Third Party Evaluation and Remidial Measuers for Rural Water Supply Scheme at Vadoli-Nileshwar

Digvijay Patil, Milind R. Gidde, P.D. Patil

Abstract: ***Government of Maharashtra empaneled Technology and Development Cell (TDSC) as third-party evaluator in all district to improve Rural Water Supply Schemes (RWSS) for improving sustainability, efficiency and equitability of these schemes. The objective of the paper is to investigate and design of rural water supply scheme. The investigation was carried out during 2018-19 in Vadoli-Nileshwar village. Investigation was completed in three stages out of that first stage is to collect document related to scheme like detailed project report, second stage is to verify all documents in scheme and third stage is to verify physical assets of scheme like source well, raising main, storage reservoir and distribution network. Investigation was notified that Vadoli –Nileshwar water supply scheme is completed in 1981, scheme is designed for 2900 peoples with daily demand 40 lit/person/day. But due to increasing population, increasing daily demand and newly developed area water supply is insufficient. For solving this problem, scheme is redesigned in which raising main, storage reservoir, pumping machinery and distribution network is designed for 3700 peoples with daily demand of 115lit/person/day and 12 supplying hours. Scheme was designed by 'Jaltantra' software. It is expected that, if this revised design is considered, the problem of water availability to consumers will be solved.***

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Keywords : Investigation, verifying physical assets, insufficient water supply, design, distribution network, storage reservoir, Jaltantra.

I. INTRODUCTION

Provision of drinking water supply in rural areas was primarily the responsibility of the States, but it was observed during mid-sixties that water supply schemes were implemented only in the easily accessible villages, neglecting hard core rural areas. Government of Maharashtra empaneled Technology and Development Cell (TDSC) as third-party evaluator in all district to improve Rural Water Supply Schemes (RWSS) for improving sustainability, efficiency and equitability of these schemes.

In this study assessment of Vadoli-Nileshwar water supply schemes through design verification, physical asset verification, and performance of scheme as per detailed project report (DPR). Vadoli Nileshwar is a village located in Karad Taluka of Satara district. The Vadoli Nileshwar village has population of 2662 as per Population Census 2011. This village is having main drinking water source as a public well and ESR. With help of motor pumps water is collected from the source in the ESR. The total demand for drinking purpose of village is 115 liters per person per day. Due to insufficient pressure head of oldest ESR which was constructed in 1981 the actual distribution area is not covered under the distribution pipeline network laid in 1981 and it will affect the actual distribution of drinking water in some region of distribution area. For solving those problems scheme which includes pumping machinery, raising main, storage reservoir, distribution network is redesigned by using Jalatantra software.

I. OBJECTIVES

- To collect all documents about scheme.
- To verify document related to scheme.
- To investigate and verify physical assets of scheme.
- To check the availability of water in Source
- To check the machinery in pump house
- To search areas which has water supply is insufficient.
- To redesign pumping machinery by using Jalatantra software.
- To redesign elevated structure reservoir Jalatantra software.
- To redesign distribution network for newly developed area Jalatantra software.

II. LITERATURE REVIEW

Alua Omarova [2019] He presented water supply problems in rural area. The survey was carried out by him during July–December 2017 in four villages in central Kazakhstan. He notified three reasons for this situation: residents' doubts regarding the tap water quality; use of other sources out of habit and availability of cheaper or free sources.

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Another problem concerned the volume of water consumption, which dropped sharply with decreased quality or inconvenience of sources used by households. His paper suggests that as well decentralization of water management as monitoring of both water supply and water use are essential measures.

Bhavana Ajudiya [2017] She design and planned Water supply system includes water sources, water storage at the location; water distribution network and Underground sump along with pumping mainline with a suitable pump.

