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WASTEWATER TREATMENT AND MANAGEMENT IN URBAN AREAS - A CASE STUDY OF KISHANGANJ, BIHAR, INDIA

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ABSTRACT

The rapid growth of the population, the technological and industrial boom have brought enormous problems and degradation of the environment. Effective collection and treatment of urban wastewater is a critical problem in a developing country like India. The study area is Kishanganj. The wastewater treatment at Pachhimpali and wastewater reuse at Pachhimpali have been taken for the study. The wastewater quality has been studied by taking samples and the results were compared with FAO irrigation water quality standards. This research paper highlights the present wastewater treatment and management aspects of the city. An attempt has been made to identify the relevant management strategies to improve the wastewater management in the city. The suggestions could be made for utilising the treated wastewater for growing greens, vegetables and for agriculture.

I. INTRODUCTION

Water resource development has taken place all over the world. There is a tremendous amount of pressure in protecting the water resources available in the country. Protecting the surface water resources from wastewater pollution plays a vital role for the development. The disposal of wastewater into the surface water bodies leads to serious problems and affects the people in health aspects. Especially in the urban areas, the pollution of domestic effluent discharges into the nearby surface water bodies created problems for the public. There are many ways of safe disposal of wastewater. But improper management of wastewater generation in the urban areas find its own way of getting into the surface water. Hence, the effluent discharge affects the surface water bodies. The water quality changes in the surface water bodies created many health problems to the public.

Urban conglomerations are increasing at a very fast pace. Pivotal to the urbanization phenomenon are the associated problems of providing municipal services and water infrastructure, including the provision of both fresh water resources and sanitation services. Indian cities are no exception to the urbanisation process and have tremendously expanded. The major cities are growing with a daily average addition of 1000 persons. As a result of this tremendous growth, service infrastructure is not able to keep up to provide the city a healthy environment. Ample supplies of clean unused water can no longer be taken for granted due to population growth, increasing urbanisation and industrial water demands. Pollution of fresh water streams and ground

water by industrial discharges result in depletion of existing water sources. Hence, it is increasingly becoming obvious that reuse of wastewater is a viable solution in many instances.

II. STUDY AREA

Kishanganj district is an important region in the state and has been a centre of activities for many historical events from the days of the early Cholas.During the period of Khagada Nawab Mohammed Fakiruddin one of the Hindu saint arrived,he was tried and wanted to rest at this place but when he heard that this place name is Alamganj the river name is Ramzan and the Jamindar name is Fakiruddin he refused to enter at Alamganj.After that the Nawab decided and announced some portion from Kishanganj(Present) gudri to Ramzan pool Gandhi ghat as Krishna-Kunj.As time passed by name gets converted to present KISHANGANJ.Kishanganj city is located at the north-east part of India it is srounded by two international border i.e, Nepal and Bangladesh. Co-ordinate of this City lies between 26°04′46″N and 87°56’14″E.

Kishanganj city is divided into seven(07) blocks namely Thakurganj, Bahadurgunj, Kochadhaman, Pothiya, Terhagachh, Dighalbank, and Kishanganj. Each block consists of 15 Panchayat. The climate is Tropical and temperature ranges from 19°C to 31°C. The Mahananda river is the most important river in the city and the tributaries of Mahananda i.e., Dock river,Mechhi river,Ramzan river also drain in the city.

III. POPULATION GROWTH

Climate data of Kishanganj, Bihar													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C	24.0 (75.2)	26.6 (79.9)	31.9 (89.4)	34.7 (94.5)	33.7 (92.7)	32.5 (90.5)	31.9 (89.4)	31.9 (89.4)	31.8 (89.2)	31.1 (88)	29.0 (84.2)	25.3 (77.5)	30.37 (86.66)

The principal factor for determining the future water needs of a city are its population and its industry production. As these factors increase, the use of water and the disposal of wastewater will increase. The present and estimated future population is presented in the Table1.

