

Techno Economical Study of Drinking Water Supply Scheme in Gandhinagar

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Abstract— Narmada canal based drinking water supply project is on the prime focus for Gujarat Water Supply & Sewerage Board as there is a major issue of sustainable source in the State. This study aims to techno-economical evaluation of Narmada Canal based water supply project for Gandhinagar (NC-14). The technical parameters like population forecasting, water demand, design of pressure main is done by EPANET and BRANCH, and economical parameters like line losses in water transmission main, cost per KL of water supply and financial analysis based on present water tariff structure, economical parameters like line losses in water transmission line, cost per KL of water supply and financial analysis based on present tariff structure are studied and calculated and compared with actual project. Revenue model is recommended to make the project self supporting. The effect of the scheme on public health is evaluated against previous water supply system.

Key words: EPANET, Water Supply

I. INTRODUCTION

Water is elixir of life. The prime aim of any water supply scheme is to provide safe and adequate water to the community. Whenever any water supply project is in consideration, the possibilities of various configurations taken into consideration, various possibilities are checked. First hand pump on bore wells, second small individual water supply scheme and finally regional water supply scheme. The approach of adoption of most feasible and appropriate option is followed based on availability of water against demand, quality, geographic area etc.

II. STUDY AREA

Gandhinagar Water Supply Project (NC-14)

Gandhinagar is about 24 km to North East of Ahmadabad and the spreads over is about 57 Sq. Km including the area of Sabarmati River which divides the town. The project is prepared based on source Narmada Main Canal passing near village Nabhoi@ NMC Ch.230.83 km 10 km away from Gandhinagar city. The off-take point is located @ 800m away downstream of main canal crossing of river Sabarmati.



Fig. 1: Gandhinagar city

- 1) Gandhinagar City
- 2) 39 villages of Gandhinagar District
- 3) Gujarat Electricity Company Thermal Power Station
- 4) Institutions like 1. Infocity 2. DA-IICT 3. National institute of Co-operative Management 4. Puri foundation 5. Institute of Hotel Management 6.NIFT 7. GIDC of Gandhinagar
- 5) Air force, military, BSF and CRPF campus situated near Chiloda

III. METHODOLOGY

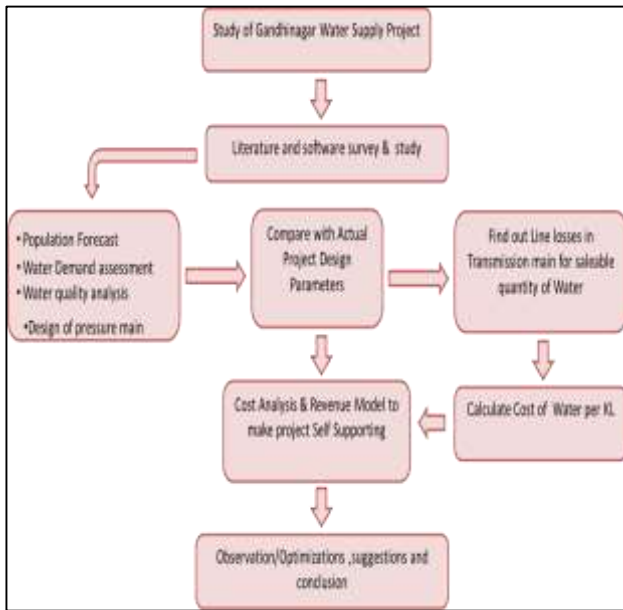


Fig. 2:

IV. RESULT & DISCUSSION

A. Population Forecast for Gandhinagar City:

Year	Arithmetic Increase	Geometric mean	Logistic
2011	262178	300067	
2021	328757	460330	
2031	395336	706188	199000

Table 1: Population Forecast

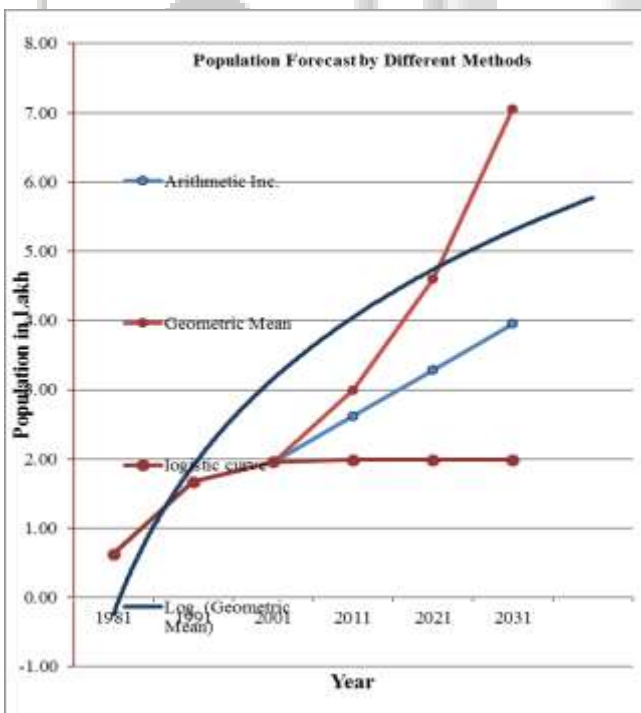


Fig. 3:

