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Pre Feasibility Study of Underground Drainage System for Kupwad City

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Abstract: *The Sewage is a critical issue and its management in the environment is more critical. Kupwad city with a population of 72386 souls (as per census 2011), facing problems of proper sewage system and disposal. To create a healthy environment in town and provide sufficient sewage systems, this paper has performed a pre-feasibility study and comparative analysis between combined drainage systems and underground drainage systems, for Kupwad city, using ArcGIS software. Keywords: Prefeasibility, economic analysis ArcGIS, Kupwad.*

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I. INTRODUCTION

The urban and rural infrastructure, mainly the water supply and sewerage system are vital, for household and industrial activities [4]. If the sewage is not suitably collected, treated, and disposed of, the related effects cause serious peril to the environment such as pollution, epidemics, etc. [7]. Globally, the sewage facility is lacking in most of the low or middle-income countries. Nearly 2 billion peoples do not have basic sanitation facilities, these 673 million still defecate in open places. At least 10% of the world’s population consumes food irrigated by using sewage [5]. This results in the spread of epidemics and various diseases, uncomfortable living conditions, water quality, and land deterioration, etc. [6]. In India, 70 percent of sewage finds its way to ponds, lakes, and rivers without treatment [1]. At the national level, there is no drainage facility in 48.9% of households, while 33% of households have only open drainage systems [8]. Kupwad city is a part of Sangli-Miraj-Kupwad Corporation, from western Maharashtra. Kupwad city has a current population of 93816 souls and is spread in 20.63 sq.km and has a combined drainage system for a limited area. The study aims at checking the prefeasibility of the designed sewer system, the work-undertaken uses ArcGIS as a tool [2].

II. PREFEASIBILITY STUDY

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A. General Information of Kupwad city

TABLE I
General Information of Kupwad City

Sr.no	Title	Description
1	Population(As per census 2011)	72386 souls
2	Area	20.63 sq.km
3	Location	North-West of Miraj town, Sangli, Maharashtra.
4	Latitude: Longitudes:	16 ⁰ 50' 74 ⁰ 36' to 74 ⁰ 38'
5	A current sewage collection system	Combined system
6	Population Density	842 per Ha.
7	Source of water supply	Warna river

B. Land use and Land Cover of Kupwad city

The land use and a land cover map were prepared using ArcGIS software as shown in figure 1. Kupwad City was developing fast with time. There was more percentage of the residential area increased. As barrel land was also more, it was concluded that there will be more increase in population and an increase in the residential area.

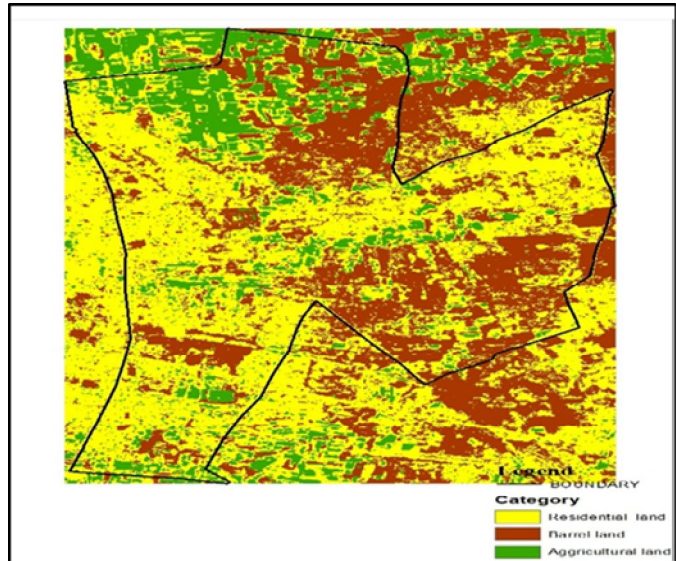


Fig. 1 hardcopy Land use map of Kupwad city

C. Rainfall intensity of Kupwad city

The Average monthly rainfall intensity of kupwad city was obtained from IITM, Pune. From this, it is observed that avg. monthly rainfall for Kupwad city is medium. For this intensity the existing combined system is running over capacity, therefore it is not functioning properly [3].

