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Water Economics for Present Water Supply System at Mandya City

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***Abstract*— Water economics is an applied branch of Economics which is concerned with the application of concepts of economics for better water management. The present Water Supply System is studied and the externalities are identified on the basis of supply conditions throughout the Mandya city. Cost production per kiloliter of water based on Investments made is calculated and found out to be high when compared to Cost production per kiloliter excluding Investments. Other than these the implicit cost is calculated in terms of Value of Time.**

Keywords—Cost Production per kiloliter, Explicit costs, Implicit costs, Value of Time

I. INTRODUCTION

The now world famous proclamation that Water should be considered as an economic good which started in Dublin conference [4]. The major discussion was whether to consider water as an economic good or not. Few agreed to be an economic good and few were against this concept. However, Water is considered to be an economic good because of its wide range of application in number of ways as extensively used by humans. Economics is not just about financial and commercial aspects instead it can be used to mean the process of integrated decision making about the allocation of water resources [5], investments and costs associated from its supply, distribution till it reaches the consumer end. It also pays close attention on the finances, costs, tariffs, dues, expenditure and revenues associated with its supply and distribution.

II. BACKGROUND

A. Geography of the City

Mandya is spread over 17.05 square kilometer having population of 137,735 (as per 2011 census) situated at 76^0 19' – 76^0 20' South and $12^0$13' – 13^0 4' East & is about 2500-3000 feet above sea level. The major source of water is River Cauvery. Rate of supply is 21MLD and the per capita demand is 135LPCD [6] and supplied by means of 18 Over head tanks. There are 35 wards [6] to which the water is supplied on alternate days.

B. Board History

Mandya City Water Board which is a Division of Karnataka Urban Water Supply and Drainage Board started their operation in Mandya city and commenced first stage of treatment and supply in the year 1985 with 3.48 crores of Investments. Later it was upgraded to II stage water treatment and distribution in the year 2000 with 22 crores of Investments. A new proposal has been approved for 24x7 water supply with 215 crores Investment in the following year as per the source.

III. WATER TREATMENT AND DISTRIBUTION

Mandya Water Board operates two water treatment facilities, with total capacities of 6 MLD and 15 MLD. The water is pumped via channels from the source to the treatment facility. One treatment facility is situated in the city premises and receives water via pipelines through gravity. The other treatment facility is situated about 15 kilometers from the source but has a BPS at 6 kilometers away from the source. The raw water from source reaches aerator then to 1st and 2nd clarifier, here alum is added and then passed to 1st and 2nd filter beds. Post chlorination is done and stored at sump before distribution. Filters are back washed once in 24 hours. Residual chlorine is checked regularly daily at the consumer level and is maintained at 0.2 milligrams/Liter. Water samples are collected and qualitative analysis is done in order to check and keep the water quality parameters under limit. Treated water is then supplied to 18 over head tanks and distributed through conduits.

Water is supplied everyday for an hour at a rate of 135LPCD [6] starting at 6 A.M. Every hour is dedicated to each area, such that all the 35 wards will be completed in 2 days duration. Therefore the supply per area becomes every alternate days. However, the supply is interrupted if there is a power supply failure.

A. Abbreviations and Acronyms

WSS - Water Supply System, WGS84 - World Geodetic System84, UFW - Unaccounted For Water, INR - Indian Rupees, MWS - Mini Water Supply, O&M – Operation and maintenance, VOT – Value of Time, HP – Horse power, BPS – Booster Pumping Station

B. Units

- MLD – Million Liters per Day
- LPCD – Liters Per Capita per Day
- ML – Million Liters
- m – Meter

C. Means of Household Access

Mandya water supply system has 18,436 connections as of December 2014 as per board engineer. Other than these, as

per 31.05.2006 the domestic drinking water requirement is supplied through 1132 number of MWS schemes, 932 number of piped water supply schemes through bore wells along with 9902 number of bore wells installed with hand pumps [7]. About 195 commercial connections and 225 non-domestic connections are also present as per board engineer
.

