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An Approach towards Minimizing Sewage Inflow in Kelo River across Raigarh City

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Abstract: ***Raigarh is a rapidly growing industrial city situated in the state of Chhattisgarh, spread over an area of 46.54 km2. It is characterized by its rising population, mounting urbanization, and motorization. The population, of the city, is 1,66,460 as per the census year 2011 and it will be increased by 2,90,988 till the year 2035. There will be an increase not only economically but also there will be a rise in population along with infrastructure works so there is a basic need at the construction of a sewage treatment plant with a view of sufficient capacity to treat the sewage. The objectives of this study are to review and evaluate sewage treatment technologies and propose a sewage treatment plant to improve Kelo River water.***
Keywords: Sewage Treatment plant, Population, Raigarh City, Kelo River, Clean India, Sewage Collection Management.

I. INTRODUCTION

Raigarh city is situated in the Chhattisgarh State of India, it is a district headquarter. The city is known for its mineral as well as silk industries. Its total population over the past two decades increasing from 12,65,529 in 2001 to 1493984 in 2011. Raigarh city has a very dense and narrow marketplace and curving road. Raigarh city is a municipal corporation and administrative headquarter of Raigarh district situated in the Indian state of Chhattisgarh. It is a rapidly growing small city. The Kelo River flows through the City, which is one of its main water sources.

Based on population, Raigarh district comes at number seven in Chhattisgarh. Raigarh district is situated in the upper eastern part of Chhattisgarh State. It lies in Bilaspur Revenue Commissioner's division. The district was constituted on the 1st of January 1948. It is bounded on the east by the Sundergarh, Jharsuguda, and Bargarh districts of Odisha. On the north by Jashpur and Surguja districts, on the west by Korba, Janjgir-Champa, and parts of Raipur districts, the south-west, and south by Mahasamund district. It extends from 210 20' to 220 47' North latitude and 820 57' to 830 47 East longitude. The total geographical area of the district is 7086 sq. km.

The Raigarh city does not have any sewerage system, and neither sewage treatment plant exists. The city does not have any particular type of drainage system. Roadside open drainages are the means of transportations of the wastewater. Also, there is no systematic and organized method to collect and treat waste from the septic tank. Overflow of septic tank effluent directly discharges to the stormwater drains, which ultimately fall into the local channel and finally drain out to the Kelo River. Hence complete sewage treatment plant is required to be developed.

II. NEED OF STUDY

Based on the present sanitation condition of Raigarh city, it was observed that there is no proper sewage collection management and treatment system in the city to name the worth.

There is an immediate need the implementing a lasting solution to the problem of effective handling of sullage and sewage generated by implementing an immediate septage management system and treating them before discharging in Kelo river. Providing sewage treatment plant to take care of the year 2035 requirement and constructing it at suitable locations so that entire sewage can be drained into the plants as far as possible by gravity.

III. SCOPE OF WORK

The scope of work includes the survey of Raigarh city and total sewage generation which meets the Kelo River, and calculate the probable flow of wastewater considering for design horizon of the year 2035. Also, the sewage treatment plant is designed for keeping in mind the future population growth of Raigarh city. The complete study has shown in the flow chart below.

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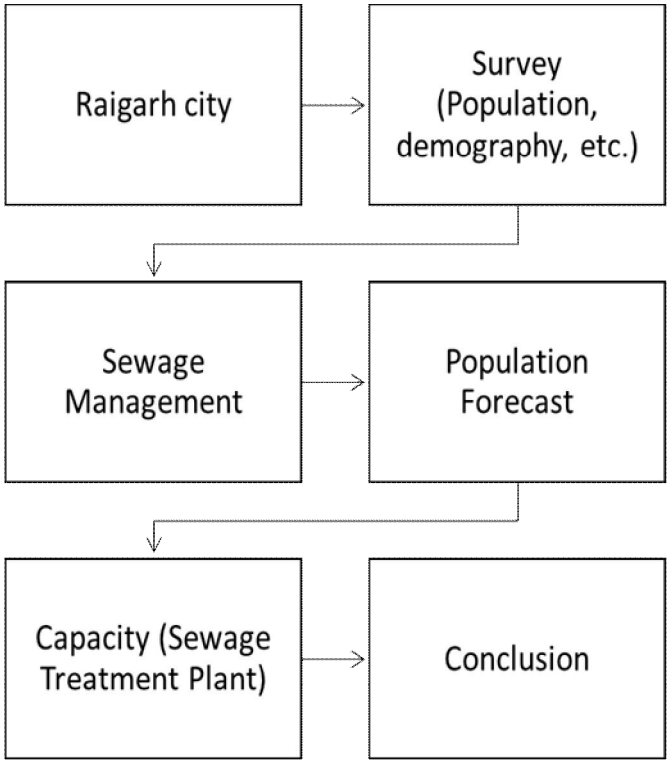


