Evaluation and Planning of an Equitable Water Supply for the Rural Water Distribution Network at Undri Village in Kolhapur District, Maharashtra

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Abstract: ***This article presents the design of a rural water distribution system that is intended for use in rural areas of the country. The network for the distribution of water supplies is intended to accommodate the anticipated population in thirty years' time. The most effective and cost - effective method of water distribution has been designed with the use of EXCEL, Google Maps, Google Earth, GIS and AutoCAD. The research region is scheduled to get an intermittent water supply, taking the 55 liters per capita per day (lpcd) water consumption into account. When designing an inexpensive water supply distribution system, factors such as the flow velocity in the pipe, the material of the pipe, the level of the reservoir, the peak factor, and the available commercial pipe sizes are taken into consideration. The Undri village section of the Panhala taluka in the Kolhapur district of Maharashtra is the target for the water supply distribution system that has been constructed.***

Keywords: Water networking, Kolhapur, Rural Water Management, GIS, Jaljeevan skim

1. Introduction

1.1 Freshwater stress

Our planet distinguishes out from all the others that we are aware of because of the water. While the worldwide supply of freshwater is sufficient to cover all of the needs for water now and in the future, its spatial and temporal distributions are not. (Cosgrove, W. J., & Loucks, D. P., 2015). Everyone today has concerns about the possibility of water shortage and its effects on our ability to produce energy and food in the face of rising, primarily population - driven water needs. Water is one of the most essential requirements of life. Assured availability of potable water is vital for human development. India is home to 18% of global human population and 15% of global livestock population. However, it has only 2% land mass and 4% of global fresh water resources. According to the World Economic Forum's Global Risk Perception Survey, which it conducted among 900 renowned experts, water problems will have the greatest impact on society over the next 10 years. (http: //www3. We forum. org/docs/WEF_Global_Risks_2015_Report15. pdf). As per estimates; in 1951, per capita annual freshwater availability was 5, 177 cubic meters which came down to 1, 545 cubic meters in 2011. It is estimated that in 2019, it is about1, 368 cubic meters which is likely to further go down to 1, 293 cubic meters in 2025. If present trend continues, in2050, fresh water availability is likely to decline to 1, 140 cubic meters. With the growing population and expanding economic activities, there is an increase in demand for water in various sectors, viz. agriculture, industry, domestic, recreation, infrastructure development, etc., whereas the source of water is finite. Thus, finite availability and competing demands make drinking water management a complex issue. The widening demand - supply gap is further compounded by other challenges, viz. depletion of ground water caused by over - extraction, poor recharge, low storage capacity, erratic rainfall due to climate change, presence of contaminants, poor Operation and Maintenance (O&M) of water supply systems, etc.

1.2 Previous studies

The initial water distribution network was developed by (G. Venkata Ramana et al., 2015) with the help of the EPANET software. To create the network "chowduru of proddaturu Mandal in the YSR Kadapa district of AP in INDIA. " In the end, he was able to obtain the information that there are 53 pipelines made of the same material, 49 connections, 1 tank, and 1 source reservoir from which water is pumped to an elevated service reservoir. He forecasts the population and the design in 2031. The water distribution system for rural regions, which was built by utilizing the LOOP program, was developed by (Bhavana K & Ajudiya et al., 2017). The challenges of designing a new distribution network in developed rural regions were addressed in this study, which was beneficial to water supply engineers who are working on the topic. This network designed at sokada village in Gujarat state. (Bolognesi A. et al., 2010) proposes a new modal named genetic heritage evolution‟ by stochastic transmission GHEST, a multi population evolutionary strategy like algorithm applied to the design of water distribution network. (Srivastava, H., & Singhal, A.2018) designed the water distribution network using EPANET. A network is laid according to old days requirement and is not suitable to the future needs and demands. The network was proposed according to the master plan keeping in view the ease and accessibility of the network with roadside and straight as it will help the laying out easy and less complicated. To design network in Chirala Municipality in Prakasam District of Andhra Pradesh. Vasan, A., & Simonovic, S. P. (2010) designed the water distribution network with using EPANET. To design the system in punagamain Gujarat. The network is divided into two zones and spans in an area of 600.83 Ha and comprises 109 junctions and 144 pipes. In the mentioned study it was reported that the water was taken from the source and was stored in the Ground Service Reservoir. Depending on the need it was pumped up to the Elevated Storage Reservoir and from there the water was supplied to the houses via gravity system which is in close connection with this study. (Farmani et al., 2005) gives the full in information about design. We can design any town for W. D. N with using this paper. Authors also design the any town for WDN. Pipe rehabilitation decisions, tank sizing, tank sitting and pump operation schedules are considered as design variables. This paper investigates the application of multi – objective evolutionary algorithms in the identification of the payoff characteristics between total cost, reliability and water quality of any towns W. D. S. To reduce cost with decrease then diameter of pipe etc. storage facility is minimizing the residence time. In this paper the authors draw the figures for better understanding. To measure the reliability of WDS and also, he solves the problems which is related to W. D. S

