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AN ASSESSMENT OF PRESENT SEWAGE SYSTEM IN MIDNAPORE MUNICIPALITY, WESTBENGAL, INDIA AND ITS IMPACT ON THE WATER QUALITY OF THE RIVER KANGSABATI

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Abstract:
The quality of life and public health are multifaceted concepts that dynamically vary with the living environment. A clean and healthy environment indicates a creative and prosperous living condition. In this current research paper, assessment of present sewage system in Midnapur town was done and the physico-chemical properties, viz pH, DO, BOD, COD, TC, FC, Conductivity & Turbidity of the water of Kangdabati river flowing through Midnapore town were studied and an attempt was made to assess the impact of discharging sewage in the Kangsabati at different points by comparing estimated values of different physico-chemical and microbial parameters of the Kangsabati River water with the standard water quality of WHO.
The sanitary system of Midnapore municipality was found to be comprised of numerous open canals and drains which drained into Kangsabati through two main canals into three major points of the river. This existing drainage network did not follow its actual surface gradient in most cases. Estimation of Physicochemical and microbial parameters of Kansabati river showed optimum levels of pH and DO however BOD and COD values showed higher ranges than admissible limits.Conductivity and turbidity levels were also higher than optimum indicating water not suitable for fresh water organisms. In this study, the Kangsabati river water contains high amount of Total Coliform(TC) ranging between 2600MPN/100ml to 30800MPN/100ml at all sites which suggested polluted aquatic environment with low concentration of oxygen. The amount of Faecal Coliform(FC) in the Kangsabati River water were found to be seasonally ranging between 1700MPN/100ml to 29000 MPN/100ml indicating mixing of waste polluted water from the nearby Midnapore Municipal area into the river water.

Keywords:- Urbanization, Population explosion, Sewage system, Sewage contamination, Midnapore Municipality, Drainage network.

Introduction:

The urban centers in India have been under extreme pressure due to population explosionespecially in the post-independence era. Although the scope of urbanization has increased gradually but considerable differences are however observed between the size of population and the extent of urbanization. The infrastructural development in cities has not been sufficient to cope with the population increase. In global as well as Indian context, sewage system in urban areas is an important phenomenon because of rapid urbanization, industrialization, and population growth, along with increase of slum and migration. The concepts of quality of life and health security is directly or indirectly associated with the infrastructural conditions like sewage system to the city population. Thus the presence of efficient drainage and sewage system plays an important role for prevention of spread of waterborne diseases in the major cities. There are almost 48.9% households have no drainage facility, while 33% households have only open drainage system in India (census report, 2011). Sewage contamination is a global threat that occurs in most areas where human beings live and also threatens habitats and biodiversity. The present paper is an assessment that highlights

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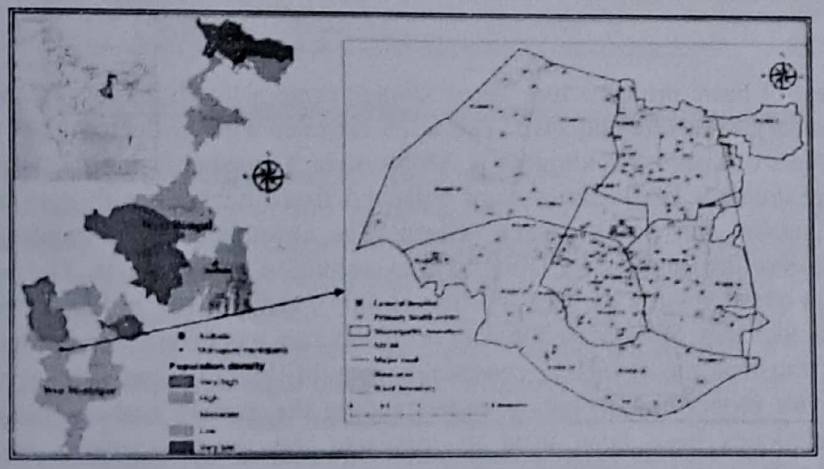
the relationship between present population size and sewage system in Midnapore Municipality area. The river Kangsabati flows in the south-eastdirection in the peripheral area of the Midnapore town. All the liquid waste generated from various sources within the Midnapore town flows through the various small existing drainage network of the city and finally drains into the Kangsabati River. The present study tries to assess the present sewage system of Midnapore Municipality and its impact on Kangsabati river where the sewage drains and possible plans for better sewage management.