IV. LITERATURE REVIEW

Gupta et.al, 2017. In this paper, the author studied the effluent of wastewater characteristics generated from the college of engineering Roorkee. It involves studies of pH values, total solids, total suspended solids, alkalinity, hardness, acidity, chlorine, BOD, COD, DO, and turbidity. The main objective of this paper is to produce an environmentally treated effluent by using a sewage treatment plant.

Bhavin et al, 2018. In this paper author studied that in India, an estimated 62,000 MLD sewage is generated in urban areas while the treatment capacity across India is 23,277 MLD, or 37% of sewage generated, according to the data released by the government in December 2015, the rest falls directly into rivers causing sewer problem.

Aswathy. M, 2017. In this paper, the author reviewed the sewage treatment plant and described it along with AutoCAD drawing both primary and secondary units. The design period should be taken between 25 to 30 years.

V. POPULATION PROJECTION CONCEPTS AND METHODS

The population of any city has been greatly influenced by various factors like urbanization trends, industrialization, social amenities, and livelihood opportunities, etc. A general understanding of demographic characteristics will provide a guide to select the statistical forecasting methods.

The main guiding principle by the CPHEEO manual.

1) Arithmetical increase method
2) Geometrical increase method
3) Incremental increase method

In the present case, the three methods as per requirements of the CPHEEO manual have been used for trial population projections. The population projection is made based on census data shown in Table 2 and

Table **3**.

As per census 2011, Raigarh city has 48 wards covering an area of 46 sq. km. The names and populations of all 48 wards are shown in the Table 1 below.

Table 1 Ward wise population for the Year 2011

Ward No.	Ward Name	Population Year 2011
1	Rajiv Nagar Ward	3005
2	Dhangardipa Rambhantha Ward	4225
3	Ambedkar Ward	3015
4	Jagatpur Ward	3968
5	Dindyal Ward	3381
6	Dhimrapura Ward	3685
7	Indira Nagar Ward	2920
8	Riya Para Ward	3456
9	Chanmari Ward	3171
10	Madhuban Para Ward	3060
11	Jogi Dipa Ward	3479
12	Ramgudi Para Ward	3491
13	Ganja Chauk Ward	3045
14	Gaushala Para Ward	3011
15	Darogapara Ward	3833
16	Baikuthapur Ward	3200
17	Bidpara Sadar Hatari Ward	3113
18	Daroga Para GandhiGanj Ward	3246
19	Bhudeo Ganj Ward	3414
20	Juna Badpara Ward	2972
21	Beladula Ward	3673
22	Chakrdhar Nagar Bangala Para Ward	2995
23	Kaser Para Chakradhar Nagar Ward	3487
24	Vinoba Nagar Ward	3349
25	Kauhakunda Ward	3321
26	Chhote Aantarmuda Ward	3818
27	Naya Aantarmuda Ward	2731
28	Panjari Plant Ward	3411
29	Jell Para Ward	3789
30	Bajirao para Ward	3586
31	Miththumuda Ward	3282
32	Fatahamuda Banjinpali Ward	2985
33	Gandhi Nagar Ward	2845
34	Ambedkar Nagar Ward	4041
35	Zopali Para Ward	4159
36	Rajiv Gandhi Nagar Nava Para Ward	3931
37	Bhajan Dipa Ward	4220
38	Dewar Para Ward	3542
39	Railway Bangala Para Ward	3332
40	Budhu Mai Mandir Ward	3516
41	Chhatamuda sahdevpali Ward	3759
42	Amalibhauna Ward	3310
43	Gorkha. Saraipali .Barmuda Ward	4683
44	Patarapali Ward	4166
45	Bhanwanpur Ward	3710
46	Urdana Krushna Ward	2925
47	Vijaypur Govdharpur Ward	3283

