has altered the way we work, travel, live and establish networks. From 1960 to 2020, the overall number of people living in urban and rural areas may be seen (Figure 1) below. This is based on statistics from national censuses mixed with UN estimates in cases where census data was not available. It can be observed that in 1960, there were twice as many people living in rural regions (2 billion) as there were in urban areas (1 billion). In 2007, the urban and rural population totaled at 3.33 billion people each. In 2020, the world's urban population grew to 4.36 billion people, while the world's rural population grew very slightly to 3.40 billion (Ritchie & Roser, 2019).

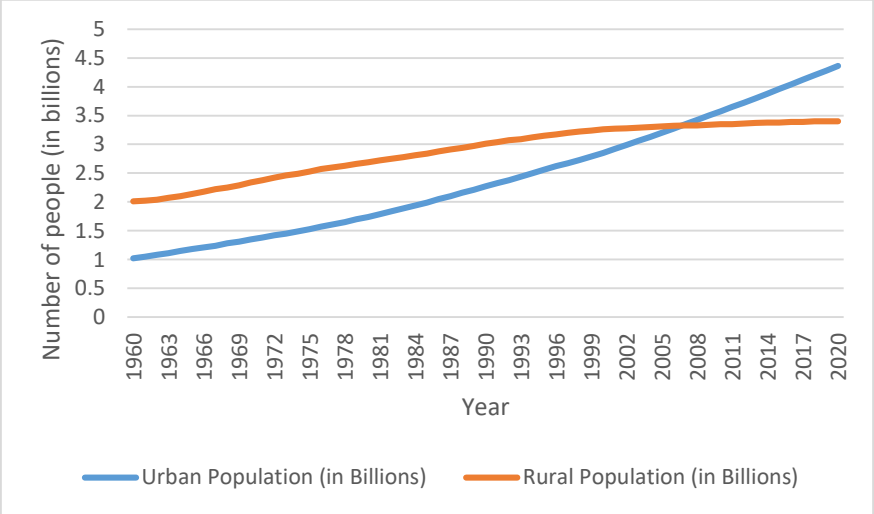

Figure 1: Number of people living in urban and rural areas, World (Source: Urbanization, 2019 by Ritchie and Roser, retrieved from https://ourworldindata.org/urbanization)

Urbanization in India is neither unique nor exclusive, but rather a global phenomenon. Despite the fact that India's urbanization is accelerating, just one-third of the country's population live in cities. According to the 2011 census, the number of census towns

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expanded dramatically from 1,362 to 3,892 between 2001 and 2011. These census towns accounted for more than 30% of the net growth in urban population between 2001 and 2011, demonstrating the character of the rural change. India is evolving from a predominantly rural to a quasi-urban society. This raises problems for long-term development while also providing an excellent chance to capitalize on the advantages of urbanization when effective mechanisms are in place (Niti Aayog, 2021).

1. Urbanization and Management of Solid Waste

Urbanization adds directly to waste creation, and improper waste management poses health risks and degrades the urban environment. With increased urbanization, changing lifestyles, and more consumption, solid waste management, which is already a gigantic challenge in India, becomes much more problematic (Vij, 2012). Solid waste's "nature" changes as societies get wealthier and more urbanized. Households produce an increasing amount of plastics, paper, metals, and other non-biodegradable (dry) waste in place of biodegradable (wet) waste. As societal prosperity rises, the amount of waste also rises (on a per capita basis). In many of its metropolitan regions, where waste creation has dramatically expanded, India has reached the peak of its waste trajectory. Urban India is thought to produce between 1,30,000 and 1,50,000 metric tonnes (MT) of municipal solid waste per day, or between 330-550 grammes per person. This totals around 50 million MT year; if present trends continue, this will increase to over 125 million MT annually by 2031. Concerningly, the composition of waste is also changing, from having a high percentage of biodegradable waste to having a higher percentage of non-biodegradable waste. The waste's characteristics dictate the management approach. Another issue is the legacy waste that is stored in various city dump yards. According to statistics from the Central Pollution Control Board (CPCB), 3,159 dumpsites around the nation are thought to have "disposed" of almost 800 million MT waste.

Source segregation continues to be a problem since it does not occur at the required rate and scale. Even while waste is segregated at the household level, it is not transported to the processing plants in a separate manner. In reality, processing only occurs by chance since certain individuals, or "ragpickers," as we call them, depend on the waste for their lives. The many possibilities for processing and managing them properly for income generation are still being worked out by city management. Worse still, our cities are becoming more and more overrun by plastic waste, particularly waste from packaging. The first Municipal Solid Waste Rules were notified in 2000, and they were founded on the then-dominant belief that waste needed to be collected, transported, and then disposed of in safe landfills. By removing it from the area, the goal was to "clean" cities of waste. Mountains of waste arose in our cities as a result of this policy's failure in practise. Due to the lack of municipal services, what could not be carried or collected clogged up our streets and neighborhoods (Narain, 2022).

Uncollected waste contaminates nearby streams, open sewers, and other bodies of water, endangering human health and creating an environmental concern. Residents may be exposed in a number of ways, such as through ingesting contaminated food or water, coming into direct touch with dirty water or soil, or breathing chemicals released by waste. Additionally, those who live close to landfills and incinerators for waste disposal are often disadvantaged, and probable health repercussions include cancer, adverse pregnancy results, and ailments affecting the skin, lungs, or abdomen. Leachate, unpleasant odors, and methane gases are produced as a result of such harmful environmental activities, but they also influence the water beneath the dump site and pollute the atmosphere nearby. The decomposition of organic stuff is what produces the unpleasant odors. Bacteria break down organic waste to produce sulphides, which break down into H_2S, a strong odor source that can also help illnesses like malaria and plague spread. Waste accumulates at every intersection and corner as a result of poor transportation and insufficient waste collection solutions (Pal and Bhatia, 2022).

