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Reuse of Treated Waste Water of Tambaram Municipality to Provide Sustainable Water Source for Arignar Anna Zoological Park Vandalur

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Abstract : The rapid growth of population in urban area leads to the requirement of huge quantity of Water for their domestic needs. Hence the needs have to be fulfilled with fresh water and the waste water generated from domestic and industries have to be treated and disposed off properly to avoid pollution and degrading the environment. The normal practice is to dispose the treated waste in the nearby stream and rivers which will contaminate the entire water body. The municipal waste water generated in Tambaram Municipality is proposed to be collected through a network of Under Ground Drainage System (UGD) and treated through a Sewage Treatment Plant (STP) and let out into the Pappan Channel and finally reaches the Bay of Bengal through Adayar River and goes as a waste. Hence in this study, it is suggested to utilize the treated waste water for the irrigation needs via Lawn maintaining, fodder crops, forest development in the Arignar Anna Zoological Park, Vandalur. The treated Waste Water quality from Metro water sample has been collected and studied; also the treatment efficiency of the proposed plant is studied with respect to the existing similar type of plant in Coimbatore Corporation. The suggestions for utilizing the treated waste water for lawn maintenance, development of fodder crops and forest development and aquaculture in the Arignar Anna Zoological Park, Vandalur will provide sustainable water source for the Zoo which is starving for the water demand in summer and drought periods and also reduction in use of potable water supplied by the TamilNadu Water Supply and Drainage Board (TWAD) Board and withdrawal of ground water by pumping.
Key Words : Waste Water, Sewage Treatment Plant, Irrigation.

Introduction

Water is one of the important basic needs of life among Air, Water and Food. Rapid urbanization and industrialization provides better improved life style to the mankind but on the other hand it depletes the available sources or pollutes the sources and make them unfit for further use.

75 % of the earth surface is covered with water. But the potable and directly usable water is only 3%, even in the above 3% less than 1% is freely available for utilization. Hence the available limited source has to be utilized effectively.

The demand for water is classified into the following three major categories.

1. Domestic

2. Agricultural
3. Industrial

Domestic need of water is to be given topmost priority with potable water, and agricultural need comes after the domestic need which is essential for the food production. Next only the industrial need comes.

The Environmental Engineering principle emphasizes REDUCE, RECYCLE, and REUSE to save the environment from pollution. No source can neither be created nor destroyed but the sources are depleted by changing from one form to other. The usage of these sources will results in generation of wastes causing pollution and degrading the environment. Hence the available sources have to be utilized effectively for the betterment of present and future generation.

Reducing the domestic usage of water can be possible only to some extent to preserve water source. Domestic usage of water yields large amount of waste as black water (sewage water) and grey water (waste water from bathing, cloth washing, utensils washing, kitchen waste etc,). The total waste water generated from the domestic water consumption is as high as 80 to 90%. Domestic waste water contains mostly organic impurities and this may be treated easily and reused for agricultural and industrial uses safely.

Due to rapid urbanization the urban population increases manifolds requiring high water demand for their domestic needs and thereby creates huge waste water. The urban population is more concentrated hence the collection of the waste water generated through UGD system and treating the same through Sewage Treatment Plant (STP) is easily achievable. Many urban cities have proper collection system and treatment plants to treat the collected effluent. In most of the cities the treated effluent has been discharged into the nearby water bodies. Often due to multivarious reasons the effluents are let into the water bodies without proper treatment and pollute the receiving system. Reuse options will emphasize proper check on the treatment of the waste and also helps to preserve the fresh water resources.

Reuse of the treated domestic waste water for industrial and agricultural purposes will be limited due to change of land use pattern the agricultural lands have been converted into housing sites and restrictions in developing industries in the urban areas.

Present waste water generation of Tambaram Municipality is about 10 MLD and projected generation is estimated to 30 MLD in 2051. Nearby surrounding areas are being converted as housing sites due to rapid urbanization and expansion of Chennai City and the cultivable land area has been drastically reduced and there is no scope for irrigation devlopmnt. The Arignar Anna Zoological Park, Vandalur is just 6.5 Km from Tambaram.[1]

The Zoo is in need of huge quantum of water for their agricultural need of lawn maintenance, fodder crops, orchards and irrigation of forest trees in a total area of 602 Hectares and starving for water in summer and drought periods and this scarcity also restricts further expansion of lawns and forest trees in the zoo.