2. Objectives of the study

In light of the findings of the literature review, we have come up with certain primary goals, which are as follows:

- To suggest provision of functional tap connection to Schools, Anganwadi centers, GP buildings, Health centers, wellness centers and community buildings.
- To monitor functionality of tap connections.
- Provision of quality drinking water according to JJM.
- To assist in ensuring sustainability of water supply system, i. e., water source, water supply infrastructure, and funds for regular O & M.
- To bring awareness on various aspects and significance of safe drinking water and involvement of stakeholders in manner that make water every one's business.

3. Study area

Numbers of visits were done for collecting data and observing suitable site for project construction, as the village is still undeveloped less obstruction were observed for our project construction. The previous sites for GSR were selected for same for future construction of Renew GSR. According to Census 2011 information the location code or village code of Undri village is 567175. Undri village is located in Panhala tehsil of Kolhapur district in Maharashtra, India. It is situated 35kmaway from sub - district head quarter Panhala (tehsildar office) and 27km away from district headquarter Kolhapur. Asper2009stats, Undri village is also a gram panchayat. The total geographical area of village is 380.44 hectares. Undri has a total population of 1, 592 peoples, out of which male population is 815 while female population is 777. There are about 315 houses in undri village.

Table 1: Location details

Village Name	Undri
Taluka Name	Panhala
District & State	Kolhapur, Maharashtra
Region	Western Maharashtra
Division	Pune
Elevation/Altitude	563meters Above Sea level
Language	Marathi

