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Effective Waste Water System for Kondave Village in Satara District

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Abstract: One of major issue found in Indian villages is "water scarcity". During recent years, there has been an increasing awareness and concern about water conservation all over the world. Effective and efficient planning of water resources can resolve water related issues in villages. Today, it becomes necessary for implementation of smart water system in villages too. In present work, kondave village located in satara district is selected as study area. Data of kondave village is collected through a field survey and documents available in panchayat samiti , gram panchayat office of kondave. The quantitative and qualitative analysis of the data revealed that venna river in kondave village get polluted due to direct disposal of sewage in it. Also village people faces water scarcity problems during summer season for drinking and irrigation purposes.

Now a days, sewage treatment and its reuse becomes an innovative way for water conservation at village level. A small scale sewage treatment plant is quite necessary in kondave village to receive the domestic waste and to treat sewage, for its secondary reuse. The current study is conducted to prepare a effective water system for kondave village .The preparation of effective water system is based upon extensive primary survey of the kondave village and its environment by using the techniques of GIS. This study mainly focuses on planning and hydraulic designing of 1 MLD small scale sewage treatment plant based on moving media bio-film reactor.

Keywords: Effective Water System , Sewage Treatment plant , MMBR,GIS,MLD

I. INTRODUCTION

The progress and prosperity of the India depends entirely on the development of social and economic life of rural area. In India, the smartness concept is not even thought about the rural areas. Smart village concept rely on sustainable parameters like water, waste water, energy, small scale industries, transportation system, health, connectivity and digitization, trade centres, education, agriculture and irrigation. The present study mainly focused on water parameter and water related issues faced by the rural community. One of major issue found in Indian villages is that "water scarcity". Most of villages in India are going under high water scarcity. Water is a basic need of community for life. The water availability and water use have been recognized with help of broadly collected data from field survey to avoid mammoth investments on unproductive structures. The present study put forward a strategic plan for effective water system for kondave village situated in satara district.50% of world population is going to be under high water scarcity according to World Water Development (UN) report [Aditya Gupta et.al, (2016)]. During recent years, there has been an increasing awareness and concern about water conservation all over the world.

Effective and efficient planning of water resources can resolve water related issues in villages. Today, it becomes necessary for implementation of effective water system in villages too. Effective water system includes provision of small scale water infrastructures, effective watershed management and rainwater harvesting in villages. The various water infrastructures like. sewage treatment plant etc. are required to be constructed at appropriate site to store water and provide to local community for drinking , irrigation purposes etc.

II. IMPORTANCE OF STP AT VILLAGE LEVEL

A. Importance

The sewage treatment is a process that excludes the contaminants from the wastewater effectively and make it clean.The basic purposes behind construction of sewage treatment plant are viz., prevention of pollution of natural stream water and thereby protecting the environment, and increases water resources at village level for various secondary purposes. The construction of sewage treatment village level helps in simplifying water scarcity issues in villages.

B. Objective of Study

To provide an effective water system for kondave village by planning and hydraulic designing of small scale sewage treatment plant of 1MLD capacity.

III. DATA AND METHODOLOGY

A. Study Area

The study area of this project is kondave village situated in the Satara district of Maharashtra state, India [Fig.1]. Kondave village is in satara tahasil of satara district. It is at a distance of 4.6 km from satara stand. S.T. bus service is available in all seasons. The village is situated nearby satara-mahableshwar state highway 58. This village has gram panchayt established in year 1941. Agriculture is a main occupation of many people and main crop being sugarcane .Village is having Primary School, Secondary School, Post Office, and Bank etc. Electricity is available in the village. Kondave is very famous agricultural market namely for sugarcane on national level. The latitude $17^0$43'35" N and longitude $73^0$56'35"E are the geo-coordinate of the Kondave. Mumbai is the state capital for Kondave village. It is located around 184.5 kilometer away from Kondave. Almost 90% of the village area is occupied by agricultural plantation, fallow land and only 10% of land occupied by Gavthan area and forest area. Kondave village has population about 4,777 and number of houses about 1260 as per census data 2011. The local language of kondave village is Marathi The cadastral map of the kondave village is shown as shown in below [Fig.1].