Materials and Methodology:

Study area: - Midnapore town is the administrative head quarter of West Medinipur district. The locational co-ordinates of the town is the intersection of 22°2' N parallel of latitude and 87°19' E meridian longitude. Midnapore Municipality which was the study area consisted of 25 wards with 1,69,264 population as per the census of 2011, out of which 84,977 were male population and 84,287 were female population. The town Midnapore stretches over an area of 18.65 Sq. Km.It is bounded by Abhas in north, river Kangsabati in the south, pilgrim road (since converted to N.H.No 60) in the east and Rangamati in the west.

Basic features of the study area:-The study area is of generally flat topography with mild slope. From the DEM map, (the G.I.S. tool for analyzing the surface slope) it has been observed that, the surface gradient of the Municipal area lies towards the eastern and southern fringes. The river Kangsabati is also considered as the place where all liquid waste are ultimately discharged through the existing drainage network. The Kangsabati river is the secondary tributary of Bhagarathi Hooghly river, is generally non-perennial river.The major drainage system in the Municipality consists of (i) Dwaribandh Khal (ii) Kangsabati river and (iii) Some erstwhile agricultural Land.

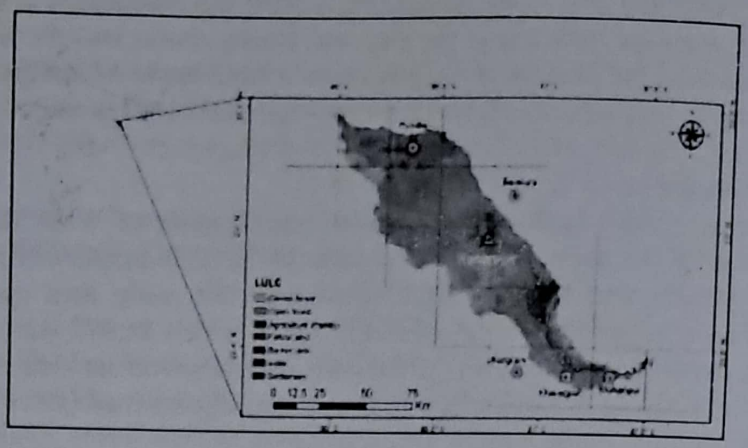
Location map of Midnapore Municipality,West Bengal, Iindia



River course:- The Kangsabati River originated from Chota Nagpur Plateau inside Jharkhand State, India. Afterthat, it passed through the Purulia, Bankura and Paschim Medinipur district in west Bengal. The Kangsabati river flows into the Bay of Bengal under the name Keleghai, named Keleghai after its confluence with the Rupnarayana River near Ghatal Sub-division in West Medinipur district. The non-Perennial River Kangsabati has been divided into three major courses, up-stream course, middle stream course & lower stream course. Jhalda in Purulia District to Sarenga in Paschim Medinipur district is its upper course flows mainly in plateau area.The middle course is extending up from Sarenga to Mohonpur in Paschim medinipur district and the lower course extended from Mohonpur to Ghatal where it meets with Rupnarayan River and named as Kaleghai. The total river basin of Kangsabati River is nearly about 465.23 km. The study area of Medinipore.

Municipality is located at the lower -middle course of it.

Kangsabati River Basin



Source: Modeling the dynamics of evapo-transpiration using Variable InfiltrationCapacitymodel and regionally calibrated Hargreaves approach. :-Srivastava, Sahoo, Raghuwanshi,Chatterjee.

Objectives of the study:-

The followings were the major findings of the study.

1. To assess the present sewage system of Midnapore Municipality with respect to itspresent population pressure.
2. To estimate the pollution level of Kangsabati river through analyzing the physio-chemical & microbial parameters of the river water
3. To propose a suitable strategies to be adopted for better sewage management

Methodology:-

For the assessment of basic infrastructure about sewage system in Midnapore Municipal area both primary and secondary data were collected. The water samples were collected from Kangsabati river at three major points or sites i. Gandhighat ii. Shibananda Yogashram and iii. Istriganj, where the major canals were drained. The samples were collected from the sites with periodical interval i.e. pre-monsoon, monsoon, and post-monsoon season. The appropriate and standard protocol were maintained to preserve the samples for laborotical examination and analysis. The household survey were done through questionnaire. At least 3% households were covered in this survey within the 25 wards of the municipal area. Some valuable data orinformation has been taken from Government and non-Government statistical report such as census report, published relevant articles or Journals of the said municipality for proper assessment or understanding the ground reality. Some Statistical and Cartographic Techniques have been used to represent the actual scenario of the study area graphically. G.I.S software like Q-GIS, Arc.GIS were used to represent the data diagrammatically. Area-velocity method were applied by using survey instruments like leveling and digital water current meter or flow meter toestimate the amount of sewage generated within the municipality.

