Existing Sewage System Analysis of Kharagpur and Midnapore Municipalities

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ABSTRACT

Waste management, especially liquid waste management, was one of the most neglected parts of urban India. Urban wastewater management faced serious challenges due to population density and urbanization. Wastewater originating from different sources, such as commercial, industrial, and residential operations, was referred to as sewage. The most important need for safely discharging runoff water was the operation of storm and sewer water drainage systems. The study presented a comprehensive examination of the sewage systems in Kharagpur and Midnapore Municipalities in West Bengal, India. For this purpose, data was collected from various secondary sources like the census of India, municipalities, and existing literature about the study areas. The field study was conducted several times, and a household survey was done to assess the sewage systems of both municipalities. The research aimed to determine the existing sewage infrastructure, residents' satisfaction levels, and the drainage network in these municipalities. It highlighted the importance of proper sewage systems, including liquid waste management, in urban areas.

Introduction:

The Census of India (COI) 2011, report indicated that India, with a population of 1,210,854,977, was the second most populous country globally. Out of this population, 483 million population resided in urban areas, with the number of cities increasing from 5,161 in 2001 to 7,935 in 2011. This rapid urbanization led to significant waste generation, particularly in Tier-I and Tier-II cities. The Ministry of Jal Shakti, Government of India, published a press release on December 2, 2022, titled "Sewage Water Treatment" based on a report released in March 2021 by the Central Pollution Control Board (CPCB). As per the CPCB, 2021 report it was mentioned that during 2020-21, urban India produced 72,368 million liters per day (MLD) of wastewater, nearly double the amount from rural areas. However, with an operational sewage capacity of only 26,869 MLD out of an installed capacity of 31,841 MLD, a substantial 45,499 MLD of untreated sewage

was released into the surface water bodies like, ponds, lakes, river etc. deteriorating water quality and causing public health issues. According to the WHO report in 2024, it was depicted that diarrheal diseases linked to unsafe water were a significant cause of child mortality, with 370,000 deaths under age five globally in 2019.

Many Indian cities struggle with inadequate municipal liquid waste management systems, leading to health risks and unsightly conditions. Auguste Tano Kouamé, the World Bank's Country Director for India, in an interview given to 'The Economic Times' on 26 January 2024 has opinioned that as urbanization rapidly increases, with 40% of the population expected to live in cities by 2036, the challenge of managing urban waste becomes more pressing. The World Bank emphasizes the need for significant investments in urban infrastructure, estimating that $840 billion will be needed by 2036 (Auguste Tano Kouamé,2024). The eleventh five-year plan highlighted urbanization as a key driver for development, but many cities still lack effective waste management systems. Effective urban waste management, especially liquid waste, is crucial for ensuring a healthy living environment, reducing water-borne diseases, and supporting economic progress. Urban Local Bodies, with the financial assistance from state and central governments, are responsible for constructing drainage networks. However, many cities fail to meet these needs, especially in slum areas, leading to issues like wastewater stagnation and flooding. Improving these systems is essential for creating a sustainable and healthy urban environment.

Research Gap: - In India, numerous research works and studies have been developed for solid waste management in various cities of India. However, the study of liquid waste management, particularly the analysis of sewage systems in tier-2 cities, has remained neglected. No studies or research work have been conducted focusing on sewage system analysis for proper liquid waste management in the Kharagpur and Midnapore municipalities. The present study focuses on the existing sewage system analysis of Kharagpur and Midnapore, both Tier-II cities, and reveals that untreated wastewater is discharged into the Kangsabati River, worsening its water quality due to the lack of sewage treatment plants.

About the Study Area: - Kharagpur and Midnapore Municipalities are located in the Paschim Medinipur district of West Bengal, India. Kharagpur Municipality is positioned at the intersection of 87º12′ E to 87°22′ E longitude and 22°17′ N to 22° 22′ N latitude, while Midnapore Municipality spans from 22°23′44.56" to 22°26′ 34.91" North Latitude and 87°17′18.57" to 87°20′30.12" East Longitude. Both municipalities lie along the

banks of the Kangsabati River. According to the 2011 census report, Kharagpur Municipality, comprising 35 wards, had a population of 293,719. Midnapore Municipality, with 25 wards, had a population of 169,127 and a population density of approximately 9,212 persons per square kilometer, covering an area of 18.65 square kilometers. The Kangsabati River, situated to the southeast of Midnapore and the northeast of Kharagpur town, serves as the primary drainage outlet for wastewater from these municipalities. Kharagpur municipality is located about 4 km from the riverbank, while Midnapore municipality is situated on the riverbank. The Kangsaboti River is a crucial component of the study area's drainage system. The location map of the present study area is shown in Fig. 1.