Hence reuse option of the treated domestic waste water of Tambaram Municipality in Arignar Anna Zoological Park, Vandalur to provide sustainable water demand of the Zoo other than domestic needs and thereby reducing the with drawl of ground water is suggested in this study.

AIM OF THE PROJECT

In this study it is suggested to utilize (reuse) the treated waste water of Tambaram Municipality in Arignar Anna Zoologicl Park, Vandalur for the need of Lawn Maintenance, Fodder crops, Orchards, Agriculture development and also to irrigate the forest lands and to develop aquaculture and recreation pond for boating.

Scope of the Project

Reuse of Waste water for irrigation is not a new invention. From ancient days itself reuse of waste water is practiced but the same is in an uncontrolled way and indirect. In Tamil Nadu, Sewage water irrigation is practiced in the Avaniapuram and Sakkimangalam Village in Madurai District.

It is estimated that roughly about Rs. 1.97 crores/year can be generated from about 365 ha of land using this wastewater generated from the Madurai city. The average return works out to be Rs. 54000 ha per year. This might seem to be higher than that prevailing return from any agricultural activities. The reason being the cultivation of perennial crops like fodder grass which is harvested routinely every 21 days. Input requirements in terms of commercial fertilizer, pesticide etc., are low. The produce finds a ready market right at the city. The fodder grass feeds the cattle population of Madurai city and its suburbs. The vegetable crops,brinjal, snakegourd, bhendi, bottle gourd and primly greens, which are a prolific yielder under highly nutrition environment, all find a ready and steady market in the city. Hence the yield,as worked out and reported, is considered to be reasonable.[2]

Studies conducted in those areas reveals that the BOD, COD, nitrogen, pH, Calcium, Potassium and Sulphate were within limits prescribed by Food and Agriculture Organization (FAO), except the fecal coli forms which were present largely due to poor quality of treatment. The latest treatment methods with disinfectants, has reduced the fecal coli forms within the standards. Hence use of treated waste water for irrigation of fodder crops, lawn maintenance and forest trees development is the best choice of reusing the treated waste water. Hence there is a lot of scope for development of irrigation potential by reuse of treated waste water.

Tambaram municipality is now proposing to drain the treated waste water of Tambaram Municipality to Adayar River through Pappan Channel and finally it reaches the Bay of Bengal. Since there is no irrigation source below Tambaram area, the entire treated water goes as a waste to sea. Hence this reuse option will facilitate saving of fresh water.

Specific Objectives:

1. To estimate the quantity and quality of the treated waste water generated in Tambaram Municipality.
2. To assess the water demand of Aringar Anna Zoological Park, Vandalur.
3. Feasibility study.