She selected village Sartanpar which is located in Jasdan taluka of Rajkot district. Sartanpar village population is 889 souls as per census 2011 and present population is 965 as in the year 2016. The project period is considered 30 years, therefore, the population is forecasted using the arithmetic Increase method. Existing water supply system is cluster water distribution system. Propose an alternate solution for water distribution system is based on elevated storage reservoir with staging height 12mt. Water distribution network is designed by loop 4 software.

Abebe Tadesse [2013] He investigate the rural water supply systems with case study in Adama area, in central Ethiopia. He collected data of quantitative and qualitative and analyzed. His study assessed issues such as community participation, water committee empowerment, management and governance of water supply schemes, women participation, functional status of water supply scheme, sanitation and hygiene issues, external support, and monitoring system of water supply schemes.

III. MEHODOLOGY

A. Collection and verify all documents related to scheme.
a) Planning Document
b) Design and financial statement.
c) Legal documents
B. Investigate and verify physical assets of scheme.
a) Source Well
b) Raising main
c) Storage Reservoir
d) Distribution Network
C. Check the availability of water in Source
D. Check the machinery in pump house
E. Finding problems related to scheme.
F. For solving problems redesign assets in water supply scheme by using Jalatantra.

II. Investigation Of Existing Scheme:

In this study scheme is investigated in three stages, first of that is to collect document related to scheme like detailed project report which includes with demand letter, survey report, financial documents like detailed estimate with abstract sheet, legal documents like work order, handover documents. Second stage of investigation is to verify documents which notified that scheme is designed in 1979, which is designed for 2900 peoples with daily demand of 40lit/person/day for six supplying hours. Second stage of investigating this scheme is to verifying physical assets such as availability of water in source well, working operations of pumping machinery, switch house, raising main, capacity and dimensions of reservoir storage and distribution network. In this verification availability of water in source well is in all months in year. Diameter of well is 8.2m and depth is 13m. 5 BHP submerged pump was installed and switch house of dimension 4m x 4m performing good but lifting of water from well to storage reservoir is insufficient for distribution, dimension and capacity of storage reservoir is ok but due to increasing of population and daily demand of water, capacity of storage reservoir is insufficient. Diameter of pipes of distribution network is as per DPR is ok but some linkages in distribution network water is get loss. Five stand posts are their but due to increasing of population, daily demand and newly developed area water supply is insufficient

III. DESIGN BY JALATANTRA

A. Input For Jaltantra

a) Input for General information of scheme

In general information of scheme various inputs like name of project, name of organization, pipe roughness, minimum and maximum head loss, maximum water speed, maximum pipe pressure, number of supply hours, source node ID, source node name, Source head and elevation

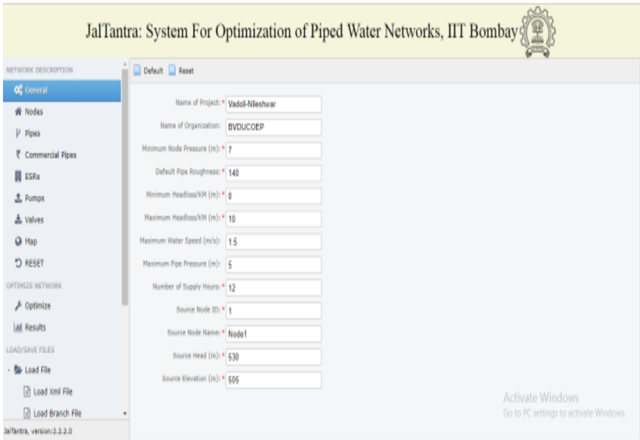

Fig-1: **Input for General**

b) Input for nodes

Input for function nodes is information such as node ID, node name, elevation of node, demand of water at that node, minimum pressure at that specific node. In this specify the node of ESR, source and stand posts. We take elevation height with help of Jalatantra map. We have discharge of water at per sand post is 0.2 lit/Sec. Detail of nodes given in following table.