Fig.1 Cadastral map of kondave village

B. Problem Statement

India has large rural area which is mostly undeveloped. And huge population lives in rural area. The number of villages in India as per 2011 census is 597,608. And 70% population lives in rural area. The village people have lack of basic and advance facilities. The physical condition of internal roads is poor. While connecting roads are narrow and damaged. Most of the village has opened drainage system or no any drainage system. So debris and garbage falling in sewer are blocking the flow and creating critical condition. The drinking water is of inferior quality which is the major reason for health problems of village people. The villages are suffering from many problems like inferior quality of drinking water supply, poor road conditions, insufficient power supply and Waste water system. So there is needed to provide solutions to above problems. This project report try to give solution for poor sewage disposal system in rural areas.

Fig.2 Poor Sewage Disposal System in kondave village

Fig.3 Photograph showing sewage flow towards the venna river

C. Methodology

The work started with collection of basic information regarding kondave village by conducting field surveys. From field survey present condition of village and current problems in kondave village are found out. Also census data ,cadastral map of kondave village and other relevant data is gathered from gram panchayat office kondave. The data regarding rainfall is collected from panchayat samiti satara. Cadastral maps were combined with attribute data. Scanning, digitization, updation and generation of data was done using Arc-GIS 9.3 software. The hydraulic designing of 1 MLD sewage treatment had been done on the basis of rural water supply manual. The treatment plant should be located as near to the point of disposal. Cadastral maps were combined with attribute data. Scanning, digitization, updation and generation of data was done using Arc-GIS 9.3 software .Flow chart for current study is shown in Fig.4.

D. Sampling

Sewage samples have been collected in the contamination free sampling bottles from kondave village. The collected samples were being analyzed for major physical and chemical parameters like pH, BOD,COD,TSS etc.

E. Laboratory testings were conducted on sewage samples in Environment Engineering laboratory.Results are shown in following table [Table.1].

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Table.1:Details of results of tests carried on sewage samples

Sr. No	Parameters	Raw Sewage Characteristics	Effluent Characteristics (Excepted)
1	pH	6.5	6.5
2	BOD	442mg/lit	< 20mg/lit
3	COD	600mg/lit	<250mg/lit
4	TSS	600mg/lit	<30mg/lit