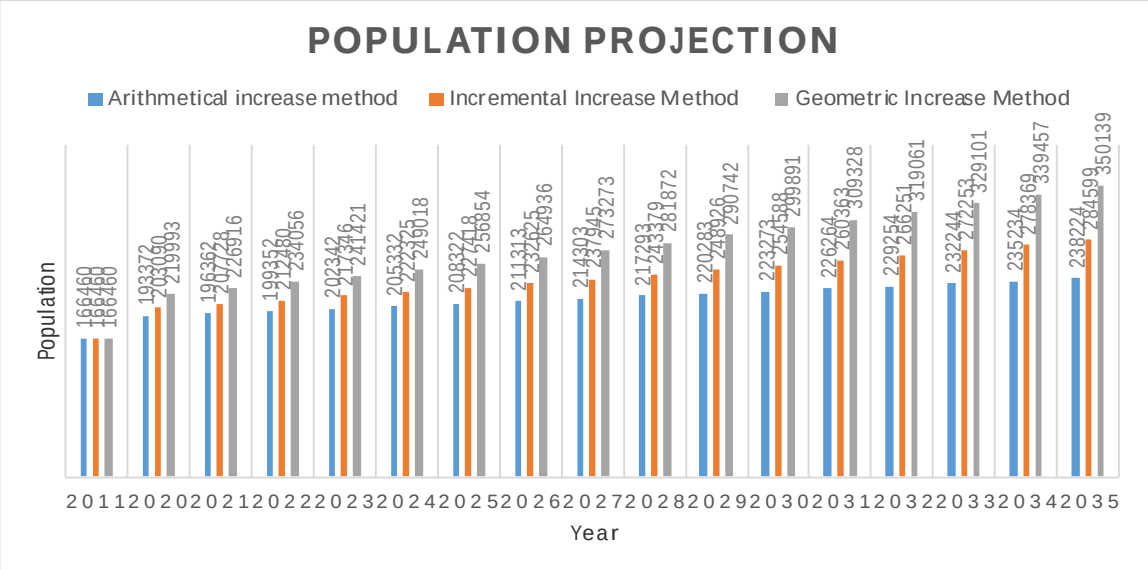
48	Boirdadar Ward	3924
Total		166460

Table 2 Population Projection by Geometric Increase Method

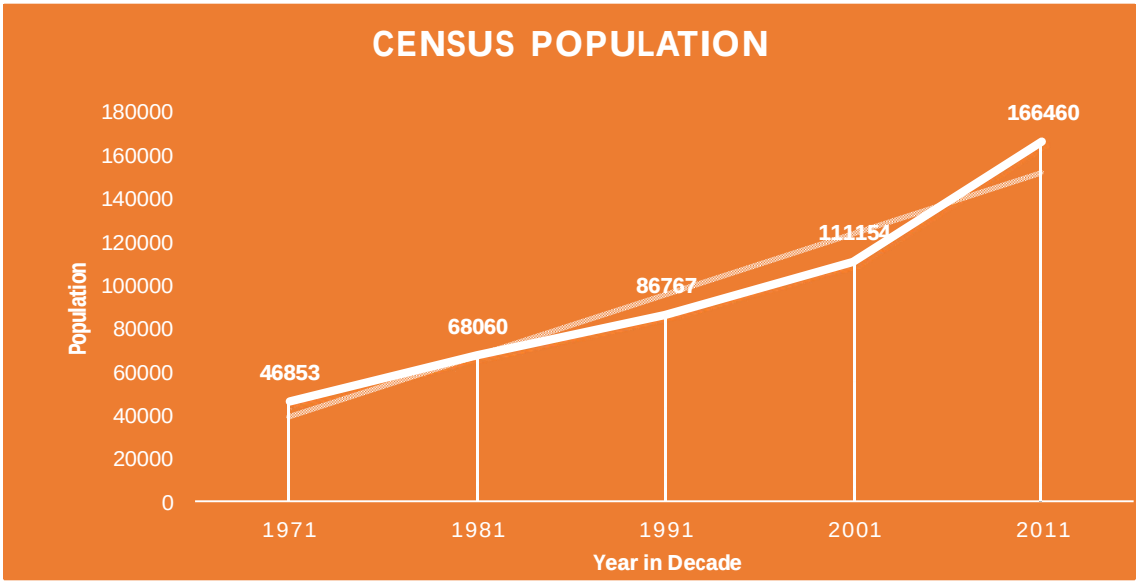
Year	Census Population	Increment per Decade	Incremental Increase	Growth Rate of city (%)
1971	46853			
1981	68060	21207		0.45
1991	86767	18707	-2500	0.27
2001	111154	24387	5680	0.28
2011	166460	55306	30919	0.50
Total	479294	119607	34099	1.51
Average	95859	29902	11366	0.38
		Geometric mean	0.36	0.36

Table 3 Population Projection Calculation

Year	Arithmetic Increase	Incremental Increase	Geometric Increase
2011	166460	166460	166460
2020	193372	203090	219993
2021	196362	207728	226916
2022	199352	212480	234056
2023	202342	217346	241421
2024	205332	222325	249018
2025	208322	227418	256854
2026	211313	232625	264936
2027	214303	237945	273273
2028	217293	243379	281872
2029	220283	248926	290742
2030	223273	254588	299891
2031	226264	260363	309328
2032	229254	266251	319061
2033	232244	272253	329101
2034	235234	278369	339457
2035	238224	284599	350139



Graph 1 Population Comparison between Arithmetical Increase method, Incremental Increase Method and Geometric Increase Method



Graph 2 Census Population Variation

VI. DESIGN OF PROPOSED SEWAGE TREATMENT PLANT

The quantity of wastewater generated, to be transported and treated will depend upon population and per capita water use. The per capita water system for domestic needs is proposed to be 135 LPCD.

The amount of water returned as sewage will be 80-85 % by the CPHEEO manual. This will result in a per capita wastewater flow of 108 LPCD. The sewage flow has been considered as 66 % of the water supply flow for computation of sewage treatment plant capacities.