2. Urbanization and Water Management

Apart from solid waste management, urbanization is a concern for both developed and developing nations in terms of water management. While cities in developed countries face high operating and maintenance (O&M) expenses as well as the deterioration of existing infrastructure, growing urbanization in developing countries is far outstripping most cities' ability to offer appropriate services to their inhabitants (Senn & Spuhler, 2018). Not only do cities offer socioeconomic possibilities, but they also cater to people's hopes and goals, which is a crucial factor in urbanization. However, cities have not been ready for this migration, and as a result, their infrastructure and resources are frequently overburdened, with the majority of the effects falling on low-income populations. Water continues to be one of the resources in cities that is most in demand. Urban borders are always extending, making surface water sources inadequate to supply the expanding population, which increases reliance on groundwater resources. Presently, around 45% of metropolitan areas' water supply comes from groundwater resources. According to statistics from the Central Ground

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Water Board (from 2017), up to 256 of India's 700 districts have reported "critical" or "over-exploited" groundwater levels. We must concentrate on managing water and its quality in our cities as a result of the continued load of contamination, pollution, and climate change on water. The demand for food and water in cities is predicted to rise significantly over the next few years due to the growing urban population. Cities are importing the water and food they require for survival, which is disrupting the nutrient cycle and harming the soil.

To handle various sorts of water, such as urban water, sanitation, storm water, wastewater, etc., many departments have been established in India. These divisions are required to strengthen their water infrastructure and solve any issues that may arise. This leads to segregated planning and implementation that is more detrimental than beneficial. For example, the closely related but separately treated topics of wastewater management, water quality, consumption, and flood control. The "systems" approach, where the complete urban water cycle is understood and integrated solutions are prioritized, is needed to replace this "siloed" approach where Water Management is perceived as a sequential, dividing process (Rao, 2022).

As a consequence, unplanned development, which results in increased solid waste output and irregular water usage, places a significant burden on our cities. Leaders in cities must act fast to plan for expansion and provide the fundamental services, infrastructure, and affordable housing that their rapidly growing populations require. To address these concerns, the Indian Institute of Public Administration in New Delhi conducted a capacity building programme under the project "Blended Capacity Building Programme for Stakeholders of River Ganga". Although it is primarily based on *Namami Gange's* goal and state regulating municipal administration, it lends itself to customization to match the unique requirements of various states and river bodies.

OBJECTIVE

To determine the impact of capacity building programme conducted for urban local body officials on solid waste and water management

METHODOLOGY

1. Locale

The locale of the study comprised of Ganga basin states. Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana, Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal, and Delhi are among the 11 states that make up the basin (Figure 2). Because the capacity building programme was a part of the project "Blended capacity building for stakeholders of the River Ganga," it was critical to grasp the difficulties that these states' Urban Local Bodies confront in terms of solid waste management and water management.

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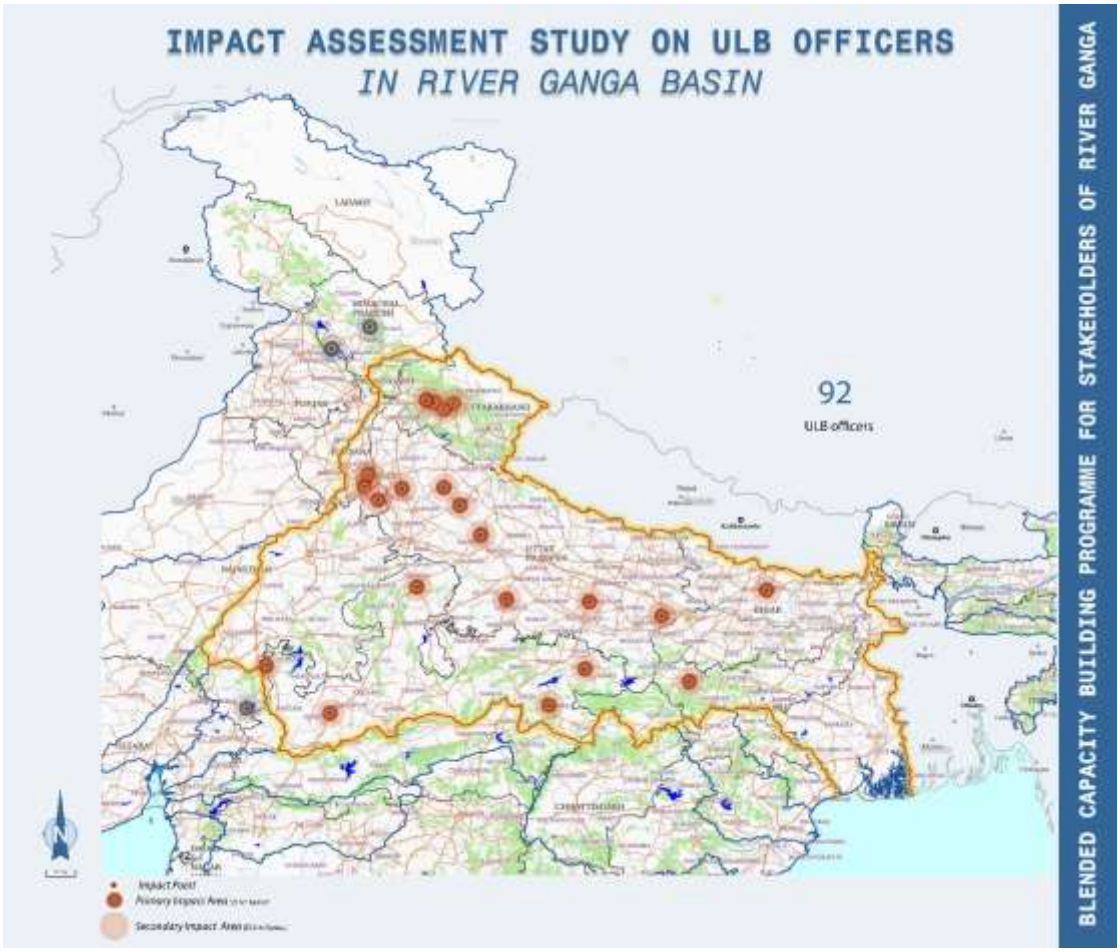