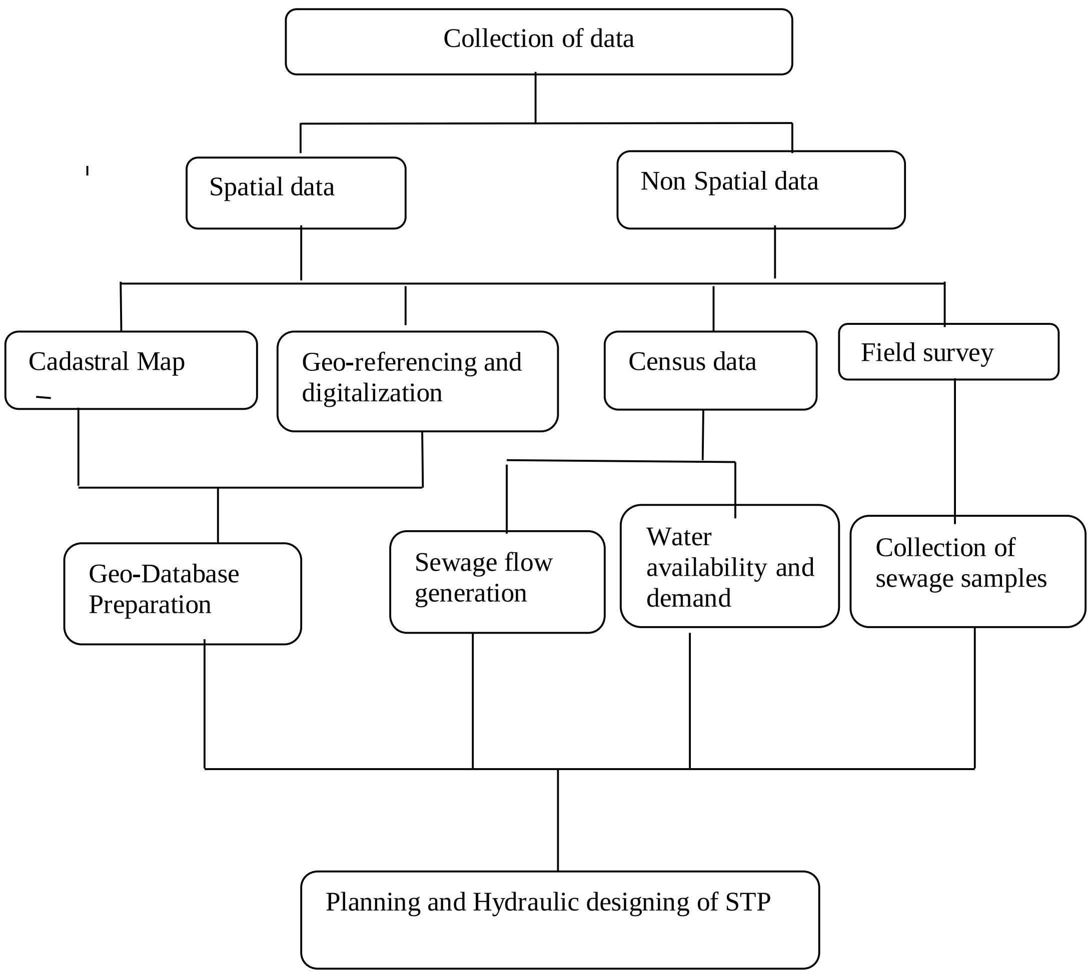

Fig.4 Flow chart

F. Design Period

Sewage treatment plant is a one of type of water works. So it includes huge and costly constructions. Various units in STP cannot be easily replaced and increased their capacities easily. For meeting the future demand of village ,water works generally designed for 15 to 20 years. So the assumed designed period for Sewage treatment plant is 20 years as per rural water system manual.

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G. Population Forecast

Incremental Increase method is modification of arithmetical increase method and it is suitable for an average size town and normal conditions where the growth rate is found to be in increasing order [G.S.Birdi,J.S.Birdi(2013)].Following table[Table.2] shows the population history of kondave village as per census data collected from Gram-panchayat office of kondave.

Table.2: Details of Population of village

Year	Population	Increase in population	Incremental Increase
1981	2505	-	-
1991	3254	749	-
2001	4605	1351	602
2011	7000	2395	1044
	Total	4494.99	1646
	Average	1498.33	823

$$P_n = P + nX + [n(n+1)/2]Y$$

Where, P_n=Population after n^{th} decade
X=Average Increase
Y=Incremental Increase
P_{2021} = 7000 + (1498.33 x1) + [1(1+1)/2] x 823
= 9322
P_{2031}= 7000 + (2 x1498.33) + [2(2+1)/2] x 823
= 12466
P_{2041} =7000 + (3 x1498.33) + [3(3+1)/2] x 823
= 16433

At the design period 20 years, the forecasted population of kondave village is 16433.Sewage treatment plant units are designed for this forecasted population.

H. Calculation of Sewage Generation

1) Ultimate Design period = 20 Years
2) Forecasted population at 2041= 16433
3) Per capita water requirement of village (assumed) = 70 lpcd
4) Average Water supply per day = Forecasted population X Per capita water requirement
= 70 x 16433
= 1.15 x 10^6 lit/day
= 1.15 MLD
5) Average sewage generation per day = 80% of supplied water
= 0.80 x 1.15
= 0.92 MLD
= 1 MLD
6) In cumec , (m^3 /sec)
Average sewage generation (m^3/sec) = $\frac{(1x10^6)}{(1000x24x60x60)}$
= 0.0116 m^3/sec
7) Consider, peak factor for sewage flow = 3
8) Maximum sewage generation (m^3 /sec) = 3 x 0.0116
= 0.0348 m^3/sec