The city population is determined based on the average of the population obtained by all three methods i.e. Arithmetic increase method, Geometric increase method, Incremental increase method.

Consider Base year = 2020

The design period for a sewage treatment plant is considered 15 years.

Design year = 2035

$$\text{Population} = \frac{\text{Arithmetic Increase method + Incremental Increase method + Geometric Increase method}}{\text{Number of forecasting method}}$$

$$= \frac{238224 + 350139 + 284599}{3}$$

$$= 290988$$

Total water consumption = Total population x Per capita demand

= 290988 x 135

= 39.28 MLD

Total water consumption for Raigarh city has been calculated as 39.28 MLD

As per norms Per capita, wastewater flow is taken as 80-85 % of total water demand.

Therefore, the Total wastewater flow for Raigarh city is 85% of total water consumption.

i.e. 39.28MLD x 85%

= 33.388 MLD

Sewage treatment plant capacity has been taken as 66 % of total wastewater flow.

i.e. capacity = 33.388 MLD x 66%

= 22.05 MLD (say 24 MLD)

The analysis shows that the sewage treatment plant will have a capacity of about 24 MLD.

VII. CONCLUSION

The ultimate goal of sewage treatment is the protection of the environment in a manner with public health and socio-economic concerns. Since there is no proper treatment plant for sewage in Raigarh city, it is necessary to construct a sewage treatment plant of 24 MLD for the expected population of the next 15 years. In the study of the sewage treatment plant in Raigarh city, it was concluded that the city has no proper treatment plant exists. As per the current situation in the city, saving the water and making the potential reuse of the treated sewage is much necessary, the idea for the proposed treatment process will be highly beneficial for making reuse of the treated sewage in the city.