Sl.no	**Sample site**	**Months Considered for study for the three specific periods**
1	Gandhighat	March, April, May,June considered as pre-monsoon period
2	Shibananda Yogashram	July, August, September, October considered as Monsoon period
3	Istriganj	November, December, January & February considered as post-monsoon period

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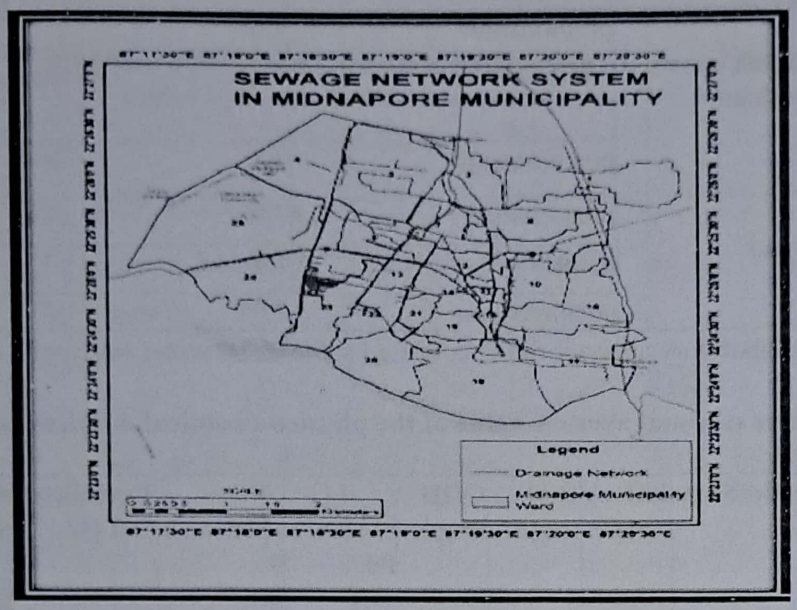
Result & Discussion

Existing Drainage Scenario of the Municipality:- There were so many small canals lied in the various wards of the Municipality. These Small canals interconnectedly carried all the domestic and industrial liquid wastes and discharged them into **1.Daribandh Khal and 2.Jharna Khal.** which finally discharged into the Kangsabati river. These two canals have been carried out maximum amount of domestic and industrial liquid waste generated within the Municipality. Though there were so many small liquid discharged points along the bank of Kangsabati river but there were three major discharged points i.Gandhighat ii. Shibananda Yogashram & iii. Istriganj. where maximum amount of liquid waste were drained into kangsabati river.

Being an oldest municipality, due to the lack of adequate land and proper urban planning for sewages the existing drainage scenario was not sufficient in respect of its present population size.



Estimation of Daily sewage generation in the Municipality:-

Discharge, or the volume of water were flowing through the two main canals i.e. Draibadh Khal and Jharna Khal in the Municipality were calculated with the equation:- Q = AV, where Q is discharge (volume/unit time-e.g. m^3/second, also called cumecs), A is the cross-sectional area of the stream (e.g. m^2), and V is the average velocity (e.g. m/s). By using the equation it was estimated that the total amount of domestic liquid waste discharged through the canals at all I,II, & III sites was 28.89 MLD. Though the maximum amount of effluents were discharged at Gandhighat in Midnapore town through Daribadh Khal. Besides it, The daily water consumption of the major four water polluting industries located within the Municipality were 637.24 KLD. Whereas, these industries discharged near about 430.80 KLD polluted water into the River daily (Action Plan For Rejuvenation of River Kansi Submitted to Central Pollution Control Board, Delhi JULY, 2020)

Water health quality assessment of the river Kangsabati:-To assess the water health quality and pollution level of river Kangsabti some physio-chemical & microbial parameters have been examined in the laboratory after selecting three sampling stations of Gandhighat (the major effluent points of discharge), Shibananda Yogashram, and Istriganj. The samples were collected in periodically i.e. pre-monsoon, monsoon and post monsoon from 2020 to 2022. The average annual value of the physical & chemical parameters are shown in tabulation with periodically

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Table: -1 Three seasonal average value of the physical parameters (three year average)

Sample sites	eriod ofsurvey	pH (Three year avg. value 2020 - 2022)	Temperature(°C) (Three year avg. value 2020 - 2022)
Gandhi ghat	premonsoon	7.15	33
	monsoon	7.51	30
	postmonsoon	7.69	25
Shibanda Yogashram	premonsoon	7.0	32
	monsoon	7.45	29
	postmonsoon	7.8	26
Istriganj	premonsoon	7.05	33
	monsoon	7.4	31
	postmonsoon	7.75	26