Figure 2: Ganga basin states

2. Sample size

The study's sample included 92 urban local body officials from the Ganga basin states who attended the capacity building programme. Approximately 40% responses were received.

3. Tool for data collection

Google forms were used to obtain primary data for the study. A questionnaire was created and sent as a Google Form via email to the sample of the study i.e., urban local body officials who attend the capacity building programme.

RESULTS AND DISCUSSION

A google questionnaire was administered *to assess the impact of capacity building programme on Urban Local Body Officials*. The questionnaire was sent to the officials via google form and their inputs were recorded to assess the impact of capacity building programme on solid waste management and water management. Inputs on gaps in the capacity building programme were also recorded from the officials. The questionnaire is placed at Annexure 1.

The respondents included officials from various managerial levels, such as city managers, executive officers, junior engineer, municipal engineer, sub engineer and sanitary inspectors. The questionnaire was also able to capture the views of respondents from various organizations such as nagar panchayats, municipal corporations, water resource department and urban administration and development department.

89.2% of the officials stated that waste segregation was practiced by their urban local body on the other hand, 10.8% of the officials stated that waste segregation was not practiced by their urban local body (ULB) (Figure 3). When officials were asked

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about the kind of waste collection system used by their ULB, it was discovered that practically almost every ULB (97.3%) used door-to-door waste collection system, while just 2.7 % opted for spot collection system (Figure 4). It was further discovered that the majority of the ULBs (78.4 %) followed the Solid Waste Management Act of 2016. On the other side, 21.6 % of the officials claimed that no solid waste management policy was being followed by their ULBs (Figure 5).

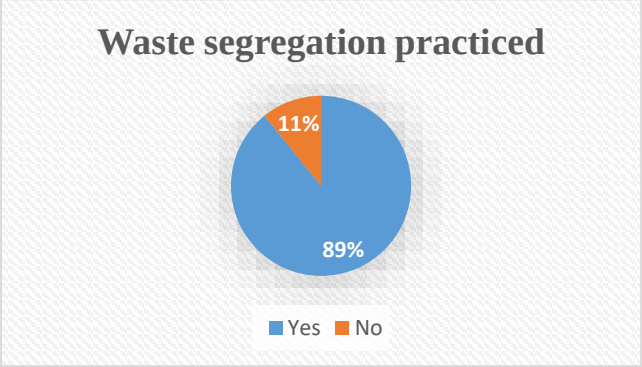

Figure 3: Response of officials on whether their ULB practiced waste segregation or not

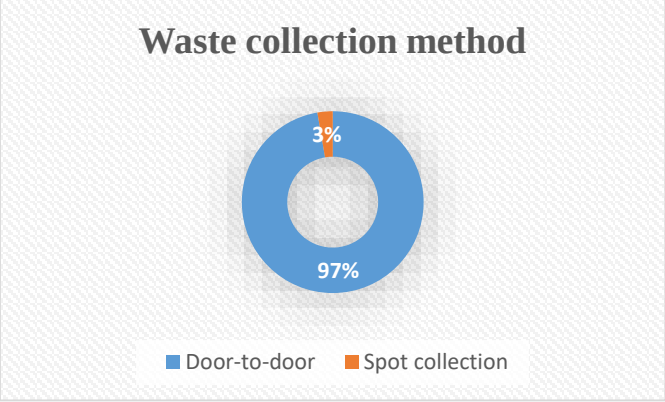

Figure 4: Response of officials on the type of waste collection method used by their ULBs

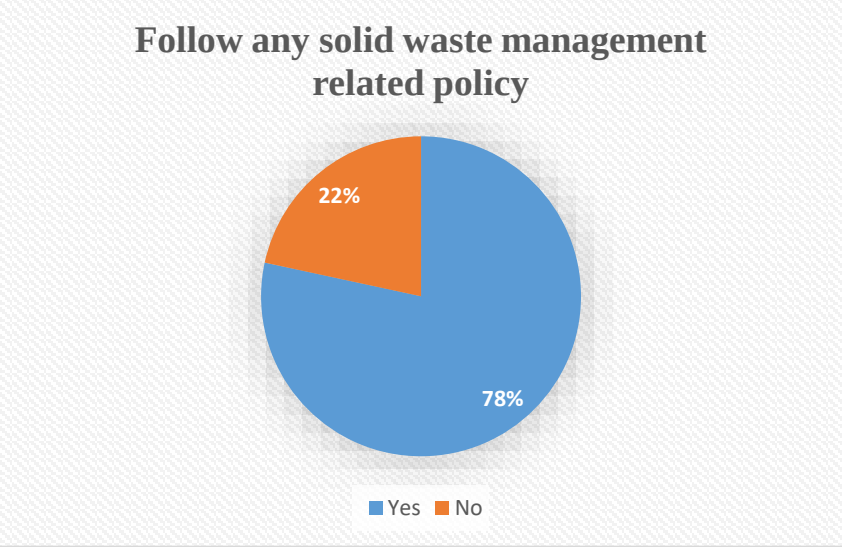

Figure 5: Response of officials on whether their ULB followed any waste management related policy or not