Table 1: Specification of nodes

Place	*Node ID*	*Node Name*
1	Node 1	Source (Well)
2	Node 2	ESR
3	Node 3	Stand post
4	Node 4	Stand post
5	Node 5	Stand post

6	Node 6	Stand post
7	Node 7	Stand post
8	Node 8	Stand post
9	Node 9	Stand post
10	Node 10	Stand post
11	Node 11	Stand post

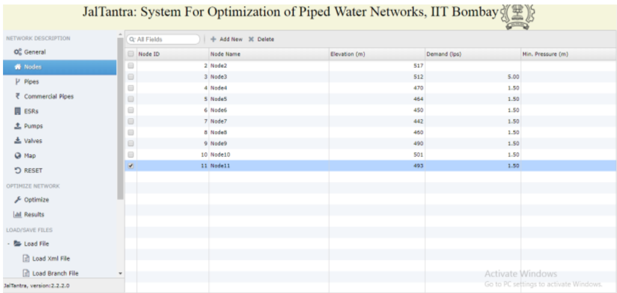

Fig-2: Input for Nodes

c) Input of pipes

Input for function pipe is pipe ID, starting and end node of specific pipe, length of pipe between starting node to end node, required diameter of pipe (not mandatory), roughness of pipe. In this length of pipe is finding out by google map.

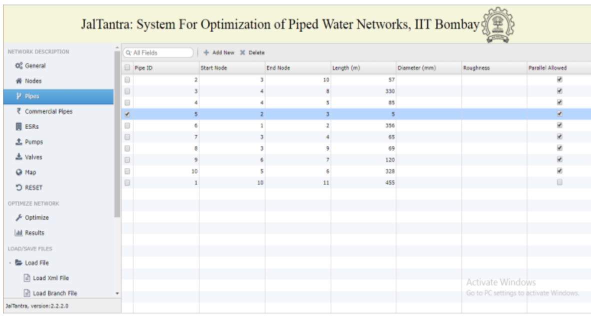

Fig-3: Input for Pipes

d) Input of commercial pipes

In this function input data like diameter, roughness and cost of pipe is used which is given by Astral Manufacturing LTD. In this design diameter of pipe which used for raising main and distribution network is from 20mm to 315mm. Rate and diameter given in following table.

Table 2: Pipe market Prices

Pipe Diameter	***Rate per meter in Rs.***
20	19
25	28
32	44
40	67
50	108
63	166
75	236
90	334
110	503
140	812
160	1054
180	1194
200	1666

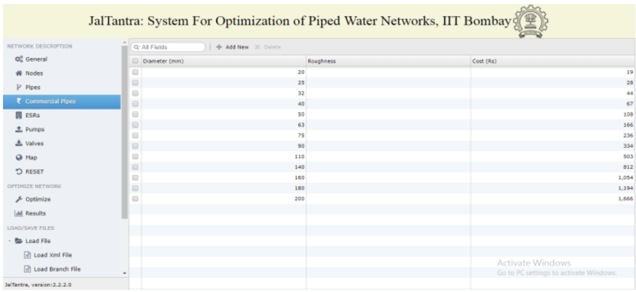

Fig-4: Input for Commercial Pipes

e) Input for ESR

i. ESR General

In for this function is water supply hours of secondary network, ESR capacity factor, maximum ESR height, list of node with and without ESR. In this design 0.33 is capacity factor assumed and 12 supply hours is assumed.

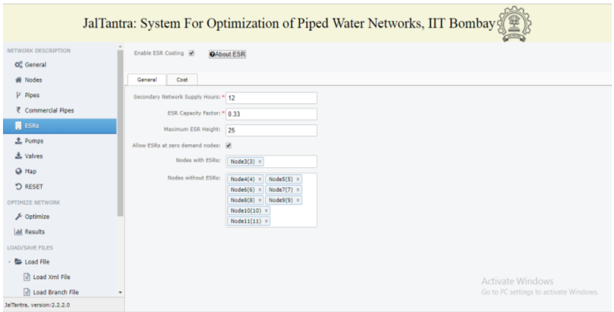

Fig-5: Input for ESR General

ii. ESR Cost

In this function input of minimum capacity, maximum capacity, base cast and per unit cost is mandatory.