Objectives of The Study:

1. To assess the existing sewage system of the Kharagpur and Midnapore municipalities.

2. To assess the resident's satisfaction regarding the existing sewage system of both municipalities.

3. To prepare an existing drainage network

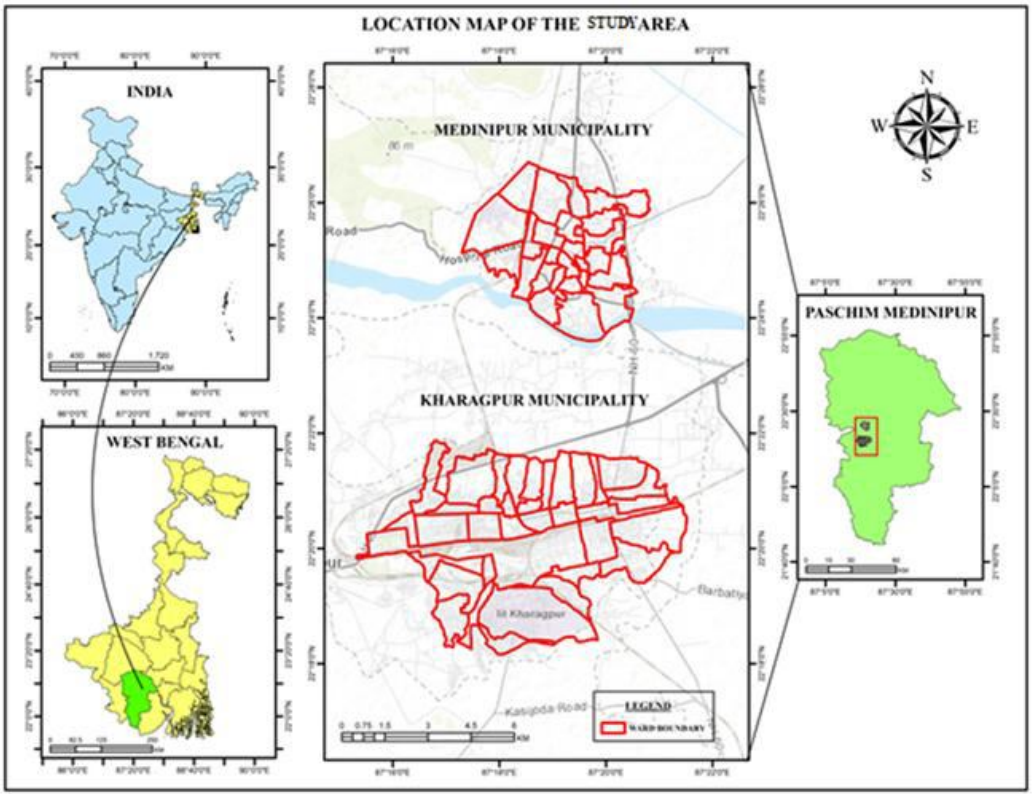

Fig. 1 Location Map of Midnapore and Kharagpur Municipalities, Paschim Medinipur, West Bengal, India

map of the Kharagpur and Midnapore municipalities.

Materials and Methods

The assessment of the existing sewage system in the municipalities of Kharagpur and Midnapore was a thorough procedure that began with establishing objectives and compiling present information. To understand the current scenario of the existing sewage system, published secondary data from the 'Village and Town-wise Primary Census Abstract (PCA) 2011, Paschim Medinipur, were collected and analyzed. The residents' satisfaction levels, data were collected through household survey. Then the data were measured and analyzed after using the Net Promoter Score or NPS metric for both municipalities.

