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Study of Public Private Partnership Models for Low Cost Sewage Treatment Plant

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Abstract - *Water is essential commodity of society. The water availability in RIT during summer season is limited and the wastewater disposal system in RIT is not methodical, it is directly discharged into open land therefore it is need to design and develop wastewater treatment plant for RIT campus. The present study will address design of wastewater treatment plant for RIT campus. Also suggest feasible PPP model for the proposed wastewater treatment plant.*

Key Words: Wastewater, Constructed wetland, Public Private Partnership,

1. INTRODUCTION

Water is a scarce and finite resource which is often taken for granted. In the 20th century, population has increased resulting in pressure on the already scarce water resources. Excessive use of natural water resources due to rapid urbanization has necessitated search for alternative sources of water for non-potable purposes. The potential sources which can be explored include harvested rainwater, reclaimed water, and seawater.

Water is essential commodity of society. The water availability in RIT during summer season is limited and the wastewater disposal system in RIT is not methodical, it is directly discharged into open land therefore it is need to design and develop wastewater treatment plant for RIT campus.

The present study will address design of wastewater treatment plant for RIT campus. Also suggest feasible PPP model for the proposed wastewater treatment plant.

1.1 Study Area

The work, the project setting is in Rajarambapu institute of technology located at Islampur Village, Sangli District, and Maharashtra, India. Fig shows the layout of the RIT collage with the location of plant area. Wastewater quantity mainly depends upon the water used in hostel campus. According to data collection, the MIDC provides the water for hostel campus daily. The water meter readings are taken at the hostel campus are obtained. Maximum limit of water usage is up to 65 units (1 unit – 1000lit) of water, above this limit the extra charges are added to bill. As per the water usage, the maximum reading of 271 units is used in month of September 2019. The average reading of year 2017, 2018 is 156 units and year 2019 up to October is 145 units.

Maximum water meter reading = 271 units

Wastewater quantity = 271 x 80% = 216.8 units

Taking the peak quantity as 220 units, and designing the units

2. METHODOLOGY

In the methodology as per collected data from the collage hostel of wastewater generation. A treatment system regards to low initial cost and which also gives more benefits from it, is selected as constructed wetlands. From the given data the design of units sedimentation tank, advance septic tank, constructed wetland and storage tank is completed. The details of the each component is in table1

PPP or the Public Private Partnership involves a contract between a public sector authority and a private party, in which the private party provides a public service or project and assumes substantial financial, technical and operational risk in the project. Sewage treatment plant (STP) projects are currently being granted on the basis of Engineering Procurement and Construction (EPC) and have a limited role for the EPC contractor in O & M of assets.

In collages with large number of population and scarcity of water, sewage treatment projects for reuse can be developed. This type of project can be developed with the private sector on PPP basis.

Under the PPP structure, the private sector partner who invests in the project assets and recovers it over a project life cycle of say 10–20 years, is likely to ensure better management of project assets and delivery of committed service level parameters during the project term.

Table -1: Details of Treatment System

Unit Name	Sedimentation Tank	Advance Septic Tank	Constructed Wetland	Storage Tank
Size	8 X 4 X 2	18 X 12 X 3	46 X 23 X1.8	8 X 4 X 2
Total area required for system	1830 Sq.m			
Cost of Construction	27,67,674			

There are several business models of PPP as described below,

BOOT (Build-Own-Operate-Transfer) contract

BOO (Build-Own-Operate)

BOT (Build-Operate-Transfer)

BTO (Build-Transfer-Operate)

By studying all this PPP models, the best suited model for sewage treatment systems is BOT.

Under a BOT model there are following types -

BOT (Build-Operate-Transfer) Toll model

Key features of toll Model

1. Bid Parameter: Total cost of project = Engineering services and design + Product providence

= 27,67,674 + 22,000

= 27,89,674

2. Revenue collection and O&M payments: There is no payment to the private player as he earns his money invested from tolls.
3. Secured cash flows in form of annuity payments: No Annuity payment is made by RIT collage to private player.
4. Risk Allocation: Private partner bears all the risks.
5. Sharing of Capital cost: There is no sharing of capital. After 10 years the owner is RIT collage.

