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Techno-Economical Feasibility of Water Supply Scheme under Public Private Partnership

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Abstract - *Maharashtra is Number one state in pollution of rivers according to report published by Ministry of Water Resources. The worst polluted river in the state is 'Panchganga' according to report. More than 28 rivers are most polluted river in state. The increasing industrialization along the river are cost and direct entrance chemically polluted water in river flow are the major reasons. Chemical, processing, sugar and related Industries highly contribute to the river water pollution in Maharashtra state. The worst part is, people near Panchganga River are dying due to Jaundice and Gastro, about 15 deaths are recorded till now. "due to pollution the time required to treat the water is increased so quantity required is falling short and peoples of Ichalkaranji city are getting water after every three to four days.*

Key Words: Public Private partnership (PPP), Techno-Economical Feasibility, Water supply scheme

1. INTRODUCTION

The state and local governments' approach towards water management has focused on asset creation and developing new bulk sources of water rather than maintaining the assets created and promoting efficient consumption. Even after consideration for affordability and minimum necessary requirement of water for survival, the overall level of water tariffs are too low to even cover the operation and maintenance costs let alone generate any surplus for capital investment. Consequences are that cities suffer from intermittent supply, insufficient coverage and poor quality of water. Moreover, the high share of non-revenue water has only compounded the financial constraints of water utilities. It has been argued particularly by multi-lateral institutions that institutional arrangements that involve private sector in partnership with public sector through public-private-partnership (PPP) could potentially improve the efficiency in water management. A number of states/cities in India have experimented with PPPs in water and sewerage services since 1990s.

2. HISTORY OFF PPP MODELS IN WATER SUPPLY SCHEMES

The position with regard to the role of private sector in catalyzing pricing reform has been controversial in ideological debate around PPPs. Early PPPs during 1990s focused on large bulk water supply projects, most of which failed to take off. Post 2000s, the focus has shifted from full water value chain engagement of private sector to engagement limited to operation and maintenance (O&M) improvements of the distribution system. In line with this shift, the financing and incentive structure and extent of involvement of private sector in a PPP project has also changed. Many new water PPPs have involved financial assistance from the respective state governments or from international funding agencies. However, for the most part, even with the support from state governments, these projects have had limited success - constrained as they have been by one or more institutional, structuring, governance or technical issue. By analysing a range of water PPP projects in India, this paper evaluates the technical and economic efficiencies achieved in these projects and also identifies project level challenges associated with policy and institutional arrangements.

3.CASE STUDY OF PROPOSED WATER SUPPLY SCHEME FOR ICHALKARANJI CITY

The Ichalkaranji city being rapid growing city called as Manchester of Maharashtra has tremendous potential for growth and development. This has caused increase in population and land use on skirts of the city. Therefore water demand of the city is increasing day by day for Industrial and household purpose. The Ichalkaranji Municipal Corporation is facing problems for providing adequate water supply for industries and household use. Therefore Ichalkaranji Municipal Corporation is searching for various alternatives regarding water supply scheme which will be economical and feasible.

Ichalkaranji town having population of 7,152 in 1848 became the capital of Ichalkaranji Jahagir. A Municipality was first established in 1893 and it was governed by the members elected by Government up to 1972. Now, it is an "A" class Municipal Council.

The city of Ichalkaranji assumes a place amongst the cities highest per capita income in the country.

Ichalkaranji was a Maratha Princely state situated on the banks of Panchganga River.

3.2Situation and Location

Ichalkaranji situated at 3km North Panchganga River. It 29 Kms.South-East of Kolhapur, 26 Kms. South-West of Sangli. Nearest Railway station is Hatakangale situated towards North at a distance of 9.6 Kms. By road.

- Latitude = 16°40′ N
- Longitude =74°27′ E

Ichalkaranji situated at an altitude of 556.00 above MSL.

The River Panchganga is flowing on the South side at distance of about 3 Km. from the town and the general slope is towards South – East i.e. towards the river Panchganga.