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In response to the question if the ULBs had collaborated with any organization to recover waste, around 74.3 % of the officials said they had not. While 25.7 % of the officials stated that their ULBs had collaborated with local organizations such as swach sulab foundation, Aankansha waste management, Sandhan trust and municipal council to recover waste in their region (Figure 6).

Figure 6: Response of officials on whether their ULB had collaborated with any organization to recover waste or not

Composting was mentioned by around half (53.3 %) of the officials as a way to recover waste in their region by their ULBs. Furthermore, 26.7 % said their ULB used at-source reduction and reuse strategy. Officials also indicated that recycling was attempted to recover the waste in about 16.7 % of the cases. Only 3.3 % of the officials said their ULBs used MRF (materials recovery facility) (Figure 7).

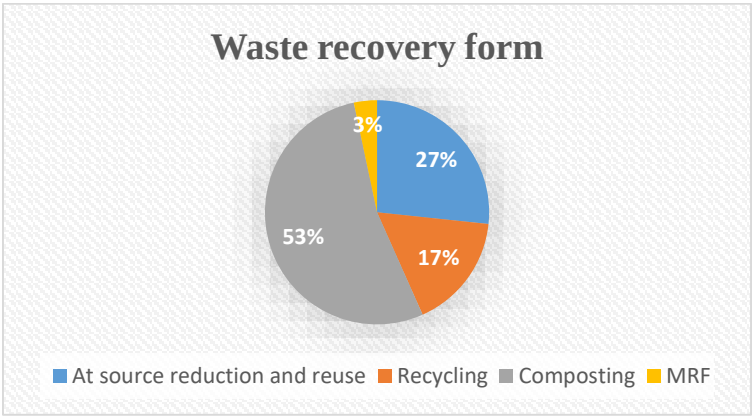

Figure 7: Response of officials on the type of waste recovery form used by their ULB

Replying to the question if the ULBs provided any incentives to the residents who practiced rain water harvesting, approximately 57.1 % of the officials stated that their ULB did not provide any incentives to those who practiced rain water harvesting. On the other side, 42.9 % of them said their ULB was providing incentives in the region for rain water harvesting (Figure 8). 68.8 % of the officials said rooftop rain water harvesting systems was practiced in their area by the residents. Simultaneously, surface run-off was used as a rain water harvesting systems by 25 % of the residents. According to 6.2 % of the officials, the residents in their region do not use any rain water harvesting systems (Figure 9).

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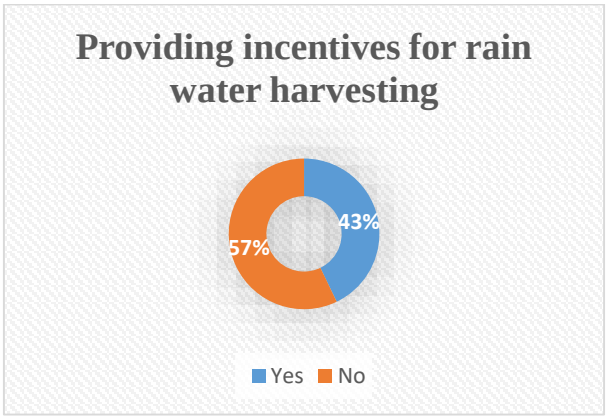

Figure 8: Response of officials on whether their ULBs are providing incentives for rain water harvesting or not

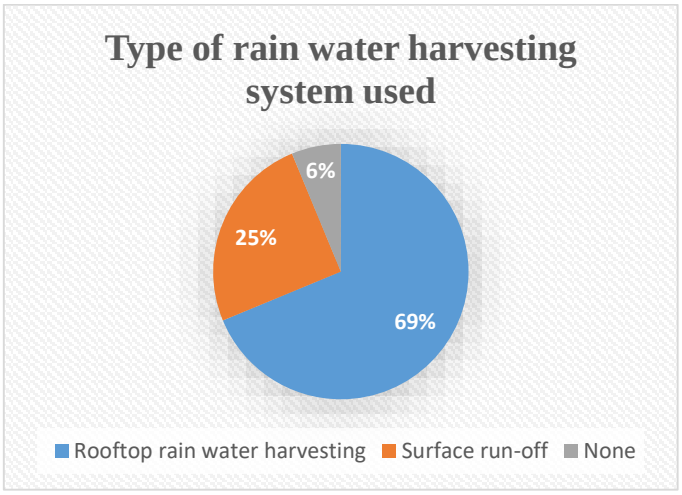

Figure 9: Response of officials on the type of rain water harvesting system used by the citizens in their region

When asked if the ULBs had collaborated with any organization to test the water quality, it was discovered that around 44.1 % of the officials claimed yes and the remaining (55.9 %) stated no (Figure 10). Drinking water and sanitization department (DWSD), public health engineering departments (PHEDs), National Accreditation Board for Testing and Calibration Laboratories (NABL), Uttarakhand Payjal Nigam and other local water agencies in the region were cited by the officials as being involved in the water quality testing procedure.