D. Consumer coping Strategy & Payment

Consumer coping strategy involves the time spent in line waiting to fetch water [4]. It also involves supply of water by means of tankers during an emergency like pipe or pump breakdown. During such emergencies, water is supplied by means of tankers. The cost of each tanker including its haul period and time wasted in waiting rounds around 300INR.

E. Drawbacks

A number of factors limit the effectiveness of better water management. The tariff fixed is 120, 240, 480INR for Domestic, Non-domestic and Commercial purpose as described by board engineer, but people still believe in low tax ideology or non-payment ideology and hence arrears of 719.81Lakhs INR up to Dec 2014 is very difficult to collect from public.

F. Power Charges

The power supply for pumping of water from the source till the consumer taps is supplied by the Chamundeshwari Electricity Supply Corporation. The total power consumption is about 1140 HP (1 HP = 746 Watts). About 850,440 Watts of power is consumed every month. But the power interruption is seen regularly at the BPS and other pumping stations.

G. Seasonal factors and supply variation

Following are some of the major factors affecting the supply of water:

- Summer season
- Unauthorized connections
- Bill pending
- Water quality problem
- Water pipe leakage
- Illegal Connection
- Valves to be repaired
- House connection disconnected
- Electricity interruption
- Seasonal population
- Pump breakdown
- Bore well- hand pump problem

All the factors mentioned above are associated with losses. But, leakage being maximum, it has to be considered as an economic loss [1] we have to calculate UFW. But UFW also signifies for implicit cost as water is lost and in turn affects the charges involves in its treatment and distribution.

IV. COST PRODUCTION PER KILOLITER

Combining the cost associated from pumping till the water reaches the consumer tap the cost production per kiloliter of water can be calculated [2] [3]. It includes, Establishment charges (Regular and contract labor), Chemicals & consumables, Maintenance of power and hand pumps, maintenance of pumping machinery, maintenance of electrical appurtenances, repairs of pipelines, materials, telephone charges, maintenance of vehicles, water quality analysis, computerization of revenue management, civil works, printing and stationary, electricity charges, water tanker charges and miscellaneous expenses. On an average the cost production of water for Mandya city excluding the Investments is 3 INR calculated using Equation (*1*). If investments are added then the cost production per kiloliter will be 38-40 INR. In order to calculate the cost production per kiloliter the rate of supply per year and the overall expenditure per year has to calculate using the above charges. Equation (*1*) shows how to calculate the cost production per kiloliter and table 1 shows how to tabulate it without investments and Table (2) with investments.

*Cost production per kiloliter = (Σ Expenditure (±investments)/Rate of Supply per Year)*1000* (1)

TABLE 1

Particulars	Cost Production per Kiloliter without Investments		
	Expenditure, INR	Rate of Supply, ML	Cost of produced water, INR
Establishment charges + Chemicals & consumbales + Maintenance + Repairs + Miscellaneous	21463027	7200	2.9 ≈ 3

TABLE 2

Particulars	**Cost Production per Kiloliter with Investments**		
	Expenditure, INR	***Rate of Supply, ML***	***Cost of produced water, INR***
Investments + Establishment charges + Chemicals & consumbales + Maintenance + Repairs + Miscellaneous	280820799	7200	39

A. Explicit and Implicit costs

Mandya consumers incur two types of costs; Explicit is defined as direct costs and the Implicit as indirect costs. Explicit costs cope with Capital investments costs and O&M costs, where as implicit costs focuses on Value of time.