The household survey in both municipalities was conducted during the

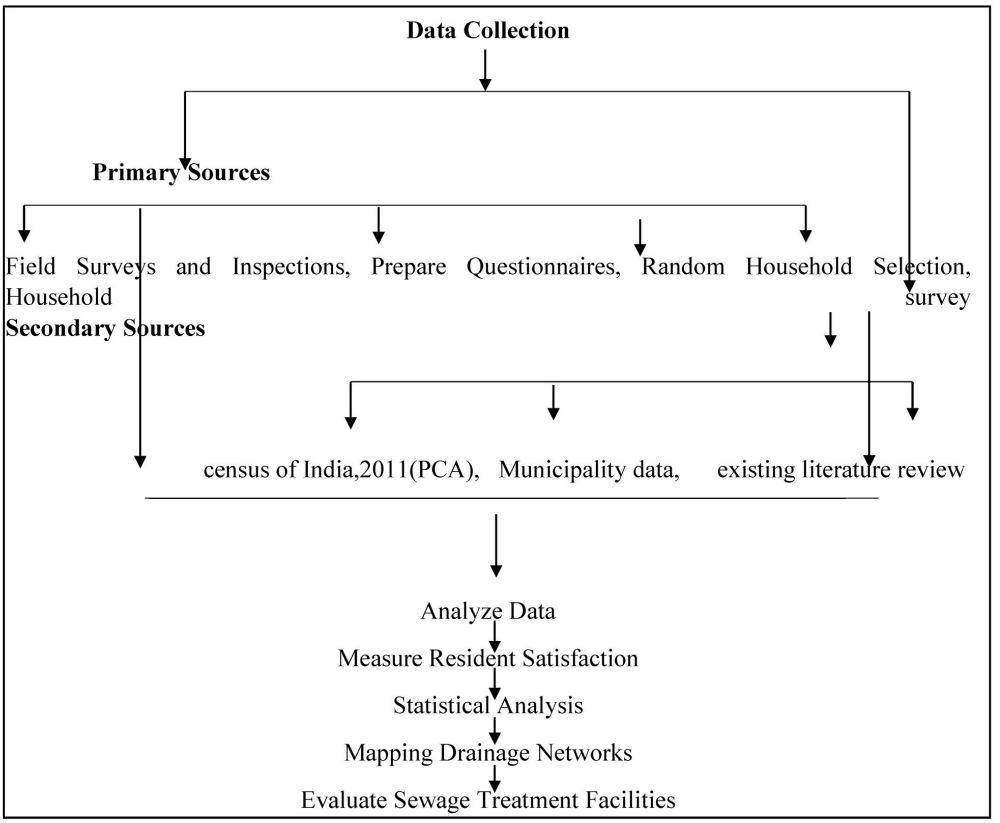

Fig.2 The tabular format outlines the key steps involved in the methodology section of the study, providing a structured overview of the research approach and data collection methods used in analyzing the sewage systems of Kharagpur and Midnapore Municipalities during the assessment period of 2019 to 2023.

assessment period from 2019 to 2023. The most valuable information regarding the past and present sewage systems was gathered from both municipalities of Kharagpur and Midnapore during this same period of study. Numerous field surveys and inspections were conducted multiple times during the assessment period in both municipal areas, including visual checks, inspections, and flow monitoring, to provide insight into the system's current state.

For the assessment of the effectiveness of the existing sewage system in both municipal areas, residents' satisfaction was measured after preparing a questionnaire and collecting their responses through the household survey. To determin the sample size (household) of the study area are estimated after using Cochran's sample size formula i.e., $n_0 = \frac{Z^2.P.(1-P)}{e^2}$ have used. In this formula, where n_0 = sample size, Z = the Z value, P= number of households, and e= the margin of error. The number of households selected randomly ranged from 10 to 11 houses in each ward of the municipalities. It is noteworthy that the highest importance was given to slum areas in every ward of the municipalities while conducting household surveys. The existing drainage map of both municipalities was prepared using Google Earth Pro satellite imagery and processed through Q.GIS image processing software. The satellite images dated 13.06.2024 for Kharagpur and Midnapore Municipality were taken into consideration for the preparation of the drainage map. The tabular format outlines

Table - 1

Area or Percentages of different latrine systems existed in the various households of Kharagpur Municipality.

No. of Households /(%0f facilities)	Piped sewer system	Septic tank	Other system	Pit With slab/Ventilated improved pit	Latrine Without slab/open pit	Night Soil disposed of into open drain	Night soil removed by human	Night soil serviced by animals	Public Latrine	Open latrine
16,901 (100%)	1,167 (6.9%)	9,388 (55.55%)	36 (2.17%)	173 (1.02%)	40 (0.24%	103 (0.61%)	52 (0.31%)	221 (1.31%)	1,483 (8.77%)	3,908 (23.12%)

Source: - village and town-wise Primary Census Abstract (PCA) 2011, Paschim Medinipur.

(Fig. 2) mentioned the methodology which was taken into consideration to fulfil the objectives.