(°F)													
Average low °C (°F)	9.8 (49.6)	11.6 (52.9)	15.9 (60.6)	20.6 (69.1)	23.6 (74.5)	25.2 (77.4)	25.7 (78.3)	25.4 (77.7)	24.8 (76.6)	21.8 (71.2)	15.2 (59.4)	10.7 (51.3)	19.19 (66.55)
Average rainfall mm (inch)	11 (0.43)	6 (0.24)	22 (0.87)	36 (1.42)	165 (6.5)	479 (18.86)	532 (20.94)	399 (15.71)	360 (14.17)	83 (3.27)	6 (0.24)	0 (0)	2,099 (82.65)

Table 1

Sl. No.	Method	Year		
		2000	2010	2020
1	Arithmetical method	773696	875151	976607
2	Geometrical Increase method	805384	936257	1152356
3	Incremental increase method	792319	925381	1072759

IV. PRESENT WATER SUPPLY STATUS

The Kishanganj city is provided with a total quantity of 85 Mld of protected water to supply to the Public through the four head works and various distribution points in the city. There are two head works, one Thakurganj at and other at pachhimpali both well located at Mahananda and Ramzan river respectively . A total quantity of 26 Mld of water is pumped from Thakurganj head works. The second head work, the pachhimpali well located 1000 metre away from the Takurganj headwork in the middle of the river Mahananda supplied a total quantity of 32 Mld. The third head work, the powakhali head feeding the city with a total quantity of 5.5 Mld. The fourth headwork, bahadurganj head work is feeding the city with a total quantity of 20 Mld. At present the per capita supply in the city is 100 lpcd.

V. DRAINAGE SYSTEM DETAILS AND WASTEWATER

Kishaganj drainage scheme has been designed to collect the sullage part of storm water (conveyed by open drain) and sewage conveyed by closed conduit, and then to treat and dispose of this in a satisfactory manner to the approved standard. The old Kishanganj town has been provided with an underground drainage system covering 77% of the old town. The sewerage system has a network of sewage collecting systems, sub pumping stations, a main pumping station and a sewage treatment plant. The newly added areas like bahadurganj municipality and kochadhaman Municipalites are completely unsewered areas and the wastewater generated in this area is ultimately mixing into the river Mahananda through surface channels and polluting the river.

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VI. INDUSTRIAL WATER REQUIREMENT AND WASTEWATER GENERATION

The total industrial water requirement of all the industries in the city is 41 Mld. The corporation is supplying water to the small and medium scale industries, which works out to be around 5 Mld. The large-scale industries are having their own sources of water supply. The three major industries are Kishanganj Distilleries & Chemicals,Sugars. These industries are discharging their effluent into the Ramzan river, Mahananda river after reducing the BOD load.

Table 2

Sl. No.	Name of the industry	Effluent quantity in KLD	BOD load	
			Before treatment	After treatment
1	Kishanganj Distilleries and Chemicals	720	9900	1590
2	Sugars & Chemicals	1250	246	2

VII. WASTEWATER GENERATION

Effective Collection and treatment of urban wastewater is a critical problem in a developing country like India. However, the solutions are expensive to construct and operate and pose technical and financial challenges for the operating authorities. Kishanganj generates about 68 Mld of wastewater. It has provision to collect only 42 Mld through its existing sewerage system and finally allowed to mix into near-by water sources. The remaining 26 Mld of wastewater is pumped into the Pachhimpali sewage treatment plant.

VIII. FUTURE WATER SUPPLY AND WASTEWATER GENERATION IN 2051

The quantity of water supply at 100 lpcd as well as at 135 lpcd in Kishanganj in 2051 is calculated. The water supply requirement and the wastewater generated in the city in 2051 is presented in the Table 3.