Table 3 shows the major capital investment required is to own a water storage tank, water related equipments like motor, pipes and tanks which average around 23000INR in Mandya city. If an additional supply from Borewell is used

then the price may also include charges of drilling, casing, etc. then the average is around 72000INR in Mandya city which is shown in Table 4. *Source: Market prices*

TABLE 3

Sl.no	Explicit Costs		
	Items	Quantity	Rate, INR
1	Electric pump	1	14000
2	HDPE Pipe PE	Approx. 15 m	1m = 95-100
3	Cable	Approx. 3 m	1m = 43-45
4	Single Phase Starter	1	3350-4000
5	500 litre Storage tank	1	2500-3000
6	Small bucket for storage at kitchen	1	150-200
7	Maintenance/ repair of pump including oil price	-	1500-2000
	TOTAL		≈23,000-25000

TABLE 4

Sl.no	Explicit Costs including additional supply		
	Items	Quantity	Rate, INR
1	Drilling	1	11,000-1500
2	Casing	-	14000-25000
3	Pump fitting including pump	1	25000
4	New connection	-	10000
5	HDPE Pipe PE	Approx. 15 m	1m = 95-100
6	Cable	Approx. 3 m	1m = 43-45
7	Single Phase Starter	1	3350-4000
8	500 litre Storage tank	1	2500-3000
9	Small bucket for storage at kitchen	1	150-200
10	Maintenance/ repair of pump including oil price	-	1500-2000
11	Wage	5 personnel	2000-2500
	TOTAL		≈72,000-75000

The O&M of pumping machinery, electrical appurtenances, power & hand pumps, vehicles, repairs of pipelines, pumps add up to the explicit costs as well. Other than these the chemical consumption also varies with seasonal variation. The consumption is high during non-rainy season compared to rainy seasons.

The implicit or the opportunity cost is the number of hours or time spent fetching water implies loss of wage income. The number of hours spent approximately results in 80% of the wage rate on an hourly basis [4]. This number of hours will be taken as implicit costs. Other than this, the time spent for repairing pipeline leakage, pump breakage and miscellaneous work will also be added. For example, agriculture is the major occupation in Mandya city [6]. Therefore by taking the daily wage of a person on the basis of agriculture is 173.33 (say 174) INR [8]. Hourly wage would end up as 7.25INR. 80% of it is predicted as VOT [2]. Therefore 5.80INR is considered as the money spent on queuing and hauling out of the tariff fixed. Total VOT per 5 persons per year is 348INR.

B. Unaccounted For Water

The city's system incurs two types of UFW losses: Physical losses which results from ineffective engineering management and administrative losses, which stem chiefly from inadequate collection procedure like unbilled or uncollected charges. UFW is measured using portable flow meter as supply is Intermittent and does not consist of meters.

CONCLUSION

From the present study we can see that how the concepts of Economics play a vital role even in the field of Engineering. The combination of Economics and Engineering formed a strong tool to calculate the cost production per kiloliter of water and also to calculate the explicit and implicit costs. The cost production per kiloliter of water is found to be 3 INR without investments and 39INR with investments and the Explicit and Implicit costs are approx. 23000 INR and approx.72000 INR. Hence I conclude saying though Water is a natural commodity, still we have to pay for its precise usage.

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REFERENCES

[1] C. J. Perry, M. Rock, D. Secklar, "Water as an Economic good: A Problem or a Solution?," Google books, 2006, pp 1-10

[2] D.Rogers, "Leaking Water Networks: an and environmental disaster,"12th International conference on computing and controlfor Water Industry, CCWI2013,Procedia Engineering vol. 70, pp. 1421-1429, 2014. (*references*)

[3] G. Sastry, "Issues of Unaccounted for water in the Urban Water Sector," Institute for Social and Economic Change, 2006, pp 1-29

[4] KyeongAe Choe, Robert C.G. Varley, H.U.Bijlani, "Coping with Intermittent Water Supply: Problems and Prospects," Activity Report, Environmental Health Project, 1996, pp 1-53

[5] Nick Hanley, Jason Shrogen and Ben White, "Introduction to Environmental Economics," second edition, Oxford University Press, pp 3-6

[6] http://www.mandyacity.gov.in/

[7] http://cgwb.gov.in/District_Profile/karnataka/Mandya_brouchere.pdf

[8] http://labour.kar.nic.in/labour/MW/1a-agri.pdf