Results and Discussion

A. i. Present sewage system analysis of Kharagpur Municipality

a. Latrine system analysis:

An analysis of the latrine systems within Kharagpur Municipality, based on the 2011 Primary Census Abstract (PCA) (Table 1), reveals a variety of sanitation facilities among the 16,901 households. The majority of households which comprise 55.55% use septic tanks, while 6.9% of households are connected to piped sewer systems. Other systems are rare, with only 2.17% of households using alternative methods. Basic sanitation facilities, like pits with slabs or ventilated improved pits, serve 1.02% of households. Primitive methods include 0.24% of households using latrines without slabs or open pits and about 0.61% of households disposing of night soil into open drains. Public latrines are used by 8.77%, of households highlighting a reliance on communal facilities. Alarmingly, a significant amount of 23.12% of households resort to open defecation, reflecting significant sanitation challenges.

Evaluating the municipality's sewage system includes assessing latrine facilities' structural health, usage, and hygiene standards, and their impact on public health and the environment. This review helps identify sanitation deficiencies and suggests improvements for waste management and connections to the main sewage system. Community involvement and education on proper usage and maintenance are crucial. A detailed report with findings, recommendations, and a phased implementation and monitoring strategy ensures sustainability and effectiveness.

According to data obtained from Kharagpur Municipality (Table 2) in 2023, depicted that approximately 7,997 sanitary latrines were constructed within a certain timeframe or as part of specific programs or initiatives in the last ten years. Additionally, 8,300 families have been provided with sanitary latrines under the Integrated Low-Cost Sanitation (ILCS) scheme, Basic Services to the Urban Poor (BSUP), Integrated Housing and Slum Development Programme (IHSDP), and Housing for Urban Poor (HUP) programs. The municipality also has 139 community latrines or public toilets, which are often located in public spaces such as markets, parks, transportation hubs, or densely populated urban areas.

Sanitary latrines are crucial for proper human waste disposal, maintaining hygienic conditions, and preventing disease spread. Their construction might be part of government-led sanitation programs, community-driven initiatives, or efforts by

Table - 2

The information about the Kharagpur Municipality initiative to improve the latrine system for the residents.

No. of sanitary latrine construct	7997
No. of family provided with Sanitary Latrine under ILCS+BSUP/IHSDP+ HUP (together)	8300
No. of Community Latrine/Public Toilet	139

Source: - Kharagpur Municipality dated 23.05. 2023 at 3.30pm.

non-governmental organizations (NGOs) or international agencies. These latrines can be found in households, schools, healthcare facilities, and public areas to ensure everyone has access to safe and dignified sanitation. Community latrines and public toilets offer an essential alternative for those without private facilities, promoting community-level sanitation and hygiene practices.

b. Drainage System Analysis:

Kharagpur Municipality's drainage system spans 676.61 kilometers,

Table: -3
Existing Drain Scenario of Kharagpur Municipality

Length of Kutcha Drain (in km.)	11.34
Length of Pucca Drain (in km.)	665.34
Total length of Drain (in km.)	676.61
No. of wards fully covered with Pucca Drain	12
No. of wards partly covered with Pucca Drain	23
Clearance of drains	Regularly
Laboure involved for drain clearance	200
Water logging situation happened in the year of	2021
Ward no. where water logging condition happened	2,3,4,5,6,7,8,10,28,29,25
Immediate action taken during water logging conditions arose	1. immediate pumping 2. clean up the drains
No. of reservoirs existed in the municipality	14
Daily amount of supplied water to the residents	135ltr/head

Source: - Kharagpur Municipality

predominantly with pucca (concrete) drains (665.34 km) and a small portion of kutcha (earthen) drains (11.34 km). Twelve wards have full pucca drain coverage, while 23 wards have partial coverage, maintained by 200 laborers. Despite regular maintenance, waterlogging affected several wards in 2021, requiring immediate measures like pumping out water and cleaning drains. The municipality also operates 14 reservoirs, supplying residents with 135 liters of water per person daily (Table 3).

However, field observations indicate poor sewer conditions, with many drains clogged by sludge, plastic, and domestic waste. Key issues include murky water due to inadequate purification and insufficient drainage leading to flooding. Household and commercial waste is often improperly disposed of in drains, and there is a lack of community awareness on waste management. Despite municipal claims of regular cleaning, the current state of many drains contradicts these assertions, highlighting the need for improved waste management and public awareness efforts.