Source ((Table-1)laboratory analysis of the collected samples by water analyzer 371(systronics)

Table: -2 Three seasonal average value of the physico-chemical & microbial parameters

Sample Site	PeriodofSurvey	DO (mg/l)	BOD (mg/l)	COD (mg/l)	TC (MPN/100 ml)	FC (MPN/100 ml)	Turbidity (NTU)	Conductivity (µs/cm)
Gandhighat	Pre-monsoon	7.2	1.95	10.16	10500	3400	20.55	335.14
	Monsoon	8.0	2.63	13.5	8000	2500	41.5	385.33
	Post-monsoon	9.0	2.21	13.6	9100	3800	15.54	945.85
Shibanandda Yogashram	Pre-monsoon	6.92	2.00	9.23	6900	2200	21.5	323.56
	Monsoon	7.55	2.65	12.5	7800	3100	37.30	175.58
	Post monsoon	8.85	2.11	11.8	10200	3250	13.7	777.43
Istriganj	Pre-monsoon	6.75	1.81	9.9	7700	2900	19.55	460.51
	Monsoon	7.62	2.69	12.3	8250	1900	33.40	297.89
	Post-monsoon	8.25	2.08	14.2	9100	2700	12.9	831.41

Table:-3Annual average value of the physico-chemical & microbial parameters

Sample Site	Period	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	TC (MPN/ 100 ml)	FC (MPN/100 ml)	Turbidity (NTU)	onductivity (µs/cm)
Gandhighat	Pre-monsoon	7.65	8.4	2.26	13.10	9200	3233	23.86	288.77
	Monsoon								
	Post-monsoon								
Shibananda Yogashram	Pre-monsoon	7.75	7.63	2.25	11.20	8300	2850	19.83	258.86
	Monsoon								
	Post monsoon								
Istriganj	Pre-monsoon	7.60	7.59	2.19	12.13	8350	2503	20.61	249.94
	Monsoon								
	Post-monsoon								
Range (2020-2022)		.23 - 9.00	5.20 - 9.56	.75 - 3.26	8.85 - 14.12	2600 - 30800	1700 -2900 0	12.9 - 41.5	111.70 - 381.50

Source:- (Table-3) laboratory analysis of the collected sample by water analyzer 371(systronics)
*Annual average value (2020 - 2022)

potential of Hydrogen(pH):-
In this study, the average periodical pH value of Kangsabati river ranged between 4.23 to 9.00 at three sample sites. So, these results indicated the water of Kangsabati river was slightly acidic which could be attributed to the regular mixing of domestics liquid waste and industrial disposals from the nearby town. Though, this value sometimes raised above9 but it was occasionally and especially occurs during the monsoon period.

Dissolved Oxyzen (DO) :-
The annual average value of DO in the Kangsabati water was 8.4, 7.63 and 7.59 at site I,II,&III respectively. The seasonal value of DO showed a range of 5.20 -9.56 at all sites. Though this value dropped below 4 at Gandhighat in June 2021.The DO value of the riverwater has been reported very much fluctuating. As per standard literature, if the DO level ranges from 5-12mg/L provides best condition for grow fish species. However, if levels drop below 4 mg/L, they may stop feeding and become stressed, possibly leading to large fish kills.

Biological Oxygen Demand (BOD): -
The annual average value of BOD were estimated 2.60 mg/L, 2.03mg/L and 2.23 mg/L at site I,II,&III respectively. As per WHO guideline the optimum value of BOD, the reported BOD value is

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not to be suitable for aquatic life.

Chemical oxygen demand (COD):-
The annual average value of COD in Kangsabati river water ranged from 8.85 to14.12 mg/l at all sites (2020 – 2022). According to WHO recommendations, optimum value of Chemical Oxygen Demand (COD) is 10mg/L in drink water.

Total Coliform (TC):-
In this study, the Kangsabati river water contains high amount of Total Coliform(TC) were ranging between 2600MPN/100ml to 30800MPN/100ml at all sites (2020 – 2022) which suggested polluted aquatic environment with low concentration of oxygen. Coliform bacteria when present in drinking water causes for the increased the risk of contracting a water-borne illness.

Faecal Coliform (FC) :-
The amount of Faecal Coliform in the Kangsabati River water were seasonally ranging between 1700MPN/100ml to 29000 MPN/100ml due to regular mixing of waste polluted water from the nearby Midnapore Municipal area into the river water. Faecal Coliform in the water caused for the high risk of several water born diseases.