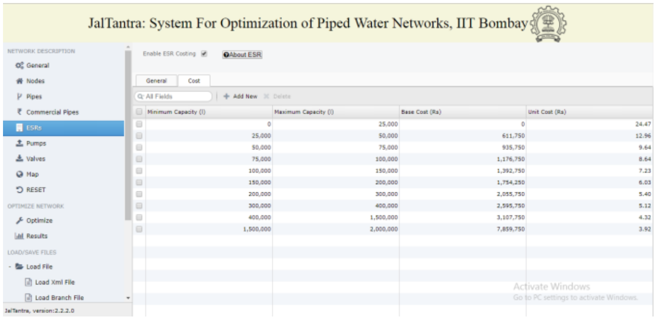

Fig-6: Input for ESR Cost

f) Input for Pump

i. Pump General

In this function input of minimum pump size available in market, pump efficiency in percentage, capital cost per kw, energy cost per kwh, design lifetime, pipes without pump. In this design minimum pump size is 3.75Kw is used, 95% efficiency is expected, capital cost per Kw is Rs 30,000 assumed, cost of energy per Kw is Rs.20 is assumed and it designed for one year due to changes in cost of energy.

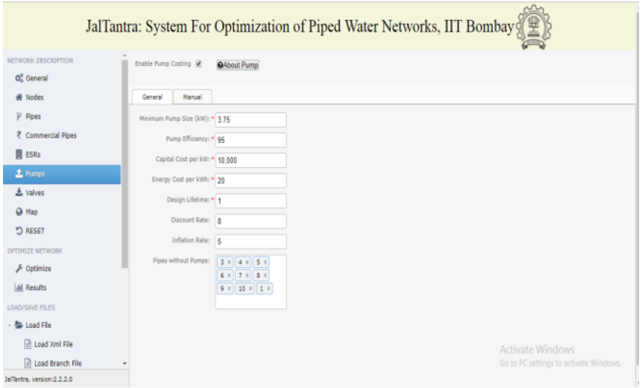

Fig-7: Input for Pump-General

ii. Pump Manual

In this function input of pipe ID which have pump is used and power of pump expected. In this design pump is used for pump the water from well and lift in ESR. The pipe ID is 6 which is starting from well and end at ESR.

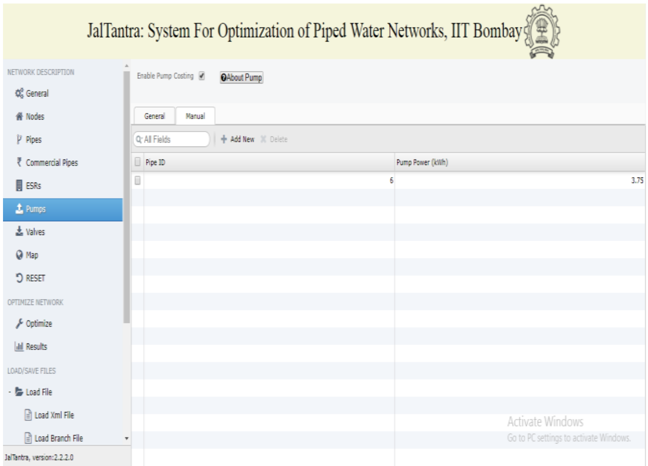

Fig-8: Input for Pump-manual

g) Input for map

Input for function map is to select the location and add node at that point and notify the well, ESR and stand post on map. Also add the pipes which are connected to nodes.

Fig-9: Input for Map

B. Output Result Of Jalatantra

a) Output Result of Nodes

In this function result of nodes is obtained. In that function result of demand at per node and pressure is obtained by using node elevation.