The article in Anandabazar Patrika on 14th February 2020 also portrayed the same observation as the researcher mentioned here.

c. Analysis of existing drain types:

The PCA 2011 data from Paschim Medinipur district (Table 4) shows that among 16,901 households surveyed, a majority (68.71%) rely on open drainage systems, using channels or gutters for wastewater disposal. A smaller percentage (7.8%) have closed drainage systems, offering more structured wastewater management. Surprisingly, a significant number of households (23.49%) reported having no drainage system at all. This highlights varying levels of infrastructure and challenges in wastewater management, underscoring the need for targeted interventions to improve sanitation and public health outcomes in the community.

Table: -4

Types of drains in Kharagpur Municipality

Total no. of Households	Closed drainage	Open Drainage	No drain
16,901	1318 (7.8%)	11,613 (68.71%)	3,970 (23.49%)

Source: - village and town-wise Primary Census Abstract (PCA) 2011, Paschim Medinipur.,

A. ii. Present Sewage system analysis of Midnapore Municipality

The analysis of data from Midnapore Municipality (Table 5) reveals that 65% of households in the municipal area are covered by water supply networks, but many in slum areas lack this system, relying instead on tube wells and wells for domestic and drinking

Table: -5

Existing Sewage and water supply Scnerio in Midnapore Municipality

Sources of water	Total existing number
Water Treatment Plant	Nil
Deep Tube well	92b
Hand Tube well	448
Street Stand post	4580
Houses connected with Water Supply Network	11,047
Percentage of households connected with municipal water supply networks	65%
Length of Water pipeline:-	558.86 km.
No. of reservoirs existed in the municipality	CWR-5 Nos OHR-13 Nos.
Daily amount of supplied water to the residents	85 LPCD (liter per capita per day)
Total water consumption in MLD	32.01 MLD
Total sewage generation in MLD	25.91 MLD
No. of existing Sewage Treatment Plant (STP)	nil
Amount of daily treated sewage	nil
Amount of daily untreated sewage generation	25.91 MLD
The drains are cleaned up in a week.	Weekly one day
No. of municipal sweepers are daily involved in drain clearances	236

Source: - Midnapore Municipality dated 05. 12.2023 at 1.30 pm.

water. Old homes typically have their own wells, with some households using both municipal piped water and groundwater sources. The municipality operates 448 hand tube wells and 92 deep tube wells across various wards, primarily serving commercial areas like bus terminals, hotels, and markets. These tube wells are aging, with no new ones being constructed currently due to municipal restrictions and regulations.

Drinking water, sourced from groundwater via 558.86 kilometers of pipelines connected to thirteen OHR and five CWR reservoirs, supplies 85 liters per capita per day (LPCD) to residents, totaling 32.01 million liters per day (MLD). In contrast, an estimated 25.91 MLD of wastewater is generated daily in the municipality. This wastewater flows untreated through major canals like Daribadh Canal and Jharna Khal, along with smaller drains, ultimately discharging into the Kangsabati River. Despite 236 daily sweepers employed for drain cleaning, these efforts are sporadic, occurring weekly or as needed, reflecting ongoing challenges in wastewater management and sanitation infrastructure maintenance within Midnapore Municipality.

b. Drainage system analysis

The drainage system in Midnapore Municipality comprises various types of drains totaling 232.95 kilometers in length, including 30.60 km of kutcha drains, 202.35 km of pucca drains, and 45 km of covered drains. Pucca drains fully cover 25 wards, with partial coverage in 11 wards, while underground drains are absent, relying solely on surface drainage systems (Table 6). However, pollution remains a significant issue, particularly from Daribandh Khal and Jharna Khal drains, which discharge wastewater into the Kangsabati River, posing environmental challenges.

In response, efforts have been made over the past five years to address drainage issues, including the construction or repair of 115 km of drains. These initiatives aim to improve infrastructure, reduce flooding risks, curb pollution, and promote environmental sustainability within the municipality.

c. Industrial scenario concerning with sewage generation

The industrial scenario of Midnapore Municipality (in Table 7) portrayed that no major industries are located in the municipal area. Here mainly food processing small-scale industries are seen like Maity Feed Foods & Packaging Private Limited,

Table: -6

Existing Drainage Network in Midnapore Municipality

Present drainage scenario	**Total existing length/numbers**
Length of Kutcha Drain (in km.)	30.60
Length of Pucca Drain (in km.)	202.35
Length of covered Drain (in km.)	45
Total length of Drain (in km.)	232.95
No. of wards fully covered with Pucca Drain	25
No. of wards partly covered with Pucca Drain	11
Length of underground drains(km)	nil
No. of drains contributing to pollution in Kangsabati River	02
Name of the major drains (khal) which carry the maximum amount of wastewater and are ultimately disposed of into Kangsabati river	1. Daribandh Khal 2. Jharna Khal
Lengths of newly constructed or repaired drains in the last 5 years	115 km

Source: Midnapore Municipality, dated 05. 12.2023 at 1.30 pm.