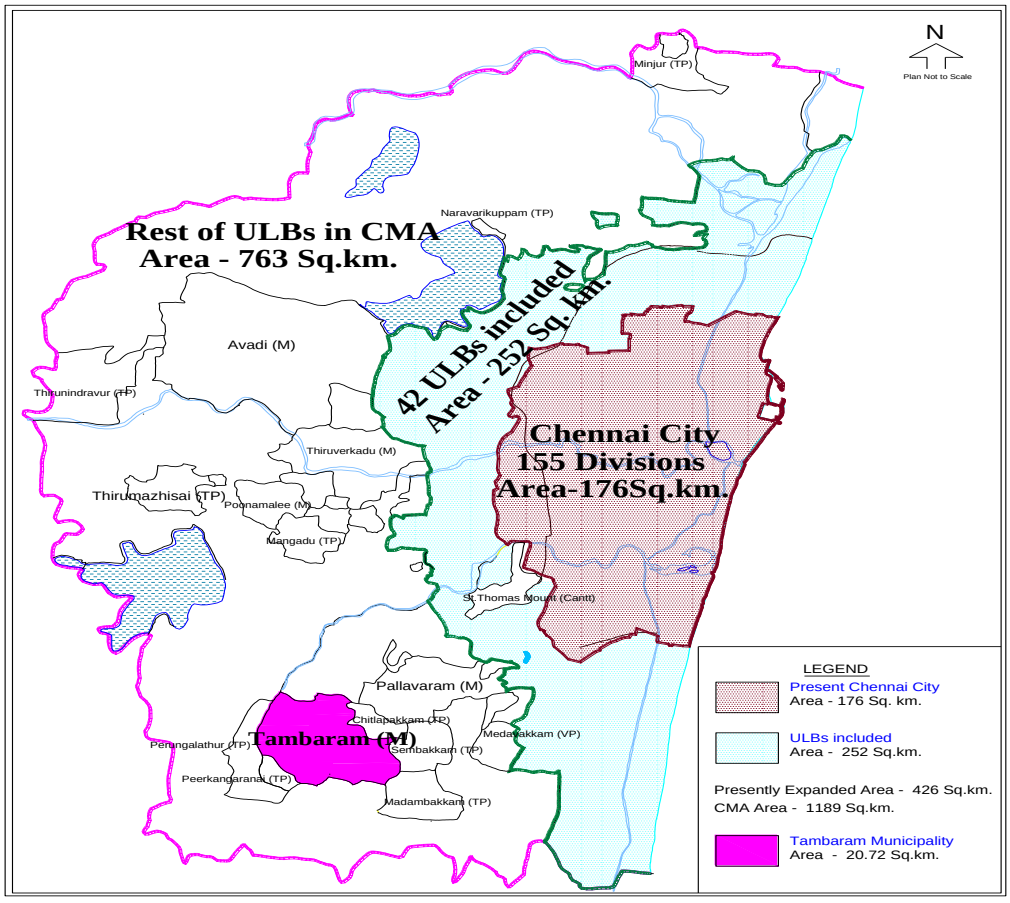

Fig: 1 Index map of Tambaram Municipality

If this study is implemented it will provide sustainable water supply for the Aringar Anna Zoological Park, Vandalur for the irrigation demand with other benefits of aquaculture development and creation of recreation pond and boating in the pond which will fetch additional revenue. Also it reduces the use of potable water supply from TWAD Board from Palar aquifer and reduces the depleting of the ground water from pumping through open wells and bore wells.

Estimation of Quantum of Waste Water Generated

Tambaram Municipality formed in 1964, is located in the GST Road, South of Chennai. This is the gateway to Chennai City for Southern Districts of Tamil Nadu (Figure 1).

The Pappen Channel (Tambaram Channel) and Adayar River are flowing adjoining the Tambaram Municipality. The area of Tambaram Municipality is 20.72 km^2. The population as per 2011 census is 164830.

At present there is no proper underground drainage network and Sewage Treatment plant. The untreated waste water flows through open channel and discharges into the Adayar River through Pappan Channel and pollutes the river largely.

Now the Government of Tamil Nadu has decided to improve the Health and life standards of the people by providing comprehensive Sewerage Schemes in the Chennai Metropolitan Area. Tambaram Municipality is a special grade Municipality and one of the biggest Municipality in the CMA. Chennai Metropolitan Water Supply and Sewerage Board have initiated action to provide Underground Drainage System and Sewage Treatment Plant for Tambaram Municipality.

The population as on 2011 is 1.64 Lakhs and the projected population in 2051 (the year in which the population is supposed to be stabilized) is 3.22 Lakhs and the waste water generated at 90 lpcd is 30 MLD.

Quality Assesment of Treated Waste Water

The quality of the treated effluent will play a major role in reuse options. The WHO has given guidelines in their Technical report series 778, titled,"Health guide lines for use of waste water in agriculture and aquaculture" (1989)[3].

The waste water reuse standards for use in agriculture has been specified in Food and Agriculture Organization for crop selection and also specified in IS 11624-1986 Quality criteria for irrigation .[4]

Results and Discussions

The Effluent Characters of the Existing SBR Plant at Coimbatore

A study on the influent and effluent characters of the similar type of sequencing batch reactor (now proposed at Tambaram Municipality) which is now working at Coimbatore Corporation is made to arrive at the actual performance. The details of the parameters of influent and effluent are tabulated below in Table 1.