3.3 Proposed Water Supply Scheme

Perennial River Krishna is flowing at 18 Km. form Ichalkaranji town on South – East side. This River is also having major storage's as detailed below on upstream & on tributary rivers from which periodical releases are being made for downstream use, due to which the river has become almost perennial

Storage's.	**Dam Capacity.**
1) Dhom.	13.50 TMC
2) Koyana.	98.78 TMC
3) Kanher.	10.10 TMC
4) Warana.	34.20 TMC

However as mentioned earlier Panchganga River get polluted and water lifting point on Krishna River also get polluted due to mixing of Panchganga River on just U/S. Considering all situations **Warana** river is assured pollution free source, hence scheme prepared accordingly.

4. PROPOSED PPP MODEL FOR ICHALKARANJI CITY WATER SUPPLY SCHEME

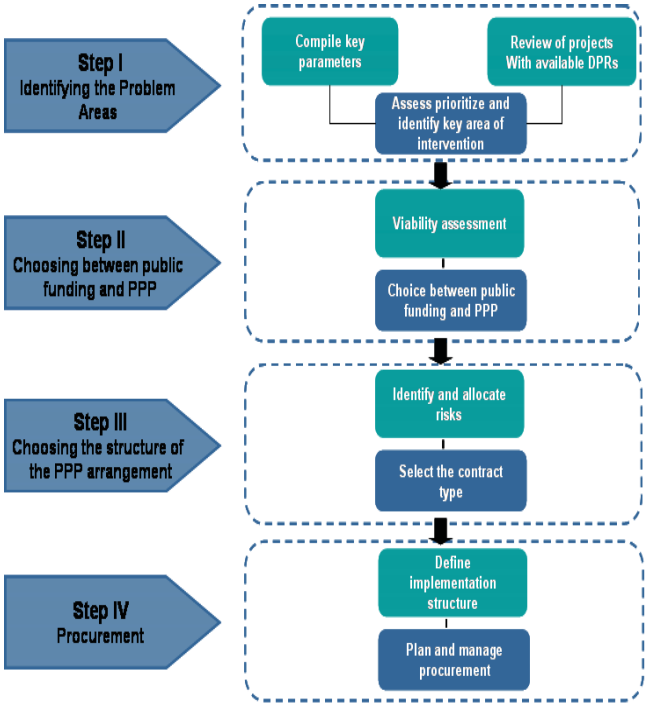

Figure No.4.1:Overview of stages in determining suitable PPP structures

4.1 Implementation of proposed PPP model for Ichalkaranji city

Step 1: Identifying the Problem Areas

The source of water for current water supply scheme is Panchganga. The Panchganga River is polluted due to mixing of untreated sewage of town and villages in the basin, as well mixing of untreated industrial effluent directly into river. Due to pollution, filter starts choking and existing treatment plant can't remove bad smell, all these leads to epidemic outbreak of water borne diseases. Mean time pollution level of Panchganga river is increased tremendously, as well as pollution level of Krishna river also get increased and water near source get polluted.The pipes laying below the ground from river to water treatment plant are mostly gone through agricultural farm, in that mostly farm, the farmer use chemical fertilizers due to this fertilizers the pipes laying below ground are started corroding and due to this the numbers of leakages are increased. Due to this losses and growing residential and industrial demand of water is not fulfilling. So there is need for continuous water supply system for the growth of City.

Step 2: Choosing between public funding and PPP

The total cost of proposed water supply system is Rs.893220000, for this type of water supply projects Central Government of India will finance 50 percent of total project cost under AMRUT YOJANA. Ichalkaranji Municipal Corporation will finance 25 percent of total project cost. The remaining project cost will be charged to users i.e. residential and Industrial water connections via PPP.