I. Design Parameters for Proposed STP

1) *Design Parameters for Inlet Chamber:*
a) *Flow:* 1.0 MLD (Avg) / 3.0 MLD (Peak
b) *Peak Factor :* 3.0 times average flow
c) *Hydraulic Retention Time:* 1 minutes at peak flow
d) *Size of Inlet Chamber :* (1.5 m x 1.5 m x 1 m)m HT. – 1 no.
e) *Plan Area of Stilling Chamber :* 2.25 sq.m
2) *Design Parameters for Screen Chamber*
a) *Flow* – 1.0 MLD (Avg) / 3 MLD (Peak
b) *Peak Factor:* 3 times average flow
c) *Velocity in the Screen Chamber:* 0.80m/s at Peak
d) *Size of Screen Chamber:* (3 m x 0.6 m x 0.3 m) , 1 nos.
e) *Plan Area of Screen Chamber :* 1.8 Sq.m
3) *Design Parameters for Grit Chamber*
a) *Flow:* 1.0 MLD (Avg) / 3.0 MLD (Peak)
b) *Peak Factor :* 3 times average flow
c) *Retention Time in Grit Chamber :* 1 min. at Peak flow.
d) *Size of Grit Chamber :* 2.6 m x 1.6 m x 0.5 m
e) *Plan Area of Grit Chamber :* 4.16 Sq.m
4) *Design Parameters for Equalization Tank:*
a) *Flow:* 1.0 MLD (Avg) / 3.0 MLD (Peak)
b) *Peak Factor :* 3 times average flow
c) *Retention Time in Equalization Tank :* 2.1 hrs at avg.flow
d) *Provide the Size of Equalzation Tank :* 9.5 m x 9.5 m x 3 m SWD + 0.3 m Freeboard
5) *Design Parameters for Moving Bed Bio Reactor*
a) *Flow:* 2.0 MLD – (Avg.)
b) *BOD Loading Rate:* 618800g/day 1.0 to 1.2 kg per m^3
c) *Specific Surface Area:* 250 to 550 m^2 per m^3 of media
d) *Oxygen Requirement :* 1.5 to 2.0 kg per kg BOD load.
e) *D.O. Required:* minimum 2.0 mg/l
f) *Aeration:* Coarse bubble, diffused aeration
g) *Sludge Retention Time:* 39 to 42 days
h) *Retention Time:* 5 to 6 hrs at Average flow
i) *Size of Bio Reactor Tank :* 6.5 x 6.5 x 2m
j) *Plan Area of Bio Reactor :* 42.25 sq. m.
6) *Design Parameters for Secondary Clarisettler*
a) *Flow:* 1.0 MLD (Avg.)
b) *Surface Loading Rate:* 1.5 m/hr
c) Provide 2 no. of Secondary Clarisettler
d) *Size of Clarisettler : (*5.7 x3.8 x 2) m
e) *Plan Area of Clarisettler :* 21.66 Sq. m. Each
7) *Design Parameters for Chlorine Contact Tank*
a) *Flow:* 1.0 MLD (Avg)
b) *Peak Factor :* 3 times average flow
c) *Retention Time:* 30 minutes at Average Flow for disinfection
d) *Mixing Arrangement:* Around the end baffles.
e) *Chlorine Dosing:* Gas Chlorination system suitable to dose 3 mg/l in treated wastewater.
f) *Size of CCT Tank :* (3.21 x 3.21x2) m
g) *Plan Area of CCT:* 10.30 Sq.m.

8) *Design Parameters for Sludge Handling System*
a) *Flow:* 1.0 MLD (Avg.)
b) *Provide 3 Sand Beds of Size:* (9 x2.44)m

IV. RESULTS AND DISCUSSIONS

A. *Water Demand and Water Availability of Kondave Village*

For estimating water demand of kondave village, the quantity of water required for important parts of kondave village were identified. The amount of water required for a village is the sum of different water uses like domestic water requirements, livestock water consumption, agriculture and industrial sectors. The detailed methodology is used in estimating the water demand and water availability of kondave village. Following graph is obtained for Water demand and water availability for village [Fig.5]