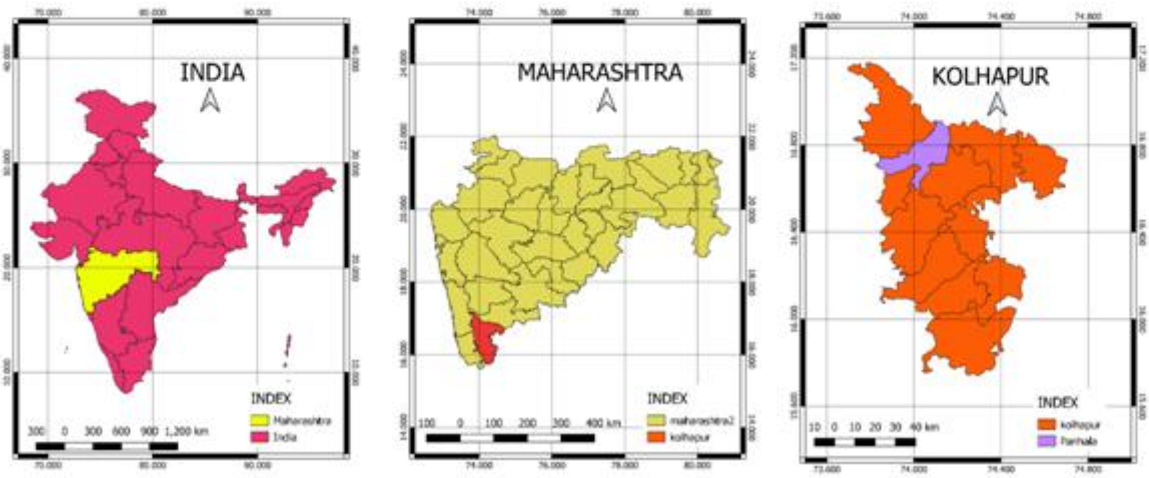
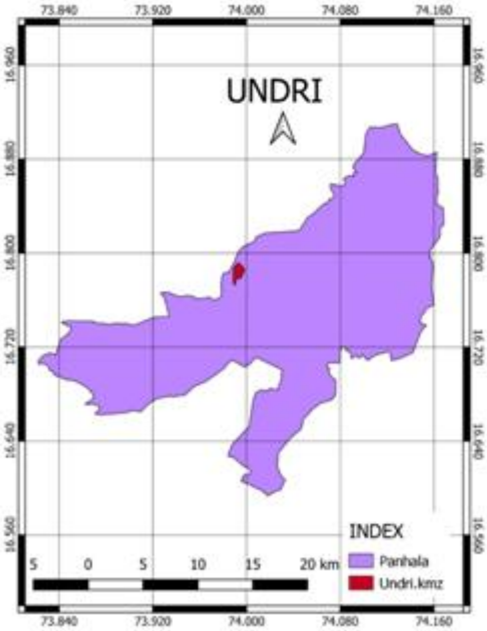


Figure 1: Study area location - Undri village



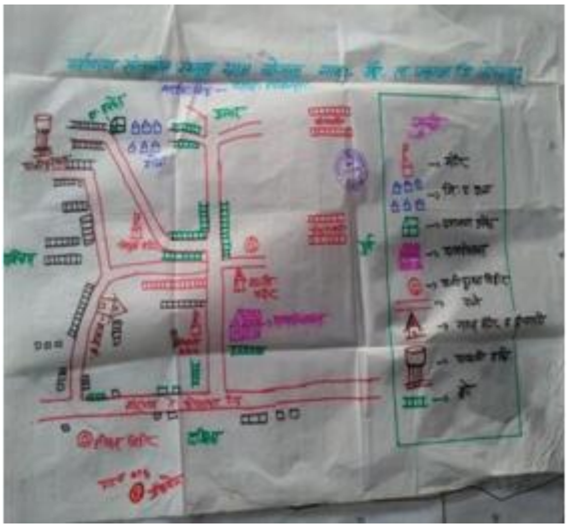


Figure 2: Rough water Distribution Network of Undri Village

4. Methodology

4.1 Water Sample Details

The water at source of river had physico - chemical parameters like Turbidity, Acidity, Chloride Content, Hardness, Solids parameters which is within safe limit as per IS standards values. Therefore, the water is suitable for potable use with primary treatment. We analyzed water samples for getting primary data.

Table 2: Physico - chemical parametres of river water samples

Sr. No.	Measured Parameters	IS Standard Values (IS10500: 2012)	WaterSample1 (Collected from Source of river)	Water Sample 2 (Collected from Home)
1	PhValue	6.5to8.5	6.72	7.28
2	Alkalinity	200mg/l	Absent	absent
3	Acidity	-	10mg/l	5mg/l
4	Chloride Content	250mg/l	14.2mg/l	15.62mg/l
5	Hardness	Upto500mg/l	460mg/l	440mg/l
6	Turbidity	5NTU	4	0
7	Dissolved Oxygen	4mg/lto8mg/l	-	-
8	Residual Chlorine	0.2 mg/l to 0.5mg/l	0	0
9	Solids	200mg/l	150mg/l	130mg/l