Table: -7

Water consumption, waste generation in the industrial area of Kharagpur Municipality

A significant number of industries are located in major industrial estates.	nil
The total number of industries that either directly or indirectly discharge wastewater into Kangsabati River.	04
Daily water consumption of the industries	637.24 KLD
Daily effluents generation by the industries	430.80 KLD
No. of industries having captive ETPs	04
Effluent treatment capacity of the said industries	430.80KLD
Effluents treatment gap	nil

Source: Midnapore Municipality dated 09. 12.2023 at 1.30 pm

Sitalamata Oil Mill Private Limited, Kamal Rice Mills Private Limited, etc. The field observation study shows that four small-scale industries were noticed that either directly or indirectly discharge wastewater into the Kangsabati River. The Daily water consumption of the industries is around 637.24 KLD. Daily effluent generation by the four industries is 430.80 KLD. The four industries have Effluent Treatment Plant (ETP). The goal of an Effluent Treatment Plant (ETP) is to discharge safe water into the environment while reducing the detrimental effects of wastewater. ETPs are specifically intended to purify industrial wastewater for reuse. The effluent treatment capacity of the said industries is 430.80 KLD. So, according to the said amount of industrial waste generation and wastewater treatment capacity in the municipal area portrayed that no untreated liquid waste is discharged into the Kangsabati River.

d. Existing Drainage Network (Ward–wise pucca drain)

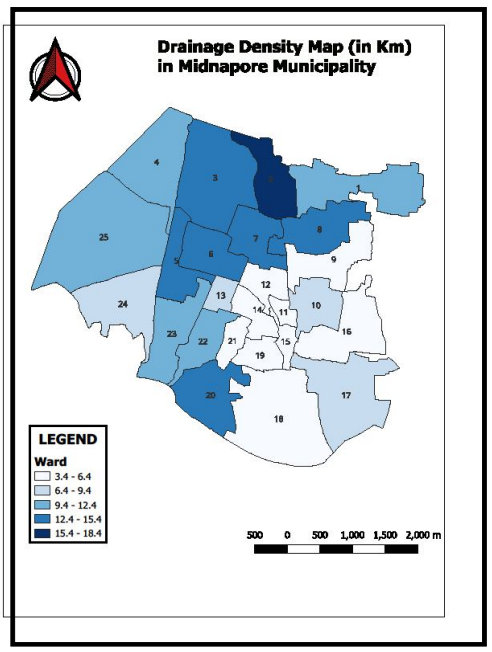

Fig 4 Drainage density map of Midnapore Municipality

The existing drainage lengths of the various wards in the municipality are not eventually distributed in the Midnapore Municipality. The drainage density in various wards of the municipality is mentioned in (Fig 4). The municipality's drainage infrastructure is strategically distributed across its various wards, with each ward hosting a distinct length of drains. Ranging from Ward No. 1 with 9.75 kilometers to Ward No. 25 with 10.38 kilometers, the total network spans 232.95 kilometers. This comprehensive system plays a pivotal role in managing surface water runoff, mitigating flooding, and maintaining the environmental resilience of the area. The lengths of drains in each ward reflect the localized needs and topographical characteristics, with some wards featuring longer drain networks to accommodate higher water volumes or specific terrain conditions. Ward No. 2 holds the longest stretch at 18.43 kilometers, while Ward No. 11 has the shortest at 3.96 kilometers.

B. Assessment of resident's satisfaction with the existing sewage system in Kharagpur and Midnapore Municipality through net Promoter score (NPS) metric.

Net Promoter Score or NPS is a metric used to quantify customer satisfaction or experience. NPS calculates a customer's level of loyalty to an organization. NPS are calculated using a single survey question and provided as a number between -100 and +100. NPS is frequently cited as the most reliable indicator for measuring satisfaction level. In 2003, Fred Reichheld, a partner at Bain & Company, invented a new technique of assessing consumer satisfaction through the NPS parameter. The differentiation between positive and negative feedback is based on NPS scores. The NPS is a metric for customer loyalty and satisfaction. It categorizes respondents into three groups based on their responses to a question. On a scale from 0 to 10.