Table 1 Characteristics of sewage waste influent and effluent at STP, Ukkadam, Coimbatore (SBR Technology)

(a) Influent Characteristics

Inlet (Raw Sewage)								
Parameters	**Flow**	**Temperature**	**pH**	**DO**	**TSS**	**COD**	**BOD**	**OIL& GREASE**
Month	m^3/day	°C			mg/l	mg/l	mg/l	mg/l
Jan-12	17799	26.65	7.57	0.39	146.45	420.19	138.87	0.38
Feb-12	15588	26.65	7.33	0.29	131.79	407.25	143.4	0.45
Mar-12	11539	29.17	7.42	0.31	127.69	417.31	174.8	0.34
Apr-12	12443	29.65	7.52	0.38	123.46	395.77	147.12	0.1
May-12	21200	31.51	7.42	0.27	124.84	419.7	137.09	0.26
Jun-12	17837	30.15	7.21	0.29	144.82	443.17	156.55	0.37
Jul-12	18315	29.6	7.3	0.24	180.25	420.10	186.25	7.8
Aug-12	17436	28.87	7.14	0.15	243.75	540	203.44	10.79
Sep-12	14036	29.02	7.36	0.22	210.34	476.06	177.93	9.1
Oct-12	12398	28.95	7.35	0.22	207.24	500	187.75	10.52
Nov-12	11110	28.9	7.42	0.25	225	502.93	185	10.43
Dec-12	13630	28.58	7.39	0.16	265.8	503.48	207.25	8.91

(b) Effluent Characteristics

Outlet(Treated Sewage)								
Parameters	**Flow**	**Temperature**	**pH**	**DO**	**TSS**	**COD**	**BOD**	**OIL& GREASE**
Month	m^3/day	°C			mg/l	mg/l	mg/l	mg/l
Jan-12	17631	26.13	7.31	4.67	8.83	34.97	8.16	0.04
Feb-12	15421	27.01	7.05	4.53	9.11	32.71	8.4	0.03
Mar-12	11500	29.73	7.11	4.48	8.96	32.3	8.35	-
Apr-12	12387	30.05	7.42	4.44	9.19	36.15	8	-
May-12	20942	31.77	7.33	4.86	8.96	33.22	8.35	-
Jun-12	17661	30.55	7.38	4.92	9	36	8.17	-
Jul-12	18215	29.8	7.4	4.76	8.1	32.41	8.4	0.32
Aug-12	17161	29.25	7.48	4.88	9.44	50.25	9.18	0.47
Sep-12	13973	29.47	7.47	5.03	9.2	47.31	8.52	0.3
Oct-12	12541	29.64	7.48	4.85	9.34	51.45	8.41	0.59
Nov-12	10672	29.6	7.5	4.76	9.26	48.06	8.53	0.69
Dec-12	13545	29.16	7.49	4.95	9.25	51	8.9	0.93

Monthly average values.
Source: STP plant record.

From the above it was observed that all the parameters of effluent are within the standards.

Suitability for Irrigation

Also a sample of treated waste water collected from Perungudi sewage treatment plant which receives waste water from Chennai Metro Water Supply and Sewage Board (CMWSSB) and near to Tambaram which may be a representative sample for the Tambaram Municipality has been tested for suitability of the treated water for irrigation. The result of the same was tabulated below in Table 2

Table 2 Effluent characteristic of Perungudi STP

Sl. No.	Quality Parameters	Value	Unit
1.	pH	7.2	
2.	EC	1410	micromhos/cm
3.	Ca& Mg	4.9	me/l
4.	Na	0.383	me/l
5.	SO_4	3.5	me/l
6.	Cl	7.8	me/l
7.	SAR	0.25	
8.	DS	762	mg/l
9.	Total Nitrogen (NO_3)	1.2	mg/l
10.	RSC	1.1	
11.	BORON	0.35	ppm

The water quality criteria for irrigation has been specified as follows in the IS 11624-1986 Indian Standard Guidelines for the quality of irrigation water. The test results concludes that

1. Total salt concentration which was measured as Electrical conductivity is 1410 micromhos/cm which is less than 1500.
2. Sodium absorption ratio is 0.25 which is less than 10.
3. Residual sodium carbonate is 1.1 meq/litre which is below 1.5.
4. Boron 0.35 ppm which is less than 1ppm.