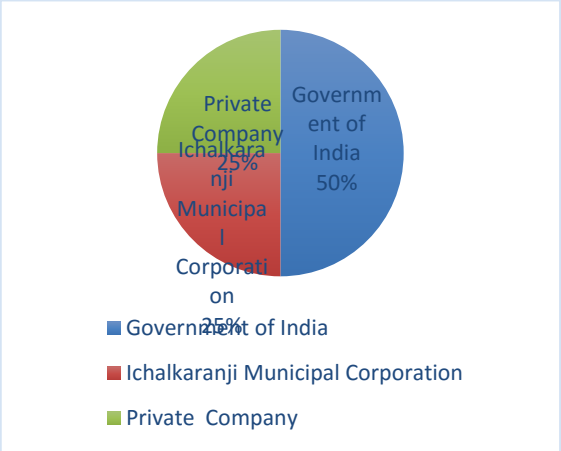

Figure No. 4.2:Percentage Investment Diagram

Step 3: Choice of PPP structure

The government of India has made Toolkit for Public Private Partnership inUrban Water Supply for theState of Maharashtra. In this manual the various PPP models for the water supply systems. From these modelsConcession Agreement for construction, Operation and Maintenance of Bulk Water Supply System model is selected. In this model the private developer is required to undertake the construction, finance, operation and management of water supply services from raw water source to the intake WTP. The augmentation activity includes construction of the raw water off-take machinery; installation of electrical sub-stations and raw water transmission lines, pure water transmission lines up to the point of the storage reservoir, and storage tanks. The capital investment required for the augmentation works needs to be borne by the private developer. The private developer is therefore required to construct the bulk supply infrastructure. From the point of the Intake of WTP to the distribution network up till the consumer end, the water supply responsibility rests with the Ichalkaranji Municipal Corporation. The operation and management of these assets during the concession period rests with the private developer. Therefore, all the associated operating expenses including the purchase of bulk water, payment of electricity charges and establishment expenses including labor charges are the responsibility of the private developer. Ichalkaranji Municipal Corporation have to take care of Operation and Maintainace of WTP to Entire Distribution network up to Consumer End.

Step 4: Procurement

After finalising the private partner by bidding process the following action plan will be applicable after land acquisition.

Sr.	Name of Work	Duration (weeks)
1	Working Survey	4
2	Head Works	
	a) Intake Well	4
	b) Connecting Pipe	3
	c) Inspection Well	6
	d) Jack -Well	12
	e) Pump House over Twin Jack well	4
	f) Power House	5
	g) Approach Bridge (2.00m Wide)	3
	h) RCC Weir (Check Dam)	8
3	Raw water Pumping Machinery	3
4	Raw water Rising Main	15
5	Break Pressure Tank	10
6	Raw water Gravity Main	15
7	Miscellaneous Works (Wire Fencing ,Approach Road)	5
	Total	97

Table No.4.1:Action plan for completion of project

4.2.1 Project Cost

1. Capital Costs

The capital costs includes costs of land acquisition and also the cost required to construct the Intake well , Inspection well, Jack well , Pump house , Break pressure Tank, laying the pumping main and gravity main.

So the capital cost of Kumbhoj to Ichalkaranji water supply scheme Project is Rs. 893220000.

2. Operating costs

a) Raw Water Charges

1.	Daily Demand (2034)	78	MLD
2.	Rate of raw water (in Rs.)	6.60	Per 10000 Liters
3.	Annual Charges for Immediate stage (year 2034) (78000000 x 6.60 x 365)/10000		
	Rs.	18790200.00	

	Say – Rs.	187.90 Lakh

Table No.4.2: Raw water Charges

b) Power Consumption Charges

1.	Consumed H.P. (2400 x 0.746= 1790.40)	1800	KW
2.	Hours of Pumping	20	Hrs./Day
3.	Daily Consumption (1800 x 0.746 x 20)	36000	Units
4.	Yearly Consumption (36000 x 365)	13140000	Units
5.	Annual Electric Charges Considering Rs.5 per unit	65700000.00	Rs
	Say-Rs.	**657.00**	**Lakhs**

Table No. 4.3:Power Consumption Charges

c) Annual Establishment Charges

Sr. No.	Post	Average Monthly Pay	Establishment Required	Monthly Pay
1	Shift Engineer	50000	4	200000
2	Clerk	22000	6	132000
3	Plumber	20000	4	80000
4	Pump Operator	20000	5	100000
5	Pump Attendant	18000	3	54000
6	Fitter/Mestry	20000	4	80000
7	Electrician	18000	3	54000
8	Valve man	15000	16	240000
9	Watchman	15000	9	135000
10	Mazdoor (Heavy)	16000	15	240000
11	Mazdoor (Light)	12000	20	240000
			Total	**1555000**
	Total Annual Establishment Charges Rs.			**18660000**
			T.A. Bills	**300000**
			Medical	**849600**
			Special Medical Bills (Accidental etc.)	**1500000**
			Gratuity	**500000**
			Total	**21809600**
				218.09 Lakhs