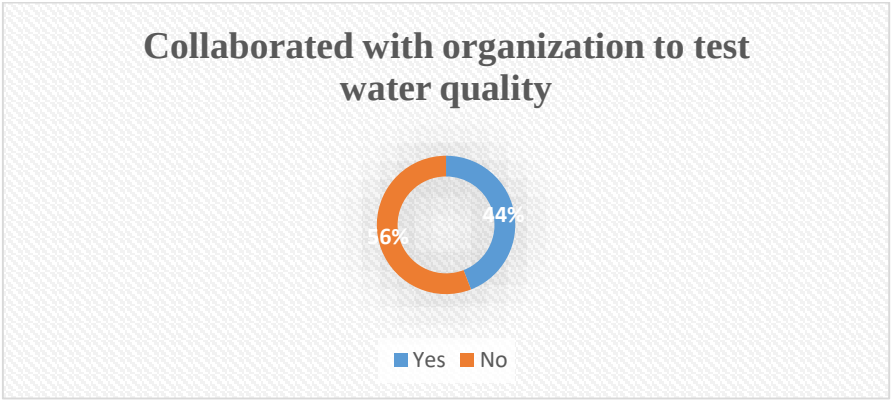

Figure 10: Response of officials whether their ULB have collaborated with any organization for testing the water quality

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Further, upon questioning about the types of water quality testing conducted by such organizations, 46.4 % of the officials said chemical testing, such as chlorides and fluorides, was done. Physical tests were done to check the taste, color, and odor, according to 35.7 % of the officials. 3.6 % of the officials stated bacterial tests such as e-coli was done. Another 3.6 % of the officials said that the collaborative organizations in their region did all types of water testing, including chemical, physical, and bacterial (e-coli). About 11% of the officials stated that none of the water quality tests were performed in their region (Figure 11).

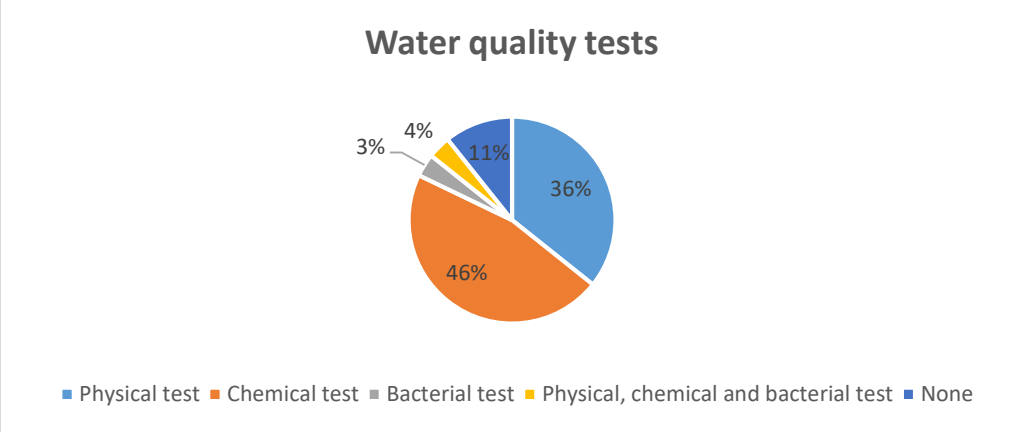

Figure 11: Response of officials on the type of water quality tests done by the collaborated organizations

In addition, officials were asked if the ULB metered water supply in their region, to this, 77.1 % of the officials claimed that their ULB did not metered water supply. While 22.9% indicated the water supply was metered by the ULB in their region (Figure 12). According to 40 % of the officials, water pricing was practiced by the ULBs in their region. On the other side, 60 % of the officials answered that no water pricing was practiced in their region (Figure 13).

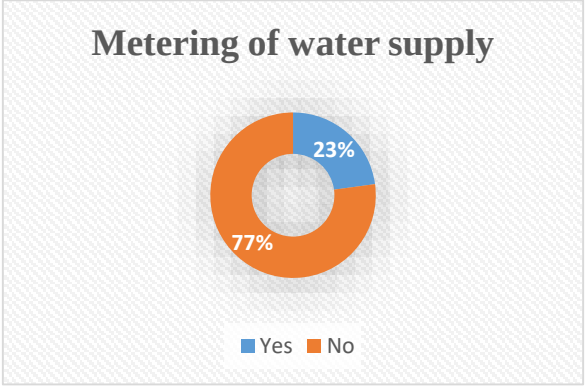

Figure 12: Response of officials on whether their ULB metered water supply or not

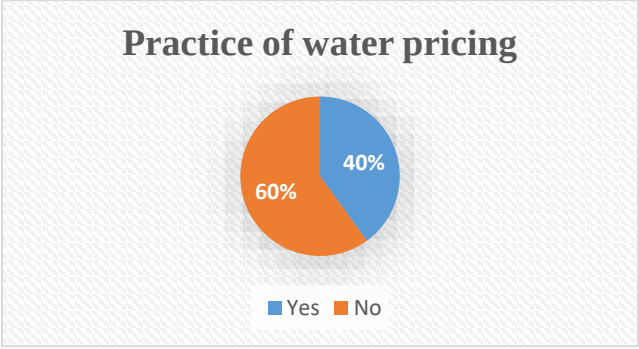

Figure 13: Response of officials on whether their ULBs were practicing water pricing or not