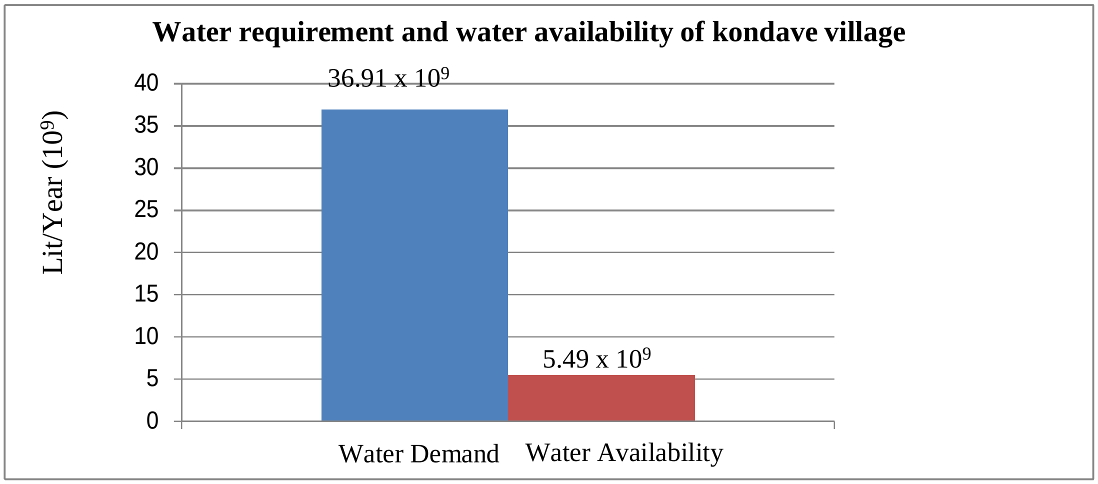

Fig.5 Water Demand And Water Availability For Kondave Village

B. *Tentative Expenditure of Proposed STP in Kondave Village*

An approximate cost of proposed sewage treatment plant in kondave village is worked out from similar type of plant approved and constructed at phaltan situated in satara district ,maharashtra .The cost of approved STP at phaltan of capacity 2.5 MLD is 237.56 lac. So for 1 MLD STP based on MMBR technology worked out to be 95.02 lac [Table 4.1]. The funds will be obtained from various government schemes or other sources.

Table.4.1 Details of tentative estimate of proposed STP

Maharashtra Jeevan Pradhikaran pune region,pune			
Approximate cost for Proposed Sewage treatment Plant in Kondave village based on MMBR Technology			
Sr.No.	Item Description	Break-ups	Approximate cost
A)	Civil Works		
1	Inlet chamber	0.75%	1.266
2	Screen chamber	1.5%	1.425
3	Equalization Tank	15%	14.25
4	MMBR Tank	22%	20.90
5	Secondary clarifier	10%	9.502
6	Chlorine contact tank	5%	4.75
7	Sludge handling system	5%	4.75
B)	Electro-mechanical works	35%	33.25
c)	Piping and walls	5%	4.75
	Total	100%	95.02 Lac

Following are some excepted benefits of sewage treatment plant after its construction in kondave village.

1) The scheme will benefit to 2230 households & present population 8,900 souls.
2) Thus treated water will be reused for agriculture and increase in productivity in agriculture & livestock due to regenerated water
3) The gram panchayat propose to sale water for irrigation & earn revenue to meet the operation cost of project
4) Indirect benefit, which could not be quantified, is **-** improved health conditions and saving in expenditure on medicines & health care.
5) The Pollution of venna rievr will be reduced to the maximum extent which will be help to keep healthy environment in village.
6) *Ground Water Recharge:* Treated effluent can be use to recharge the ground water. Surface spreading, percolation tank, and injection wells are the methods of recharging.
7) *Agricultural Reuse:* Kondave village contains nearly 85% of agricultural land hence treated effluent can be used for agricultural activities. Irrigation and development of greenery can be largely benefited by treated sewage due to the micro nutrients like N, P, S, minerals, salts etc. present in treated effluents.

V. CONCLUSION

A. Detailed study of kondave village gives a useful direction for resolving village level problems and helps to suggest need of water infrastructure for effective water system in kondave village.
B. .By studying water demand and supply parameter of kondave village , it is come to know that kondave village has deficiency of water for drinking and irrigation purposes. So this study suggest provision of water structures construction in village.
C. GIS helps to understand complete terrain parameters which lead to finalize water infrastructure development planning and management with respect to water conservation
D. According to study, there is no any waste water treatment system in kondave village. So this study suggested need of provision of a waste water infrastructure in kondave village i.e STP based on phytorid system.
E. Considering area requirement, operating flexibility, cost comparison, better quality of effluent and reuse of treated wastewater; it is proposed to provide MMBR based STP for the project.The details of capital investment will be approximate 95.02 lac.
F. Identifying and analyzing village problems will help to find appropriate solutions in future.

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