Table No. 4.4: Establishment Charges

Therefore total Operating Costs includes raw water charges, electricity charges and Establishment charges which total is **Rs.106299800.**

3. Maintainace Costs

Sr. No	Name of Sub work	Net Cost	Gross cost with 9 % E&P Charges	% of M & R	Total M&R charges
1.	Head Work				
	a)Intake Well	3985992.19	4344731	0.50	21724
	b)Jack well	25724909.81	28040152	0.75	210301
	c) Inspection Well	3494990.29	3809539	0.50	19048
	d)connecting Pipe	8683900	9465451	0.25	23664
	e)Pump house	15981328.37	17419648	1.75	304844
	f)Power house	3660451.24	3989892	3.75	149621
	g)Approach Bridge	12061400	13146926	0.75	98602
3	Raw Water pumping Machinery	110924900	120908141	2.75	3324974
4	Raw Water Rising Main	284518412	310125069	0.25	775313
5	Break Pressure Tank	3320500	3619345	0.25	9048
6	Raw Water Gravity Main	241974835	263752570	0.25	659381
-	Miscellaneous Works	528100	575629	1.0	5756
	Total Annual M & R Charges Rs.				**5602275**

Table No. 4.5:Maintainace cost

Therefore the Maintainace cost includes Maintainace of new proposed system only, it does not includes the Maintainace of existing water treatment plant and existing distribution system.

4.3.1 Financial feasibility

For the new proposed water supply system the new water rates are adopted which is flat tariff rate as follows,

Sr. No.	Type of connection	Proposed rate for Unmetered Connections
1	Domestic	2800 Rs./No.
2	Industrial & Commercial	9000 Rs./No.

Table No.4.6: The Water Connection charges of Ichalkaranji

Therefore total collection of Ichalkaranji Municipal Corporation as per new proposed rates is Rs.235661000. But the Ichalkaranji Municipal Corporation will take care of Operating and Maintainace of water treatment plant to distribution system end so therefore they require some amount of money which will 4 crores rupees. Therefore Rs.195661000 available.

Therefore Payback period required to return the capital investment with interest of 12% as per Indian Nationalise Bank is given as follows,

Year	Capital Cost	Annual O & M	Yearly Cash Inflow	Net Yearly cash Inflow	Future worth Factor	Future Worth	Liable Amount
0	223305000	0			1	-223305000	
1	223305000	111902075	195661000	83758925	0.8929	74784754.46	-148520242.5
2	223305000	111902075	195661000	83758925	0.7972	66772102.2	-81748140.34
3	223305000	111902075	195661000	83758925	0.7118	59617948.39	-22130191.95
4	223305000	111902075	195661000	83758925	0.6355	53230311.07	31100119.12
5	223305000	111902075	195661000	83758925	0.5674	47527063.45	78627182.57

Table No. 4.7:Payback Period

In this table Cash Inflow is taken positive and cash outflow is taken negative.

Payback Period = 3 + (22130191.95/53230311.07)

= 3.42 Years

Therefore payback period for capital cost of Rs. 223305000 at 12% interest rate is 3.42 years by even yearly cash inflow i.e. Rs.195661000. As per this PPP model the contractor's investment will be return within4 years and after 5 years period completion the project will be transferred to Ichalkaranji Municipal Corporation.

5. RESULTS

The source of water for current water supply scheme is Panchganga. The Panchganga River is polluted due to mixing of untreated sewage of town and villages in the basin, as well mixing of untreated industrial effluent directly into river.so its need to find out new economical source of water supply which is Warana River.

The new water supply system is designed which has Inspection well 4.0 m diameter,2 Nos. of Circular Jack well of Size 10 M. Diameter,BPT of Capacity 7, 50,000 litres, Rising main of 1524mm diameter and 10 mm thickness, Gravity main of 1524mm diameter and 10 mm thickness and 12mm lining provided for both and 45mm cement sand gunite externally and 800 HP 5 numbers of pumps(3 working + 2 standby) This whole work cost around 90 crores.

The water supply system designed under Public Private Partnership , in which contractor has to operate, Maintainace and repairing for 5 years, in which the Ichalkaranji Municipal Corporation has pay yearly to contractor from water bill and rest of the system from Water treatment plant to Consumer has to operate and maintained by Ichalkaranji Municipal corporation. The contractor gets his initial investment within working 4 years of water supply system after its construction.