Evaluation of NPS:

The data (Table 8) for Midnapore Municipality, the residents' satisfaction regarding the present sewage system are measured using the NPS metric. Since NPS uses a 0-10 scale, we need to adapt the satisfaction levels to this scale. Here's a suggested mapping for our data:

Excellent = 9-10, Good = 7-8, As usual = 5-6, Poor = 0-4

1. Categorize Residents:

Promoters (9-10): Residents who rate 'Excellent', Passives (7-8): Residents who rate 'Good'

Detractors (0-6): Residents who rate 'As usual' or 'Poor'.

2. The formula for Calculation of NPS:

$$NPS = \frac{(\text{Number of Promoters} - \text{Number of Detractors})}{\text{Total No of respondents}} \times 100$$

3. Data Tabulation

Satisfaction Level	Numerical Value	Number of Residents
Excellent	9 - 10	31
Good	7 - 8	59
As usual	5 - 6	78
Poor	0 - 4	79

- **Promoters**: 31 residents (Excellent)

i) Midnapore Municipality

Table: - 8

Ward-wise resident's satisfaction about present sewage system of Midnapore Municipality

Ward No.	Excellent	Good	As usual	poor	Ward No.	Excellent	Good	As usual	poor
1	1	2	5	2	**14**	0	0	5	5
2	1	2	3	4	**15**	1	5	2	2
3	4	2	3	2	**16**	1	2	4	3
4	1	4	2	2	**17**		3	5	2
5				9	**18**	1	3	3	2
6	0	2	3	5	**19**	1	3	4	2
7	1	2	2	4	**20**	1	2	3	4
8	1	2	3	4	**21**	0	2	8	
9	1	6	2	1	**22**	0	2	4	4
10	3	2	2	4	**23**	2	1	3	4
11	1	3	2	4	**24**	0	4	3	2
12	7	2	0	1	**25**	0	0	6	4
13	3	3	1	3	**Total**	**31**	**59**	**78**	**79**

Source: - Ward-wise resident satisfaction with existing sewage system data was collected through the household survey in Midnapore Municipality during the assessing year of 2019 to 2023.

- **Passives**: 59 residents (Good)
- **Detractors**: 78 + 79 residents (As usual + Poor) = 157
- **Total number of respondents**: 247

NPS = $\frac{31-157}{247} \times 100$ = "51.01

Therefore, the **NPS** = -51.01

Interpretation and remarks:

An NPS of -51.01 is quite low, indicating a high level of dissatisfaction among the residents regarding the sewage system. The negative score highlights that the number of Detractors (dissatisfied residents) significantly outweighs the number of Promoters (highly satisfied residents). The NPS suggests that the majority of residents are not satisfied with the effectiveness of the existing sewage system in Midnapore Municipality. This points to a critical need for improvements to address resident concerns and enhance overall satisfaction.

ii) Kharagpur Municipality

Satisfaction level as opinioned by the residents of Kharagpur Municipality about the present sewage system during household survey

Table- 9

Ward No	Excellent	Good	As Usual	Poor
1	1	3	4	3
2	2	2	4	2
3	1	2	3	4
4	3	1	3	3
5	1	3	3	2
6	0	5	1	4
7	0	2	3	4
8	1	3	4	1
9	2	2	3	1
10	1	3	2	3
11	1	3	2	4
12	1	2	3	4
13	0	4	6	1
14	1	3	2	3
15	1	1	6	2
16	3	2	2	3
17	1	5	0	4
18	2	3	5	0
19	1	1	6	2
20	0	7	0	3
21	2	1	6	0
22	0	2	5	3
23	3	1	5	1
24	2	4	2	2
25	0	2	9	0
26	1	1	2	6
27	2	2	4	2
28	0	3	3	4
29	2	2	2	4
30	2	3	2	3
31	2	2	2	4
32	1	0	5	4
33	1	2	2	4
34	2	2	2	4
35	0	2	4	4
Total	43	86	117	98

Source: - Ward-wise resident satisfaction with existing sewage system data was collected through the household survey in Kharagpur Municipality during the assessing year of 2019 to 2023.

Evaluation of NPS: -

Here, the same NPS metric is applied to assess the residents' satisfaction level with the existing sewage system maintained by Kharagpur Municipality (Table – 9).