Table 3

Sl. No.	Zone	Population in 2051 (lakhs)	100 lpcd		135 lpcd	
			Water supply ($M m^3$)	Wastewater generated ($M m^3$)	Water supply ($M m^3$)	Wastewater generated ($M m^3$)
1	Thakurganj	5.20	18.98	15.18	25.62	20.50
2	Pachhimpali	4.81	17.56	14.05	23.71	18.97
3	Bahadurganj	5.03	18.34	14.67	24.76	19.81
4	kochadhaman	4.78	17.45	13.96	23.56	18.85
5	**Total**	**19.82**	**72.34**	**57.97**	**97.65**	**78.12**

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IX. POLLUTION CONTROL LAWS

There is a high level of awareness among the people all over the world, regarding the ill effects of pollution of land, surface streams and air. An industry has to treat its effluent discharges to render it fit for disposal on land or streams, rivers or other water bodies satisfying the tolerance limits specified by the pollution control boards agencies. A good amount of capital investment and running cost is paid by the industries to treat the wastewater for disposal in rivers and streams, which is eventually used by somebody else. It is only rational to renovate most of the treated wastewater to meet industrial water quality standards and reuse it. Reuse of treatment wastewater for agriculture and industrial purposes have been well recognised by many countries.

X. WASTEWATER QUALITY ANALYSIS

The wastewater quality has been studied by taking samples and analysing them for their suitability to be used for irrigation. The quality parameters for these samples were tested and the results are shown in Table 4.

Table 4

Sl. No.	Locations	pH	TDS (mg/l)	BOD (mg/l)	FC
1	Inlet to Lagoon No. I	7.21	820	225.7	Yes
2	Outlet from Lagoon No. I	8.67	790	115	Yes
3	Outlet from Lagoon No. II	7.56	845	102.9	Yes
4	Outlet from Lagoon No. III	7.77	830	9	Yes
5	Oorani near lagoons	7.68	1100	3	Yes
6	Used Open Well near Oorani	7.92	1015	0	Yes
7	Unused open well near Oorani	7.32	980	10	Yes
FAO (1985) Irrigation Standards		**6.5 – 8.4**	**450 – 2000 (slight to moderate)**	**< 100**	**< 1000**

From the above table, it could be observed that the pH in all the three Lagoons is meeting the FAO irrigation water quality standards (6.5 – 8.4) and the TDS in the three Lagoons are lying in slight to moderate limits (450 – 2000 mg/l). The BOD in the inlet is high as of the organic content in the city wastewater is usually high. After biological treatment for eighteen days in the Lagoons, it is reduced drastically to 115 mg/l and 102.9 mg/l, which is very close to FAO water quality standards in the first and second Lagoons respectively. The BOD in the third Lagoon is 9 mg/l that is highly suitable for irrigation. The BOD in the Oorani and well nearby is very low and those are not contaminated due to the treatment plant. Proper collection of sewage and pumping of the same on the farm is essential to utilize the available land. If the Lagoons are used properly, a considerable decrease in the BOD could be achieved and the quality of wastewater would be fit for irrigation. If this 232.28 ha of land is utilized properly, it will lead to an enormous amount of agricultural production as well as revenue generation. The nearby villagers have an interest to use the wastewater for their agricultural production.

XI. WASTEWATER REUSE IN PACHIMPALI

The wastewater reuse in Kishanganj is taking place in a very limited way only in Pachimpali, in an area of 2.52 ha for producing greens. Therefore, the ward survey conducted to assess the social acceptance of use of sewage for agriculture was limited to only 2 wards in Pachimpali zone. The result of this survey is presented in Table 5. This table indicates that 67% of the people surveyed are aware of the wastewater reuse whereas 33% are unaware. Among the people who are aware, 84% accept the sewage irrigated agricultural products. Among these who are unaware, 5% accept sewage for irrigation. In all 58% surveyed accept sewage irrigation.

XII. CONCLUSION

This research paper highlights the present and future water supply demand, present wastewater treatment and management aspects of Pachimpali treatment plant and the status of wastewater reuse in the kishanganj. An attempt has been made to identify the relevant management strategies to improve the wastewater reuse and management in the city. The large quantum of wastewater collected in the Pachimpali treatment plant will be diverted into the nearby 6 villages for their agricultural purposes after the treatment is completed.The suggestions could be made for utilizing the treated wastewater for growing greens, vegetable, and for agriculture. The wastewater collected in the Pchhimpali treatment plant after treatment has to be released for the usage of nearby villagers for their agricultural production. Remedial measures need to be taken for improving the wastewater reuse pattern in Kishanganj.

REFERENCES

(i) Data on Kishanganj Corporation, 2000.

(ii) FAO Irrigation water quality standards, 1985.