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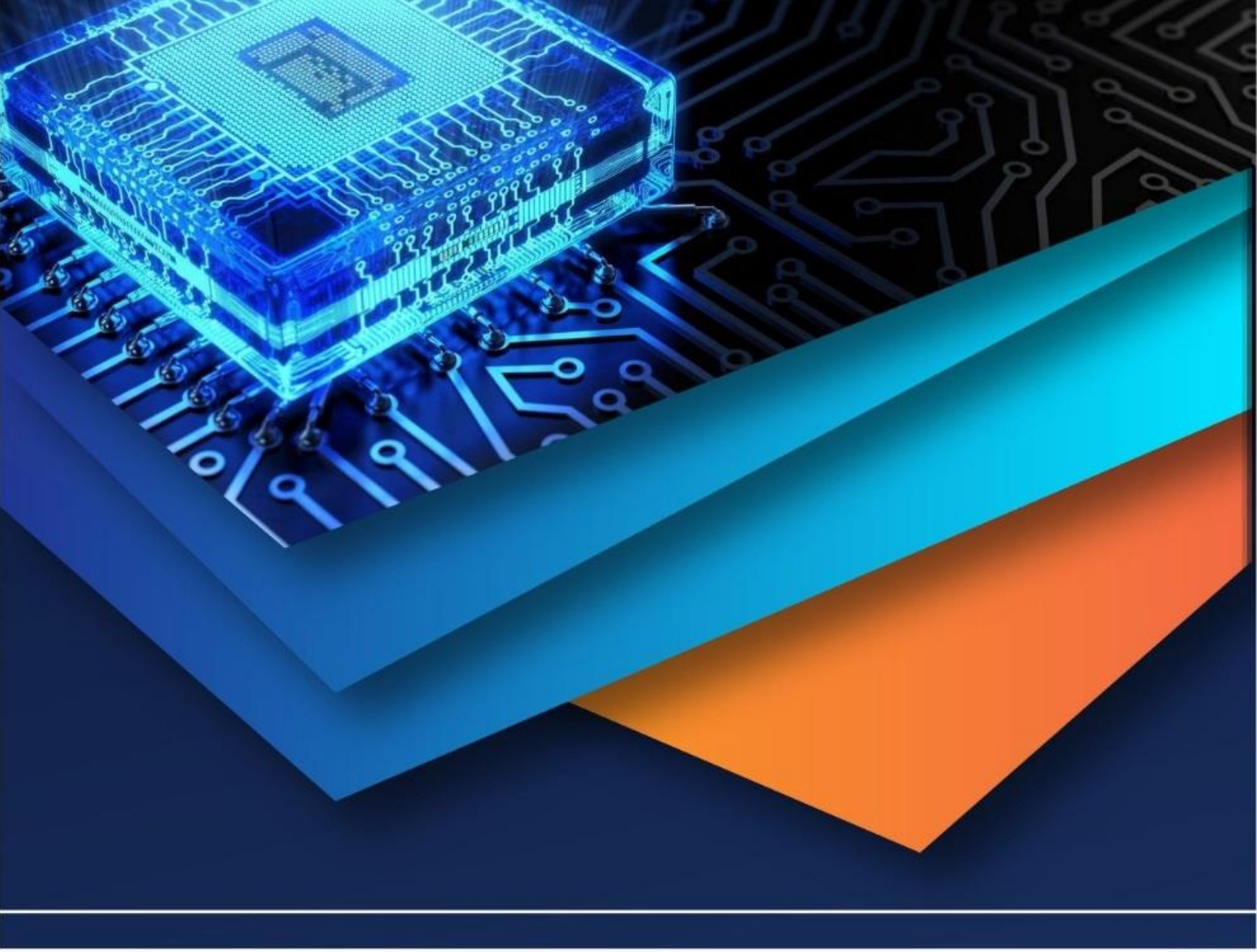

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