So the proposed water supply system under public private Partnership will give smoothly working of water supply and also give clean and required quantity of water and it

will also help to minimise the financial loss of Ichalkaranji Municipal Corporation

6. CONCLUSION

The existing water supply scheme is insufficient for Ichalkaranji city. Due to rapid Increasing in population and Industrialization the demand of water is increasing day by day. The Panchganga River is polluted and hence not suitable for drinking and Industrial use. Maharashtra is Number one state in pollution of rivers according to report published by Ministry of Water Resources. The worst polluted river in the state is 'Panchganga' according to report. More than 28 rivers are most polluted river in state. So some conclusion are listed below,

1. Due to this new water supply system the water demand of increasing population will be full filled. The quality of water will also improve so the cost on water treatment will be reduced due to new and clean source of supply i.e. Warana river.
2. In Ichalkaranji city the 90% industries are textile industries, in textile industry the large amount of water is required for seizing, blitching, dyeing, finishing purpose, but in existing water supply system the water provided after three to 4 four days, due to this the growth of Industry the production of textile industries also decreased, so the new water supply system will provide water as per there requirement also this will help them to increase their production and growth of Industries.
3. The existing source of water supply system is Panchganga River, which is worst polluted river, resulting in spreading various water borne diseases throughout year, which causes financial loss and also emotional loss due to death of persons. But in this water supply system the water is clean so there will be no chances of any disease.
4. In the existing water supply system there is always problem of leakage, because of this the Ichalkaranji Municipal Corporation has facing financial loss due to frequent repairing of existing water supply system, but in new water supply system the Operation Maintainace and repairing will be handled by Private company for 5 years after completion of its work. So the financial loss of Ichalkaranji Municipal Corporation will be automatically reduce.
5. The new water supply system which is under Public Private Partnership, so the water supply will work smoothly due to control of private company and also the leakage and repairing problem will be quickly solved than existing water supply system.

REFERENCES

[1] Albert P. C. Chan , Patrick T. I. Lam , Yang Wen , Ernest E. Ameyaw, Shouqing Wang, and YongjianKeASCE (2014): "Cross-Sectional Analysis of Critical Risk Factors for PPP Water Projects in China", *Journal of Infrastructure Systems, ©ASCE,* 21(1), pp. 1-10.

[2] Cheung, E. and Chan, A. (2011): "Risk Factors of Public-Private Partnership Projects in China: Comparison between the Water, Power, and Transportation Sectors" *Journal of Urban Planning and Development, ©ASCE,* 137(4), pp. 409-415.

[3] Erik Porse, S.M.ASCE and Jay Lund, M.(2015): "Network Analysis and Visualizations of Water Resources Infrastructure in California: Linking Connectivity and Resilience *"Journal Of Water Resources Planning And Management, ©ASCE* 142(1), pp. 1-9.

[4] Gibson, R. (2012): "How to Accelerate Design and Construction for Large Water Supply Projects *"Pipeline Conference 2012*, *©ASCE,* pp. 889-900.

[5] Hossam Abdel Meguid and Bogumil Ulanicki(2011): "Feedback Rules for Operation of Pumps in a Water Supply System Considering Electricity Tariffs", *12th Annual Conference on Water Distribution System Analysis 2010, ©ASCE*, pp. 1188-1205.

[6] Lucy Corcoran, Aonghus McNabola and Paul Coughlan, (2015):"Optimization of Water Distribution Networks for Combined Hydropower Energy Recovery and Leakage Reduction", *Journal of Water Resources Planning and Management, ©ASCE,* pp. 1-8.

[7] Meng, X., Zhao, Q., and Shen, Q. (2011): "Critical Success Factors for Transfer-Operate-Transfer Urban Water Supply Projects in China *"Journal of Management in Engineering, ©ASCE,* 27(4), pp. 243-251.

[8] Morteza Farajian and Qingbin Cui. (2011): "A Multi-Objective Decision Support System For PPP Funding Decisions *"International Workshop on Computing in Civil Engineering 2011,* ©ASCE, pp. 210-218.

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