B. Design Water Demand:

Description	Demand in MLD in Year						
	2001	2006	2011	2016	2021	2026	2031
Gandhinagar city	43.03	54.52	66.00	79.75	93.50	107.25	121.30
Industrial Demand	13.00	13.00	13.00	13.00	13.00	13.00	13.00
Institutional	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Air Force Command	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Thermal Power station	103.05	103.05	103.05	103.05	103.05	103.05	103.05
Gardening	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Rural	13.479	14.62	15.77	16.84	18.06	19.20	20.21
total	181.06	193.70	206.32	221.15	236.11	251.01	3265.87

Table 2: Water Demand

C. Design of Pressure Main:

1	Water requirement		
		Year	
	Initial	2001	181 MLD
	intermediate	2011	206 MLD
	Ultimate	2021	236 MLD
2	Length of Pumping main	5200	Meter
	Static head including residual head	16.28	Meter
4	Design Period	20	Years
5	Combined efficiency of Pumping set	75	%
6	Cost of Pumping Unit Rs.	17500	Per KW
7	Interest rate	10	%
8	Life of electrical motor & Pump	15	Years
9	Energy charges	3	Rs. per unit
11	Hours of Pumping	24	Hours
12	Stand by KW 1 st Stage & 2 nd Stage	50	%

TABLE 3: Description of Pressure Main

E. Line Loss:

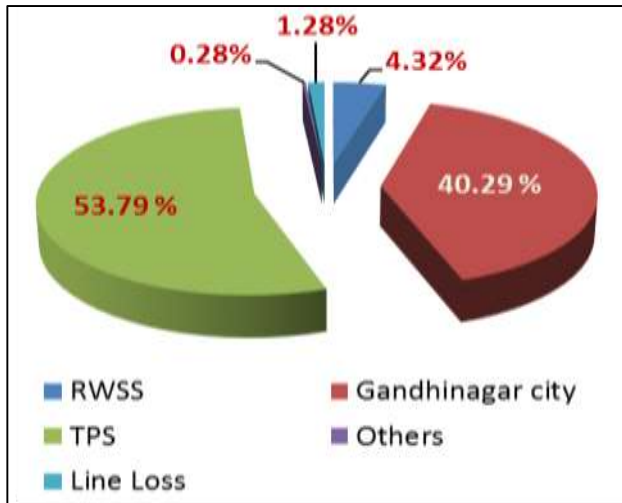


Fig. 7: Line Loss

No. of Days	: 30 Days
Total pumped Quantity:	2765.31ML
Average Daily Pumping:	92.17 MLD
Total Water Supplied	: 2797.87 ML
Average Daily Supply	: 90.99MLD
Loss of Water	
In Transmission:	1.18 MLD
% Loss of Water in transmission:	1.28%

Table 4: Water Auditing

F. Actual Cost of Water Per KL:

Sr no	Description	Bulk water pipeline project
1	Raw water Charges(Rs)	267727308.00
2	O&M Charges paid	3500000
3	Electricity bill paid	36000000.00
4	Office establishment	50000000
5	Annual Depreciation	6806000
	Total Expenditure	319227308
6	Quantity of water supplied	20
		33798982 KL
	Average cost per KL	9.44

Table 5: Cost of Water Per Kl

G. Financial Analysis:

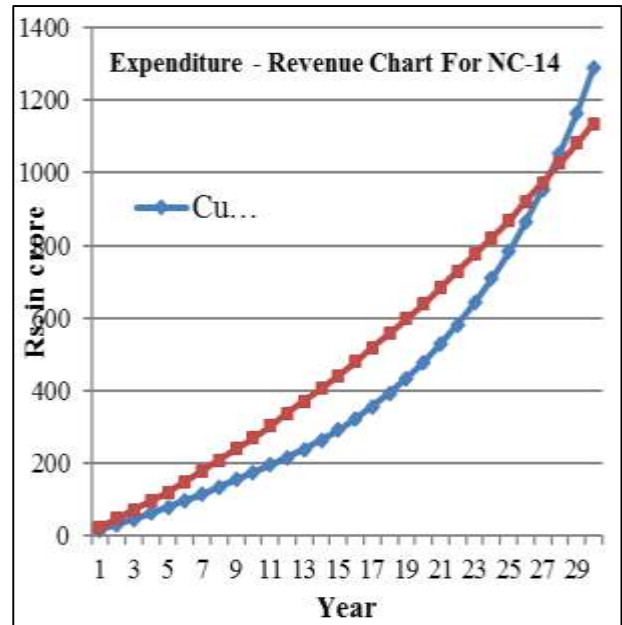


Fig. 8: Financial Analysis

Looking to the expenditure-revenue statement of NC-14 project based on present tariff structure, it is seen that after design period of 30 years there is a deficit in revenue. Cumulative expenditure after design period is Rs. 1287.56 crores against the cumulative revenue of Rs. 1135.57 crores considering 100% recovery from consumers.