Turbidity: -
The periodical value of Turbidity in the Kangsabati river water were ranging between 12.9 to 41.5 NTU seasonally at all considered sites . The medium amount of turbidity suggests medium water clarity.There is an inverse relationship between Turbidity and water clarity which determines the quality of aquatic environment. It can harm fish and other aquatic life by reducing food supplies, degrading spawning beds, and affecting gill function (Minnesota Pollution Control Agency Year).

Conductivity:-In the present study the conductivity amount were ranged between 111.70 -381.50 µs/cm in the Kangsabati river water, which indicated the medium amount of impurities in the river water. Conductivity is an electrolyte solution measured of its ability to conduct electricity. Conductivity is a vital parameter when determining water quality. As salinity and temperature increase, conductivity also increases, which can have a negative effect on thequality of water. This is because the higher the conductivity, the higher amount of impurities (dissolved substances, chemicals, and minerals) are in the water (Atlas Scientific: - Environmental Robotics, sep. 2022).

Land use and land cover map of mid Napore municipality
By assessing the temporal landuse & landcover changes of the study area, the objectives of this present study are to analyze the environmental degradation which affected the health quality of Kangasabati due to discharging of liquid waste from the study area into Kangsabati river. Another objective of this study is to analyze the effects of urban expansion with temporal extension of built-up area and population growth of Midnapore Municipality.
Midnapore Municipal area is close to JUNGALMAHA Larea. In the year 1991 there were 203.81 hector land under dense vegetation whereas in 2021 this was occupying only 23.12 hector land. This data clearly shown that how much deforestation were taken place in last few time. There are near about 180.69 hector dense forest area were replaced by built up area to meet habitation demand and others purpose for its population.
The present work considered various landuse type such as waterbody, dense vegetation, degraded vegetation, grassland, agricultural land, buit up area, fellow land & lateritic soill and to understand the changes of landscape in last few decades. The fellow land area within themunicipality decreased near about 406.56 hectors in last 30 years. The above study have been shown how other landcover

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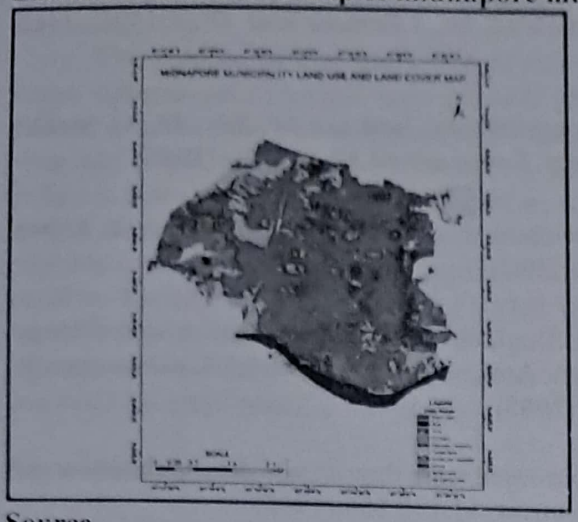
were replaced by built-up area for that habitat of its present population.

Based on the LULC and our analysis of the study area it can be concluded that underground pipeline system, regular clearance and maintenance of the existing canals and sewage treatment plant for treatment of sewage before discharge to Kangsabati river is required for better management of liquid waste.

Landuse & land cover map of midnapore municipality, 2022



Source

Operating software	**Q-GIS**
Image	**sentinel-2**
Satellite/sensor	**Landsat5/TMLandsat7/ETM+Landsat7/ETM+**

Conclusion

This study report by considering several parameters described the threatening conditions facing the aquatic ecosystem of the Kansavati Rive. A quick examination of the river water shows that the pollution of the water was increasing day by day due to the mixing of polluted water from various sources such as polluted untreated domestic waste water, mixing of agricultural pesticides, mixing of industrial (four major polluted Industries, as mentioned earlier) liquid waste etc. Besides it, the existing drainage network was not developed to follow its actual surface gradient. This leads to water logging condition in some wards like 1,8, 9, 16, 18, & 21 in this Municipality during Monsoon period with intense rainfall. Irregular clearance of drains and main two canals in the Municipality was also leading to huge siltation within the canals and the two major canals. Thus, the existing sewerage system was reducing its water holding capacity and invited water logging hazardous condition. There were a need for citizen awareness about not to

throw garbages into the drains. A master plan has been needed to be prepared as to how the existing drains could be constructed in line by maintaining its the surface gradient. At the same time, the proper infrastructure should be developed so that the liquid waste can be treated and discharged into the river.

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