Table 3: Node Result

Node ID	*Node Name*	*Demand*	*Elevation*	*Head*	*Pressure*
2	Node2	0.00	517.00	528.08	11.08
3	Node3	10.00	512.00	528.05	16.05
4	Node4	0.4	470.00	511.48	41.48
5	Node5	0.400	464.00	510.67	46.67
6	Node6	0.400	450.00	509.19	59.19
7	Node7	0.400	442.00	508.74	66.74
8	Node8	0.400	460.00	510.26	50.26
9	Node9	0.400	490.00	511.74	21.74
10	Node10	0.400	501.00	511.74	10.74
11	Node11	0.400	493.00	510.06	17.06

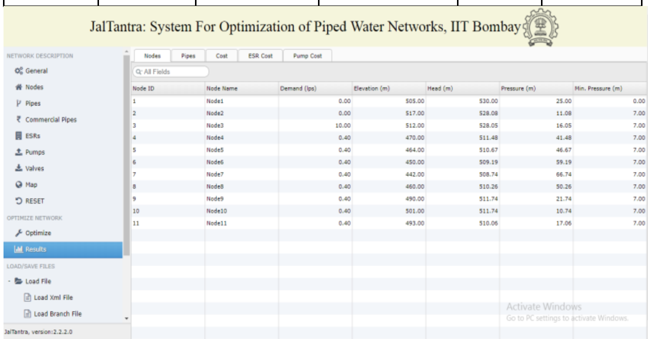

Fig-10: Output Result of Nodes

b) Output result of Pipe

In this function result of pipes design is obtained. In that length of pipe, flow of water lit/sec, diameter of pipe, Headloss per Km and cost of per pipe from start node to end node.

Table 4: Pipe result by Jalatantra

Pipe ID	*Start Node*	*End Node*	*Length*	*Diameter*
1	10	11	455	40
2	3	10	57	50
3	4	8	330	40
4	4	5	85	50
5	2	3	5	140
6	1	2	356	140
7	3	4	65	63
8	3	9	69	40
9	6	7	120	40
10	5	6	328	50

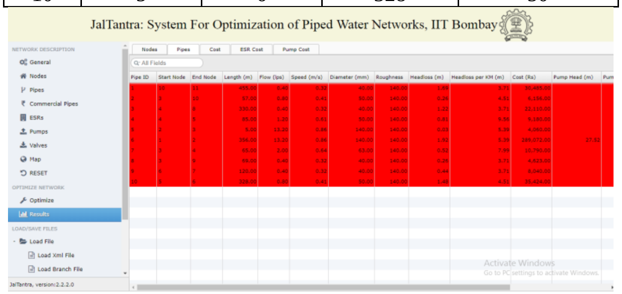

Fig-11: Output Result of Pipes

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c) Output Result of Pipe Cost

In this function total pipe cost is obtained. In this result 40mm pipe of 974m which has cost Rs.65,258 , 50mm pipe of 470m which has cost Rs.50,760 ,63mm pipe of 65m which has cost Rs.10,790 ,140mm pipe of 361m which has cost Rs.2,93,132. Hence total cost of all pipes is Rs.4,19,490.

Table 5: Pipe cost result by Jalatantra

COST RESULTS OF NEW PIPES		
Diameter	***Length***	***Cost***
40	974	65,258
50	470	50,760
63	65	10,790
140	361	2,93,132
Total	1,870	4,19,490

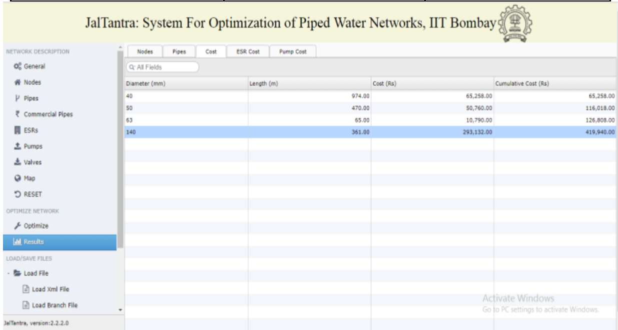

Fig-12: Output Result of Pipes cost

d) Output Result of ESR Cost and Capacity

In this function total ESR cost and capacity is obtained. In this result capacity of ESR is 1,88,179Lit. is obtained and cost of ESR is Rs.1,84,470.58 is obtained.