Build Operate and Transfer (BOT) Annuity Model:

Under BOT annuity, a developer builds a highway, operates it for a specified duration and transfers it back to the government. The government starts payment to the developer after the launch of commercial operation of the project. Payment will be made on a six-month basis.

Key features of Annuity Model (AM)

1. Bid Parameter: Total cost of project = Engineering services and design + Product providence
   = 27,67,674 + 22,000
   = 27,89,674
2. Revenue collection and O&M payments: Revenue as water given to RIT campus of quantity whichever may come at the end of year, and O&M payment will be made to the private player.
3. Secured cash flows in form of annuity payments: Annuity payment is made by RIT collage to private player for water usage in every year for 10 years.
4. Risk Allocation: Private partner bears the construction and maintenance risks as in BOT (Toll) projects and also all the revenue risk as well as the inflation risk.
5. Sharing of Capital cost: There is no sharing of capital. After 10 years the owner is RIT collage.

Hybrid Annuity Model (HAM):

Key features of Hybrid Annuity Model (HAM)

1. Bid Parameter: Total cost of project = Engineering services and design + Product providence
   = 27,67,674 + 22,000
   = 27,89,674
2. Revenue collection and O&M payments: Revenue as reuse of water in RIT campus of quantity 220 cum, and O&M payment will be made to the private player.
   Cost of water usage in RIT campus = 9,90,000
   O& M payment = 82,940
   Revenue made = 4,12,060
3. Secured cash flows in form of annuity payments: Annuity payment is made by RIT collage for 10 years
4. Risk Allocation: Private partner bears the construction and maintenance risks as in BOT (Toll) projects. Collage bears all the revenue risk as well as the inflation risk.
5. Sharing of Capital cost: 40% of the bid project cost shall be payable to the Private partner by the authority in five equal installments linked to physical progress of the project Private partner has to initially bear the balance 60% of the project cost through a combination of debt and equity.

40% of the bid project cost = 27,89,674 X 40% = 11,15,869

60% of the project cost = 27,89,674 X 60% = 16,73,804

Cost per year to pay –

60% of the project cost = 27,89,674 X 60% = 1,67,380
82,940 = 2,50,320

Revenue made = 4,12,060 / year

Annuity to private player = 2,50,320

Benefit per year = 1,61,740

3. CONCLUSIONS

From the above results of different PPP models and there risk management, the hybrid annuity model gives most of the situations in the hand of collage authority and also private player which creates win – win situation. This paper highlighted the different PPP models and financial criteria's. The collage authority has reduced the responsibility of arranging cost of project.(only 40%) .Payments done after assuring the work. The private player has to arrange only 60% of project cost. (In AM it is 100%) so the best feasible PPP model for our case is hybrid annuity model (HAM).

REFERENCES

[1] Patil Y., Munavalli G. (2016). "Performance evaluation of an integrated on- site greywater treatment system in a tropical region." Ecological engineering, ELESVIER, 95,495-500.

[2] García Avila F., Pati~no-Ch_avez J., Zhinín-Chimbo F., Donoso-Moscoso S., Flores del Pino L., Avil_es-A~nazco A. (2019). "Performance of Phragmites Australis and Cyperus Papyrus in the treatment of municipal wastewater by vertical flow subsurface constructed wetlands." International Soil and Water Conservation Research, ELESVIER, 7, 286-296.

[3] Gholikandi G, Moradhasseli M, Riahi R. (2009). "Treatment of Domestic wastewater in a pilot-scale HSFCW in West Iran" Desalination, ELESVIER, 248, 977–987.

[4] Kouki, S., M"hiri F., Saidi N., Belaïd S., Hassen A .(2009)."Performances of a constructed wetland treating domestic wastewaters during a macrophytes life cycle" Desalination, ELESVIER, 246, 452–467.

[5] Lu S., Pei L., Bai X. (2015). "Study on method of domestic wastewater treatment through new-type multi-layer artificial wetland" International journal of hydrogen.