All these parameter shows that this water is low hazardous for irrigation as per is 11624 – 1988, Guidelines for the quality of irrigation water, hence this treated water can be used for irrigation purposes.

The fecal coli form level in the treated waste water is less than 100 MPN per 100 ml as per the records of the sewage treatment plant at Ukkadam, Coimbatore and Perungudi. Therefore water can be used safely, WHO recommendations allows a fecal coli form presence up to 1000 MPN/100 ml.

Social Acceptance

The study conducted by Ambujam, N.K. (1993) on the reuse of waste water for Irrigation reveals that [5]

1. Wastewater reuse should be implemented when it is found economically viable.
2. Waste water should be reused when it is environmentally safe.
3. Govt. should promote reuse of waste water to meet the acute shortage of water
4. Land disposal is more beneficial than disposal on water bodies.
5. Treatment of waste water and quality of treated effluent should be monitored.

The study also reveals that about more than 50% of people are not against the use of waste water for irrigation and more than 30% of people are in the opinion for the use f the waste water after treatment and 10% are unaware of this issue.

Treated waste water Irrigation is an alternative source for irrigation needs.

1. Waste water generation volume is increasing day by day due to rapid urbanization.
2. Integrated approach of treatment and reuse of waste water is useful in water pollution control.
3. Prevents the surfaces water body pollution since in land application the land soil act as a living filters and provides further tertiary treatment of treated waste water in the aerobic soil zone.
4. Water starved area can be brought into cultivatable areas.
5. Recycling of nutrients back to soil and nitrogen usage by plants will reduce the eutropication.
6. Modern methods of treatment system provides for treatment to any standard so it is safe and easy way of disposal of waste water.

1. Treatment cost of the STP can be managed with the beneficiaries due to the increased production and revenue generation.
2. Dependable source of supply and hence it provides sustainable supply.
3. Socially acceptable since it is treated and disinfected.

Under the light of the above discussions, the project is viable and acceptable.

Feasibility Study

As per the present population of 1.65 lakhs the waste generated at the rate of 80 lpcd comes to 13.2 MLD. The present need of the Vandalur Zoo with an increase of cultivatable area of fodder crops and lawns, orchard farms to 140 ha, will be 10 million liters per day. There is a scope of increasing the utilization of entire water potential by way of creating further development of lawns and increasing the fodder crop area and irrigating the forest trees and developing boating in the Hassan/Otterilake may increase the water demand and utilization of the entire available treated waste can be possible. Also the excess water can be allowed to lower down tanks for irrigation which results in additional irrigation potential in the nearby areas. Further the surplus water can be sold for maintaining the centre meridian crops in the Tambaram- Chengalpattu Highway for a length of about 33km with an average width of 10m, for an area of 33 Hectares. The water demand of this sector can also be met with the treated waste water.

The STP site is located near the service road of Chennai Bye Pass road and Darkas road junction with latitude of 12°56'11" N and longitude of 80°06'00" E and elevation is 62 feet.

The Otteri Lake in the zoo premises is situated at a latitude of 12° 53 '04" N and Longitude of 80°05'00" E and elevation is 112 feet. The elevation difference will not allow for gravity flow and hence pumping can be done easily since the level difference is only 50 feet.

The distance between STP and Otteri Lake is 6600 m. The pipe lines can be taken as underground lines along the service road of the Chennai Bye-pass and Tambarram –Chengalpattu NH-45 in a closed conduit of 900 mm dia pipes. The alignment details of pipeline are shown in the Figure 2.