TABLE II
Rainfall Intensity of Kupwad City

Sr.no	Month	Avg. Monthly rainfall(cm)
1	Jan	1.7
2	Feb	0.8
3	Mar	4.3
4	Apr	22.6
5	May	54
6	Jun	119
7	Jul	150.6
8	Aug	107.2
9	Sep	131.3
10	Oct	108.3
11	Nov	25.2
12	Dec	5.6
13	ANNUAL	730.6
14	MAM	80.9
15	JJAS	508.1
16	OND	139.1

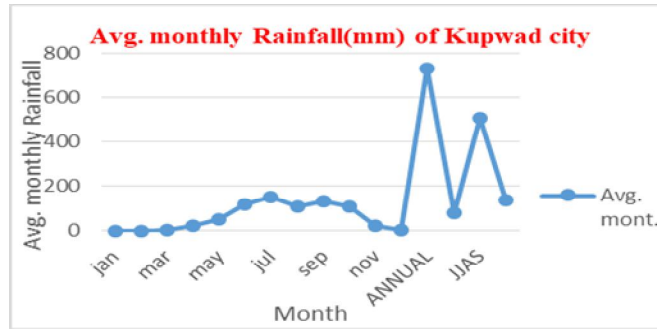


Fig. 2. Avg. monthly Rainfall of Kupwad city.

D. Soil Study of Kupwad city

The soil is classified into four types: Sandy soil, Silt Soil, Clay Soil, Loamy Soil. From a soil map of Kupwad city, we came to know that for Kupwad city soil types were loamy soil and soft murum soil. These soils had 35-45% water content and voids ratio up to 0.6 - 0.7. It was concluded that the soil strata was feasible for the design of UGD.

From the survey, carried out in Kupwad city, we came to know that, there was only 60 % of the combined drainage system was provided and rest was disposed of in open drains. The existing system failed when the surface flow mixed into it, which resulted in choking, waterlogging, etc. So to overcome this it was found that, an underground drainage system was feasible.

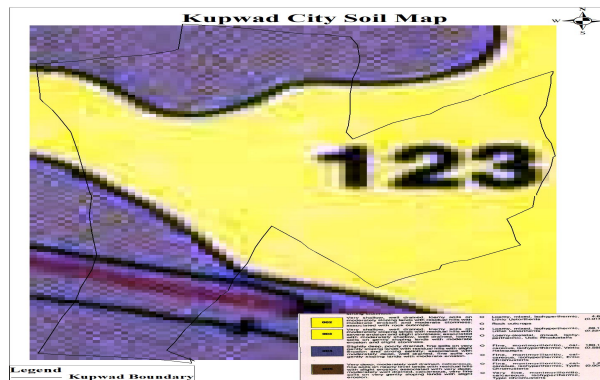


Fig. 3. Soil Map of Kupwad city.

E. Contour map of Kupwad city

The contour map of Kupwad city was prepared using ArcGIS software as shown in figure 4. As the proposed system was gravity-based, the contour map has ensured that the site was feasible to collect sewage at a single point. So it was feasible to design a centralized collection system. A slope was in one direction i.e. South-west.

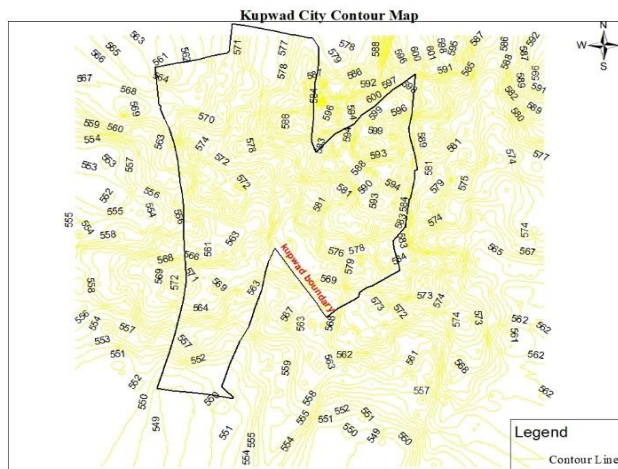


Fig. 4. Contour Map of Kupwad city.

F. Existing Condition in Kupwad city

Currently in Kupwad city, for an area of 10km, the combined collection system is provided. Whereas the remaining city has no provision of any collection system. The existing system is going through various issues such as a provision in the partial area, rupture, and cracks in the structure, less capacity as the population is increased, the formation of waterlogged areas due to overflowing, deterioration of water quality of surface and sub-surface water sources, Land degradation, etc. To overcome this issue, we need to complete the existing system throughout the city or design and construct an Underground drainage network for the city.