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In response to the question whether the ULBs kept track of water body cleaning, 69.4 % of the officials indicated that their ULBs were monitoring the cleanliness of water bodies. The remaining 30.6 % answered that their ULB did not monitor the clean-up of water bodies (Figure 14). According to 32.1% of the officials monthly monitoring was done, another 39.3% said seasonal, 10.7 % said yearly monitoring, 3.6 % said quarterly monitoring, fortnight basis monitoring was stated by 3.6%, another 3.6 % stated day to day monitoring was done and the remaining 7.2% officials stated that the cleaning of water bodies was not monitored (Figure 15). The rationale for day-to-day monitoring was stated as, because the Gangotri Dham in their region is closed for six months owing to snow cover, day-to-day monitoring is carried out throughout the summer season.

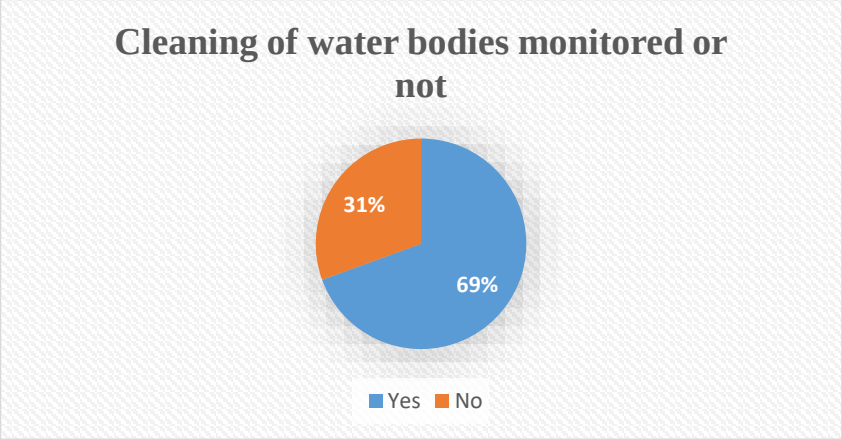

Figure 14: Response of officials on whether their ULBs were monitoring the cleaning of water bodies or not

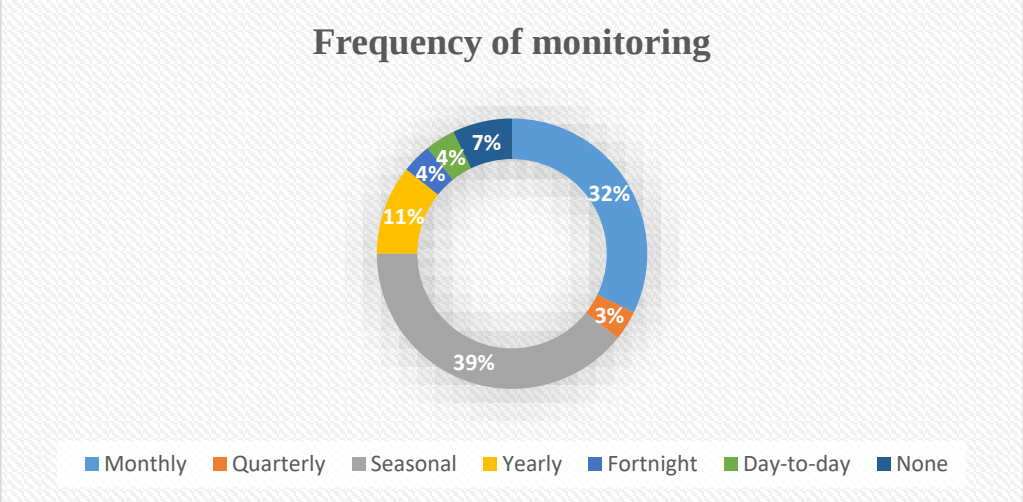

Figure 15: Response of officials on the frequency of monitoring the cleaning of water bodies

48.6 % of the officials stated that there were no wetlands in their region, while the remaining 51.4 % indicated their ULB contains wetlands (Figure 16). About one-fourth of the officials' (25%) said river flood plains were the type of wetlands found in their ULB. Around 30 % responded that man-made wetlands were created for storage purposes, 5% mentioned talab, 20 % claimed lakes were the sort of wetlands seen in their ULB, 5% mentioned marshes as the type of wetland found in their region, another 5% said ox-bow lakes and the remaining 10% stated that no wetlands were present in their region (Figure 17). Construction of safety wall, regular cleaning and imposing penalty for littering the water bodies were opined by the officials as the most used method for protecting the wetlands. Some officials stated that plantation is used as a method to protect the wetlands in their region.