The formula for NPS calculation= $\frac{(\text{Number of Promoters} - \text{Number of Detractors})}{\text{Total No of respondents}} \times 100$

Step 1: - Total Number of Responses

Total Responses= 43(Excellent) + 86 (Good)+ 117(As Usual) + 98(Poor)=344

Step 2: - Classify Responses

- Promoters: 43 (Excellent)
- Passives: 86 (Good)
- Detractors: 117 (As Usual) + 98 (Poor) = 215

Step 3: - Calculate Percentages

Percentage of promoters = $\frac{43}{344} \times 100$ = 12.5%

Percentage of detractors = $\frac{215}{344} \times 100$ = 62.5%

Step 4: - Calculate NPS

NPS = 12.5% - 62.5% = -50

Therefore, the NPS is -50, indicating a significant number of detractors compared to promoters.

Interpretation of the NPS results and remarks

i) Promoters (12.5%): - Residents who are highly satisfied with the sewage system and are inclined to refer others to it are known as promoters. Only 12.5% of respondents, however, fit this description, suggesting that only a tiny percentage of people are really happy with the current system.

ii) Passives (25%): - Although they aren't quite pleased, passives aren't fervent enough to qualify as promoters. They may not care and may even be persuaded by more appealing options. With 25% of the respondents falling into this group, there is a moderate level of satisfaction without any strong opinions.

iii) Detractors (62.5%): - Residents who are dissatisfied with the sewage system are likely to be detractors and voice their negative opinions. Detractors made up 62.5% of the responses, indicating a high degree of discontent. These locals might believe that there is much space for development in the sewage system, or that it is insufficient.

Interpretation and remarks: According to the NPS assessment, the Kharagpur municipality's present sewage system has a lot of difficulties fulfilling the expectations of the local population. Through focused measures to tackle the problems and include the community, the municipality can strive to enhance contentment and eventually attain a higher Net Promoter Score.

Existing Drainage Network Map of Both Municipalities

The existing drainage network map of Kharagpur and Midnapore Municipalities prepared through Q.GIS software from Google Earth Pro are mentioned in Fig 5 & 6. It is observed that more than 87% of drains lay along both sites of roads.

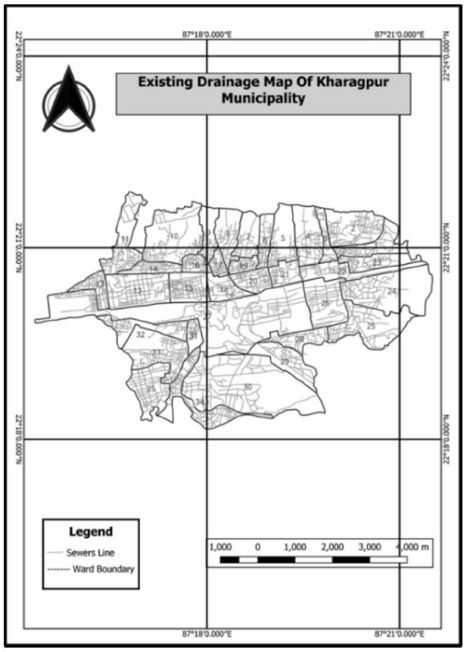

Fig 5 Existing drainage map of Kharagpur Municipality

Fig 6 Existing drainage map of Midnapore Municipality.

Conclusion: - The existing sewage facilities of both municipalities have been discussed using primary and secondary data. Information obtained from both sources about the current sewage systems in Kharagpur and Midnapore municipalities suggests they are inadequate given their populations. The lack of sewage treatment plants in both municipal areas has resulted in the raw discharge of contaminated wastewater into the Kangsabati River which negatively impacted the water health quality of the river. Resident satisfaction with the existing sewage system indicates that the local governing authority, i.e., the municipality, does not adequately maintain the sewage system. The present study asserts that to clean the urban environment and protect public health from various waterborne diseases, the Kharagpur and Midnapore Municipalities should give extra attention to drainage clearance, maintenance, and develop sewage treatment plants immediately. The study also suggested

that putting in place regular maintenance plans and real-time monitoring systems to quickly find and fix problems like leaks or blockages which could enhance the sewage efficiency. To ensure long-term sustainability, local communities should be involved in the upkeep and monitoring of the sewage systems as well as public education on appropriate waste disposal methods. The study may claim that securing funds from both public and private sectors and implementing laws that encourage the construction and upkeep of strong sewage systems. In addition to being an infrastructure requirement, fixing the flaws in Kharagpur and Midnapore's sewage systems is essential to creating a more hygienic, sustainable, and clean urban environment. By putting these upgrades into practice, citizens' quality of life will be greatly improved, and the towns' general growth and development will be aided. The measurement of residents' satisfaction levels regarding the effectiveness of the existing sewage systems in both municipalities might suggest that the present scenario of sewage systems is unable to maintain the requirements of the residents in both municipalities.

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