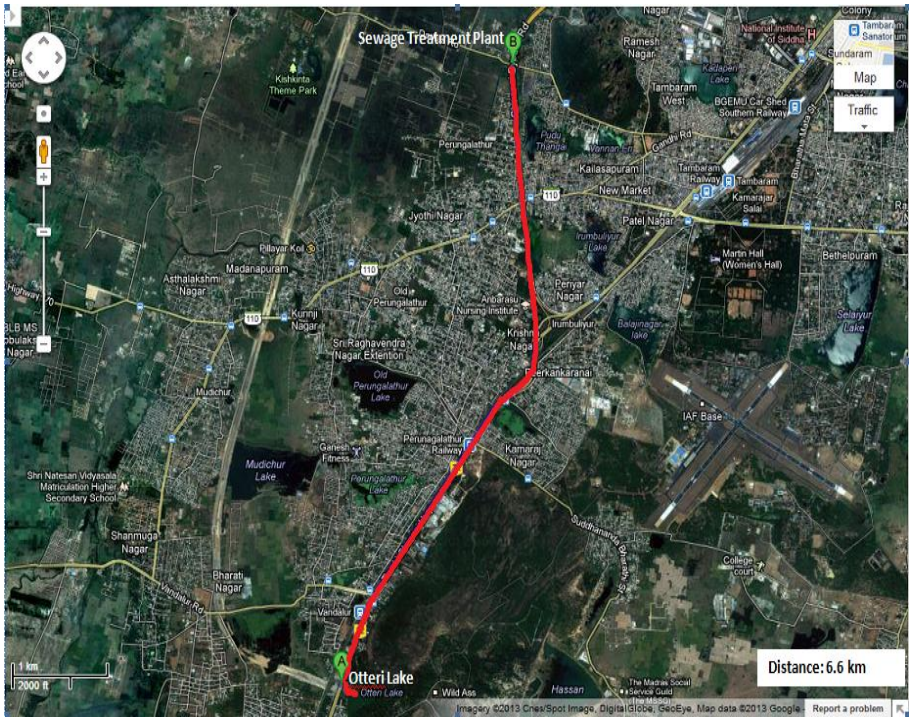

Fig: 2.Proposed alignment for conveyance of treated waste water from STP Tambaram to Otterilake in Vandalur zoo

A valve arrangement is to be provided at the off take point to direct the excess water, comes during monsoon period to the Pappan Channel and also to divert the untreated water in the case when the STP is shutdown for repair and maintenance without allowing the waste to the zoo premises. Power required for pumping may be managed through solar power or by generating power from bio gas produced in the STP.

Since the demand is less than the treated waste effluent and forming the conveyance system along the road side through underground pipelines without any land requirements, the project is feasible and provides sustainable supply to the irrigation demand of Arignar Anna Zoological Park Vandalur.

Conclusions

The demand for water in each and every sector, ie. Domestic, Agriculture and Industrial is increasing day by day whereas the sources are limited. Due to rapid urbanization the quantum of waste water generated is also increased. The treatment of the waste water is a must to avoid pollution in the receiving water bodies. Reuse of waste water is useful to reduce the fresh water demand, increase in food production thereby it compensates the treatment cost.

In Tamil Nadu, about more than 95% of surface water and 80% of ground water potential has been utilizedstateaccording to Water resources.[6]

The state is not having adequate water resources and depending on other states for the major irrigation sources.

1. Karnataka for Cauvery water.
2. Kerala under MullaiPeriyar Dam for the irrigation sources of southern Districts.
3. Kerala for Parambikubam Aliyar Project .
4. Andra Pradesh for Palar river source.
5. Depending on Krishna river from Andra Pradesh for the drinking needs of Chennai City.

Now to meet out the demand of Chennai City desalination project are being carried out though it is more costly.

In a state like Tamil Nadu, Where there is a limited source of water, the reuse option is a must and an integrated approach to manage the urban waste water for treatment with reuse options is the need of the hour.[7]

Under the above discussions the reuse of waste water for irrigation will provide for

1. Environmental friendly disposal of treated waste water.
2. Increase in food production.
3. Reduce the demand of fresh water.
4. Reduce the pumping of ground water.
5. Reduce the pollution in the receiving water bodies.
6. Quality of treatment is ascertained since quality check done by the end user.

Considering the potential economic and environmental benefits, it is necessary and worth to initiate and support reuse of treated waste water for irrigation projects, since the population and food requirement is growing steadily whereas the fresh water potential available is reducing.

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