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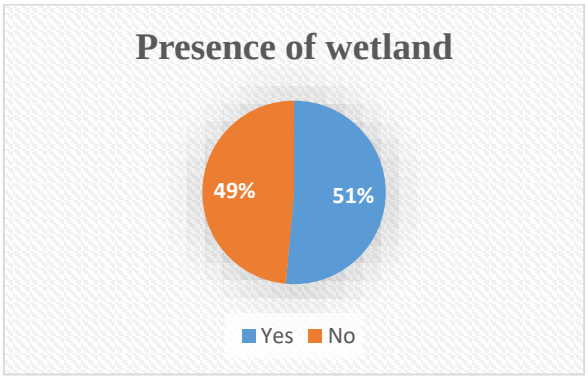

Figure 16: Response of officials on whether there are any wetlands present in their ULB or not

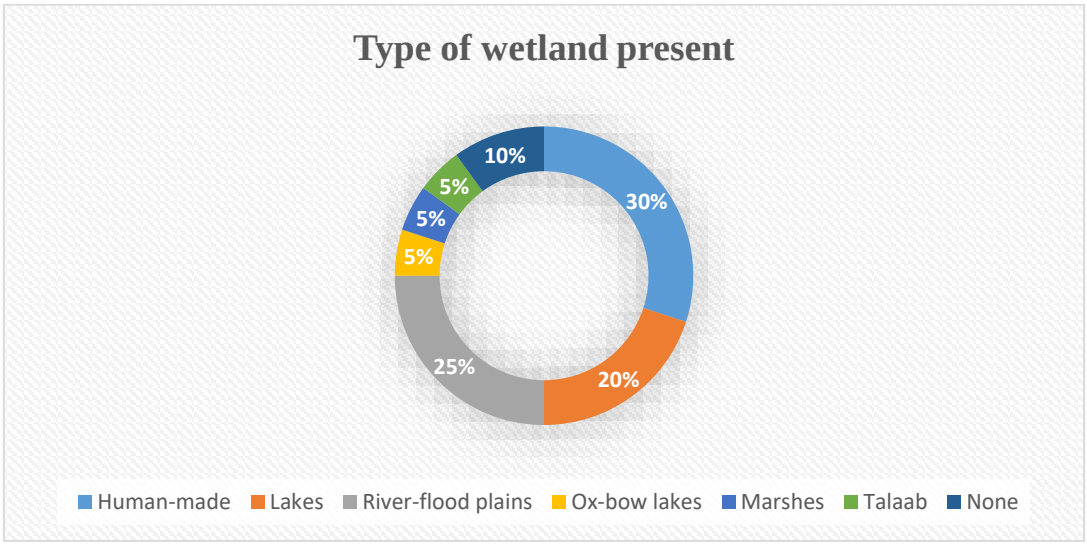

Figure 17: Response of officials on the type of wetland present in their ULB

91.4 % of the officials mentioned that they were able to implement the knowledge gained at IIPA while the remaining 8.6 % did not feel the same (Figure 18). According to 57.1 % of the officials, there are some gaps which needs to be looked after (Figure 19); such as better management of wet waste in low temperature, development of scientific landfill, solid waste management issues, interdepartmental coordination and technical support. One of the official opined that a wetland can also be developed in their region because there is a space for the same. 42.9 % of the officials felt that there are no gaps which needs to be looked after.

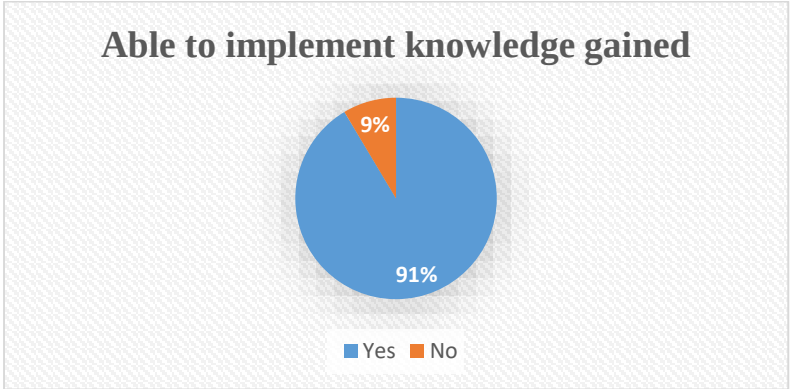

Figure 18: Response of officials on whether they were able to implement the knowledge gained or not

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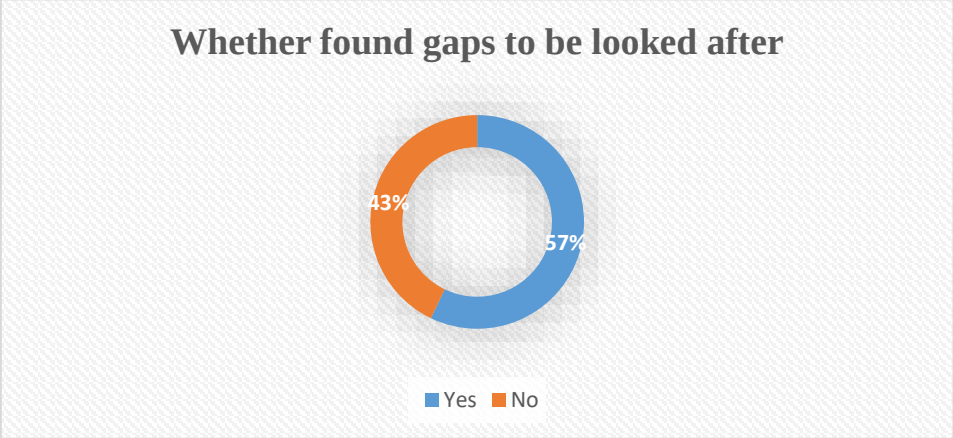

Figure 19: Response of officials on whether there are any gaps which needs to be looked after

CONCLUSION

The breakdown of the respondents reveal a near equal participation by officials from various managerial levels, viz city managers, executive officers, junior engineer, municipal engineer, sub engineer and sanitary inspectors; and organizations, viz nagar panchayats, municipal corporations, water resource department and urban administration and development department.