Table 3: Population forecasting by using various methods

Design Data – Population Forcasting					
Sr. No.	Year	Population	Increase in decade	Incremental increase in decade	Rate of growth for decade
1	1971	907			
			132		0.146
2	1981	1039		64	
			196		0.189
3	1991	1235		0	
			157		0.127
4	2001	1392		43	
			200		0.144
5	2011	1592			
	Average		**171.00**	**35.67**	**0.151**
A)	**Incremental Increase Method**				
	Pn=P+nx+n (n+1) y/2		P=Populationin2021		
			X=Av. Increase Per decade		
			y=Av. Incremental increase Per decade		
			n=No. of decade		
Year	**P**	**X**	**y**	**n**	**Population**
2023	1592	171	36	1.20	1844
2038	1592	171	36	2.70	2232
2053	1592	171	36	4.20	2700
B)	**Geometrical Method**				
	Pn=P (1+Rg) n		Rg=Rate of growth for decade		
Year	**P**	**Rg**	**n**	**Population**	
2023	1592	0.151	1.20	1885	
2038	1592	0.151	2.70	2327	
2053	1592	0.151	4.20	2874	
C)	**Arithmatic Increase Method**				
	Pn=P+nx		P=Populationin2011		
			x=Av. Increase Per decade		
			n=No. of decade		
Year	**P**	**X**	**n**	**Population**	
2023	1592	171	1.20	1798	
2038	1592	171	2.70	2054	
2053	1592	171	4.20	2311	
	Average Population				
Year	Incremental Increase Method - A	Geometrical Method - B	Arithmatic Increase Method - C	Average Population (A+B+C) /3	Remarks
2023	1844	1885	1798	**1842**	Present
2038	2232	2327	2054	**2204**	Immediate
2053	2700	2874	2311	**2628**	Ultimate

5. Results and Discussion

S. No.	Description	Values
1	Population	
	Present	1842
	Immediate	2204
	Ultimate	2628
2	Daily water demand	
	Immediate	0.147MLD
	Ultimate	0.175MLD
3	Rising main	110mm Dia. PVC10KG/CM2
4	Pumping machinery	2sets of 10HP submersible pumps
5	GSR	
	Capacity	40000liters
	Diameter of GSR	4.15m
	Depth of GSR	2.95m
6	Estimate	
	Per capita cost	Rs.2483.00
	Pumping machinery	Rs.274894.00
	Total cost	Rs.6525153.00

The project began with the initial collection of water sample, and as we collected the water, we carried out various water quality tests in accordance with W. H. O. requirements. The various characteristics of the water were analyzed, and relevant solutions were used on it in accordance with its quality. Even though we obtained the water sample during the rainy season, the water turbidity and other parameters were within normal ranges according to the water sample that we collected. Based on this information, we came to the conclusion that we may have been too late for water sample collection and that further samples will need to be taken during the next rainy season. On page no.18, you can see the results of the numerous tests that were run on water.

The next step was the theoretical one, in which we began to predict the population based on three different approaches. For design purposes, we used the average of the three predictions of the population. By calculating the water demand, we came to the conclusion that the current water needs might be fulfilled; however, in the upcoming year, the village might face problems for water; and for the future, we have successfully designed a water supply distribution system. The daily water demand that is required for the village has been evaluated in accordance with Jaljeevan norms, which state that 55 LPCD is required for the village. The levels of groundwater have been surveyed from the source of water to the current GSR using Google Earth and map marker software. Levels from the beginning to the end point of the village have been estimated, and as of the available surface, a suitable slope has been drawn in the report.

6. Conclusions

- To aim of any safe water supply system is to reduce the risk of contamination of at least to the lowest level.
- The existing water supply system for this UNDRI village has very less functional even if it is executed on a quite low technical standard.
- The existing water supply system was not as per requirement according to population forecasting therefore, there was poor water supply system.
- So we design the water supply system for this village in such a way that each and every household will get the water directly on one’s tap with equal pressure and at the same time.

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