Table 6: ESR Result by Jalatantra

COST RESULTS OF ESR			
ESR Node ID	**Node Name**	**Capacity (l)**	**Cost (Rs)**
3	Node 3	188,179	19,84,470

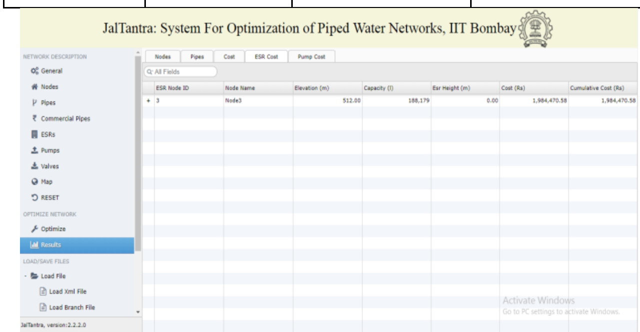

Fig-13: Output Result of ESR capacity and cost

e) Output Result for Pump

In this function total pump cost and capacity is obtained. In this function output is pump head, pump power in Kw, energy cost, Capital cost of pump and total cost is obtained

In this function result of pump design is as follows, pump head is 27.52m, power of pump is 3.75Kw, energy cost per year is Rs.3,28,500, capital cost of pump is Rs.1,12,500 and total cost is 4,41,000 is obtained.

Table 7: Pump Result by Jalatantra

RESULTS OF PUMPS				
Pipe ID	***Pump Power (kW)***	***Energy Cost (Rs)***	***Capital Cost (Rs)***	***Total Cost (Rs)***
6	4	328,500	112,500	441,000

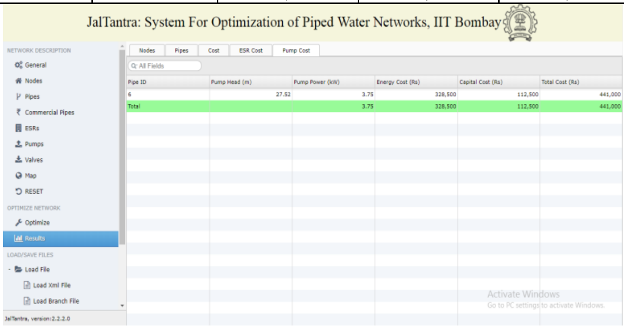

Fig-14: Output Result of Pump capacity and cost

IV. CONCLUSION

Government of Maharashtra empaneled Technology and Development Cell (TDSC, IIT, Bombay) as third-party evaluator in all district to improve Rural Water Supply Schemes (RWSS) for improving sustainability, efficiency and equitability of these schemes. Under this program Vadoli-Nileshwar water supply scheme is selected for third-party evaluation.

Investigations were completed in three stages. At first stage documents were collected related to scheme like detailed project report. At second stage collected documents were verified and at third stage, physical assets of scheme such as source well, raising main, storage reservoir and distribution network were verified. It was observed that Vadoli –Nileshwar water supply scheme was completed in 1981, scheme was designed for 2900 peoples with daily demand 40 lit/person/day. But due to increasing population, increasing daily demand and newly developed area water supply to consumers was insufficient. Hence some components of scheme are redesigned. Raising main, storage reservoir, pumping machinery and distribution network is designed for 3700 peoples with daily demand of 115lit/person/day and 12 supplying hours. Scheme was designed by ‘Jaltantra’ software. It is expected that, if this revised design is considered, the problem of water availability to consumers will be solved.

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