H. Effect of Narmada Canal Based Project On Public Health:

Energy Savings

Sr no	description	Water demand	Average depth of tube well	KW required	Annual Energy units KWH
1	Villages	10.0	170	261	228590
2	Gandhinagar city	60.0	200	1842	16135700
3	TPS	70.0	200	2150	18834000
	total	140			35198290

Table 6: Energy Data

- 1) Actual energy consumed in Tube well based w/s system -35198290KWH
- 2) Annual Energy Consumed in NC based w/s system-9631730 KWH
- 3) Saving in Energy- 25566560KWH
- 4) Annual Saving in Energy cost @ Rs. 4 per unit- 1022.66 Lacs

Equivalent Carbon Dioxide Emission

As per study carried out by IIT New Delhi, 0.87 kg of CO₂ produced per one KWH energy production in coal fired Thermal Power Station. According to that, equivalent reduction in CO₂ emission may be calculated as follows.

Reduction in Energy Consumption- 2556650 KWh
Equivalent in CO₂ emission = 25566560*0.87/1000 = 22242 M.T/year

I. Quality of Water:

Sr No	Parameter	Recommendation as per CPHEEO (1999)		Tap Water from Narma da WS project	Tube well water from Gandhina gar city and surroundi ng areas
		Desirab le	Cause of Rejecti on		
1	Colour (Hazen)	5	25	Nil	Nil
2	Turbidity (NTU)	1	10	Nil	Nil
3	Total Dissolved Solids (mg/l)	500	2000	200- 300	1000- 1900
4	Ph	7.0 – 8.5	-	8.0 – 8.3	7.5 – 8.0
5	Fluoride(m g/l)	1.0	1.5	0.2 - 0.3	0.5 – 2.17
6	Nitrates	< 45	45	6 – 10	18 – 91
7	Total Hardness	200	600	50– 60	75 – 590

Table 7: Water Quality Data

V. CONCLUSION

Population projection’ and ‘Assessment of per capita water demand’ implies burden on cost of water to the organization; the same way under estimation of these factors also leads to up gradation of water supply scheme before design period. Line losses in conveyance main are found to be 1.28 % which may consider quite satisfactory. Hydraulic Modeling of conveyance main is found optimum; follows conventional method of calculating economical size of rising main. Energy charges taken in calculations have great influence on economical size of conveyance main. Average cost of water in NC-14 bulk transmission pipeline is Rs.16.7 per KL. Present tariff structure of the scheme is unable to generate sufficient revenue that make the project self sustainable. There will be deficit of Rs.152.00 crores in NC-14 bulk transmission main Revision in tariff policy and maximum recovery of water bill should overcome the deficit in revenue. To promote the people for paying their water bills, they must be educating about the value of water. Thus, there is saving in about 25566560 KWh of energy per year; which approximate costs about 1022.66 lacs per year. Considering 0.87 Kg of CO₂ produce for generation of 1 KWh of electricity, equivalent CO₂ emission of saved electricity is about 22242 M.T per year. This energy may divert for the development of the community.

REFERENCES

[1] CPHEEO, May-1999, ‘Manual Water Supply and Treatment’.
 [2] Gujarat Water Supply & Sewerage Board, Sep-08, ‘Status Report of Sardar Sarovar Narmada Canal Based Drinking Water Supply Project’.
 [3] Gujarat Water Infrastructures Limited (GWIL), June-03, ‘Project Report Sarovar Narmada Canal Based Drinking Water Supply Project for Gandhinagar city, GUDA and TPS’.

[4] Water and Sanitation Management Organization (WASMO), ‘Quality Monitoring Surveillance data’.
 [5] Shital Lodhia, Assistant Professor, CFDA, October-2006. ‘Quality of drinking water in India, highly neglected at policy level’
 [6] A. Bhattacharya, joint secretary, Department of Drinking water supply, Ministry of Rural Development. ‘Tour Report’
 [7] Ian Smout, Sam Kayaga and Camilo Muñoz-Trochez, Dec-08, ‘Financial and Economic Aspects of Water Demand Management in the Context of Integrated Urban Water Management’.
 [8] Central Public Health and Environmental Engineering Organization, May-1999, ‘Manual Water Supply and Treatment’.
 [9] G.S.Birdi & J.S.Birdi Text book of ‘Water Supply & Sanitary Engineering’.
 [10] Tata Institute of Social Science, 2007 ‘Performance and Development Effectiveness of the Sardar Sarovar Project’.