G. Benefits of Underground Drainage System

- 1) Separate sewer systems are designed to convey wastewater and stormwater in separate pipes.
- 2) It provides on-line small storages at every junction and diversion.
- 3) The sewer must be designed to maintain self-cleansing velocity, generally obtained with a minimal flow of 0.6 to 0.75m/s
- 4) The construction costs can be lower than for the combined sewer system because two separated networks are necessary
- 5) Maintenance cost is lower as there is less need for regular inspection, unblocking and repair
- 6) The pipes and manhole walls cannot be infiltrated as they are closed.
- 7) It is mostly found in developing and developed urban areas.
- 8) It provides a high level of hygiene and comfort. Also less spread of disease and epidemics.

III.ECONOMIC ANALYSIS

Kupwad road network had a major road network of 93 km and a minor road network of 159 km. The Kupwad city road network was as shown in following figure 5.

The comparative study of the combined sewer system and underground sewer system was performed based on existing conditions and literature studies. From the comparative study, it was understood, that the underground drainage system was more serviceable than the combined drainage system.

The estimates for both combined sewer system and underground sewer system was prepared, from the abstract sheets of both underground drainage system and combined system we came to know that, on an economical basis, the underground drainage system was more economical than the combined drainage system.

Table III

Cost comparison of a combined drainage system and underground drainage system (for 10 km)

Sr.no	DESCRIPTION	Estimated cost (Rs)
1	Underground drainage system	52711710.21
2	Combined system	88060746.4

Following figure 5 has shown the selected area of Kupwad city for economic analysis.

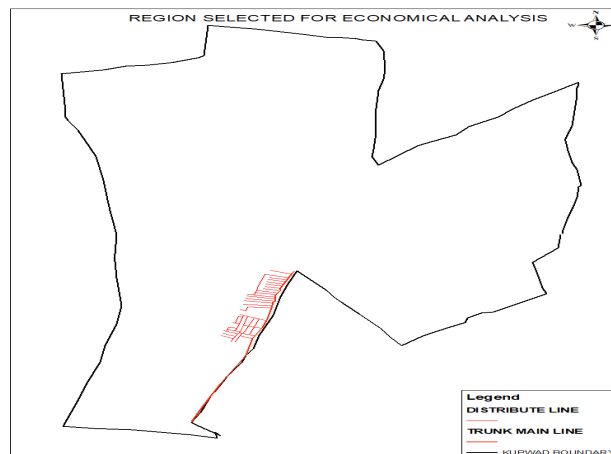


Fig. 5. A selected area of Kupwad city for economic analysis

IV. RESULT

The underground drainage system costs Rs.52711710 for 10 km which was less than a combined drainage system.

V. ALTERNATIVES AND RECOMMENDATION

- A. For current condition of Kupwad city, as the growth rate is average 20% for every decade the existing system will fail in its service. So the alternative is to design an underground drainage system for 30 years and construct it. For that various factors to evaluate this alternative is pre-feasibility study, economic analysis between the existing system, an underground drainage system.
- B. The underground drainage system costs Rs.52711710.21 for 10 km which is less than a combined system.
- C. The use of an underground drainage system will reduce the spread of epidemics, diseases in the environment. Also, the public can live in comforting surroundings.
- D. Based on the above constraints it is proved that the designing of Underground Drainage System over Combined Drainage System is more feasible to achieve more comfort, hygiene, and a healthy environment in the city.
- E. From the comparative study it is shown that the underground drainage system is more serviceable than the combined drainage system.
- F. From the Abstract sheets of both the Underground drainage system and combined system we come to know that on an economical basis the underground drainage system is more economical than a combined system.
- G. Based on the above constraints it is proved that the designing of Underground Drainage System over Combined Drainage System is more economical than a combined system.

VI. CONCLUSIONS

From the pre-feasibility study, a comparative study between UGD and Combined system and economic analysis it was found that the underground drainage system was economical than the existing system. Also, UGD is a better and convenient system than the combined system to develop an aesthetic view of the city. The study of Kupwad city and its analysis concluded that the underground drainage system was feasible in all aspects such as slope, site availability, soil type, etc.

VII. ACKNOWLEDGMENT

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