The findings demonstrates that majority of the ULBs practiced waste segregation and door-to-door waste collection system in their area. As per the mandate of Solid Waste Management Act (2016), which was being followed by the ULBs in most of the areas; composting, at source reduction and reuse, recycling and MRF (materials recovery facility) were being used as a method to recover waste.

In order to encourage citizens to take a step towards water management, it was observed that ULBs were offering incentives to the citizens who were practicing rain water harvesting. Further it was discovered that rainwater harvesting systems were not confined to rooftops but also included surface run-off systems as well. Drinking water and sanitization department (DWSD), public health engineering departments (PHEDs), National Accreditation Board for Testing and Calibration Laboratories (NABL) and other local water agencies were collaborated with in order to check the water quality by performing chemical, physical and bacterial tests.
The response of the officials highlighted that in order to measure water use, metering of water supply and water pricing was imposed by the ULBs. The study reveals apart from regular monitoring for cleaning of water bodies, some states opted for fortnight and day-to-day cleaning since the water bodies in their region were covered in snow due to snowfall. It was further noted, building of safety wall, regular cleaning, penalty for littering the water bodies followed by plantation were suggested by the officials in order to protect the wetlands present in the form of lakes, river flood plains, ox-bow lakes, marshes, talab and human-made wetlands.

A large number of officials mentioned they were able to implement the knowledge gained during the capacity building programme. However, some suggested that gaps such as development of scientific landfills, better management of wet waste in low temperature and development of wetlands should be looked after.

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ANNEXURE
Questionnaire for ULBs
Background Information
*Required
Full Name*

_____

Designation*

_____

Organization (with district and state)*

_____

Email ID*

_____

Contact Number*

_____

Solid Waste Management

1. Is waste segregation practiced in your ULB?
   ☐ Yes
   ☐ No
2. Which type of waste collection method is used in your ULB?
   ☐ Door to door
   ☐ Community bins
   ☐ Open dumping
   ☐ Spot collection
   ☐ Other: _____
3. Does your ULB follow any solid waste management related policies?
   ☐ Yes
   ☐ No
   If yes, then please specify which policy?
   _____
4. Has your ULB collaborated with any organization in order to recover trash?
   ☐ Yes
   ☐ No
   If yes, then please specify with which organization?
   _____
5. In which form your ULB is recovering trash?
   ☐ At source reduction and reuse
   ☐ Recycling
   ☐ Composting
   ☐ Waste to energy

International Journal of Current Science Research and Review
ISSN: 2581-8341
Volume 06 Issue 09 September 2023
DOI: 10.47191/ijcsrr/V6-i9-28, Impact Factor: 6.789
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☐ Other: _____

Water Management

6. Does your ULB provide incentives to the citizens who are practicing rain water harvesting?
   ☐ Yes
   ☐ No
7. Which type of rain water harvesting system is mainly used by the citizens in your ULB?
   ☐ Rooftop rain water harvesting
   ☐ Surface run-off
   ☐ Other: _____
8. Has your ULB collaborated with any organization for testing the water quality?
   ☐ Yes
   ☐ No
   If yes, then please specify which organization?
   _____
9. Which type of tests do these organizations run?
   ☐ Physical tests (taste, color, odor, etc.)
   ☐ Chemical tests (chlorides, fluorides, etc.)
   ☐ Bacterial tests (e-coli)
   ☐ Other: _____
10. Does your ULB meter water supply?
    ☐ Yes
    ☐ No
11. Does your ULB practice water pricing?
    ☐ Yes
    ☐ No
12. Does your ULB monitor cleaning of water bodies?
    ☐ Yes
    ☐ No
    If yes, then how frequently?
    ☐ Monthly
    ☐ Quarterly
    ☐ Seasonal
    ☐ Yearly
    ☐ Other: _____
13. Are there any wetlands in your ULB?
    ☐ Yes
    ☐ No

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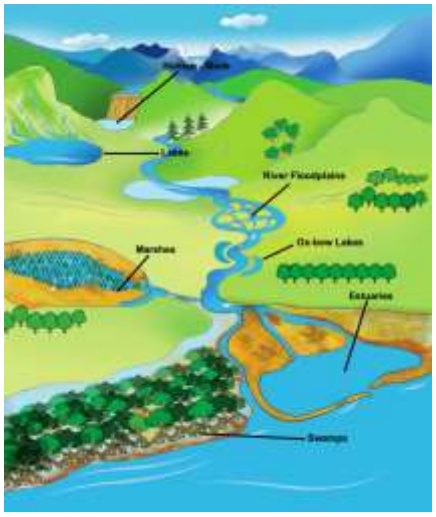

Figure 20: Types of wetlands

If yes, then which type (Figure 20)?

☐ Human-made (for storage purpose)

☐ Lakes

☐ River flood plains

☐ Ox-bow lakes

☐ Marshes

☐ Estuaries

☐ Swamps

☐ Other: _____

14. In what ways your ULB is protecting them?

_____

Training based questions

15. Was your ULB able to implement the knowledge gained at IIPA?

☐ Yes

☐ No

16. Does your ULB feel there are still some gaps which needs to be looked after?

☐ Yes

☐ No

If yes, then what?

_____

Cite this Article: Shyamli Singh, Anugya Singh (2023). Sectoral Approach for Solid Waste Management and Water Management. International Journal of Current Science Research and Review, 6(9), 6388-6396