Challenges and Opportunities in converting existing Intermittent Water Supply System to Continuous Water Supply System: A study of Khumaltar Service Area with Demand Side Management Perspectives

Prabesh Wagle

M.Sc. in Environmental Engineering Program

Institute of Engineering Department of Civil Engineering

Pulchowk Campus,TU,Nepal

prabeshwagle2047@gmail.com

977-98166590922

Dr.Mahesh Prasad Bhattrai

Associate Professor

Program Coordinator, Supervisor, M.Sc. in Environmental Engineering Program

Institute of Engineering,Department of Civil Engineering

Pulchowk Campus,TU,Nepal

bhattarai.mahesh08@gmail.com

Abstract:There are many problems in existing water distribution system of Kathmandu Valley which includes insufficient water supply, high leakage from old age existing pipes, illegal service connection and water contamination. Hydraulic capacity of old existing and new distribution network of Patan area was evaluated by using EPANET software. The EPANET analysis shows, negative pressures in 88.89 % of nodes in old distribution network for Melamchi first phase water supply while in new distribution network resulting pressures at all the nodes and the flows with their velocities at all pipes are enough to provide water to the area for the Melamchi second phase water supply. The water demand can be reduced by using water efficient fixtures from 192.45 Liters/capita/day (water use by old inefficient fixtures) to about 96 Liters/capita/day.29.7 MLD of water supplied by Melamchi First phase water supply will not sufficient to meet the average demand of 96 Liters/capita/day even if there will be the implementation of demand side strategies (using water efficient fixtures). It is projected that available water from the second phase Melamchi water supply (78MLD for Khumaltar area) will meet the average demand of year 2049 ,2047,2046,2044 and 2043 for maintaining 5%, 10%,15%,20% and 25% of loss of water respectively implementing demand side strategies using water efficient fixtures.

iii. Total water demand reduction from water efficient fixtures

The reality of achieving water demand reductions from behavioral strategies will depend on the mode of communication and tariff structures fixed by the government. As, the water use behavior is different from person-to-person actual results of water saving through behavioral change can't be realized. The amount of water can be saved from the water efficient fixtures/appliances like front load washing machines, low head shower, dual flush toilets water efficient kitchen faucets and bathroom faucets are presented in table 3.

Total estimated water use from the old traditional inefficient fixtures was 192.45 lpcd and water use of new water efficient fixtures is 96.21 lpcd. The total estimated savings will be 49.97 %. The savings from each of water efficient fixtures/appliances is shown in the chart below:

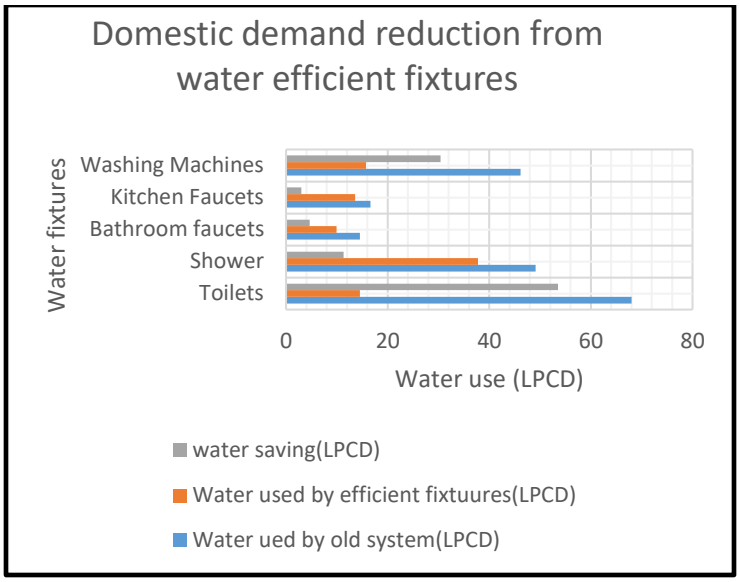

Figure. Total water saving in different domestic water uses

The above chart shows maximum water savings can be achieved in dual flush toilets (78.67 %) and front-loading washing machines (65.95%).

iv. Per Capita Water Availability in different years with losses

The total water received by Khumaltar reservoir in first phase water supply and second phase water supply will be 29.7 MLD and 78 MLD respectively. Water availability in liters per capita per day is calculated for different years for Melamchi first phase water supply and Melamchi second phase water supply is shown in the table below:

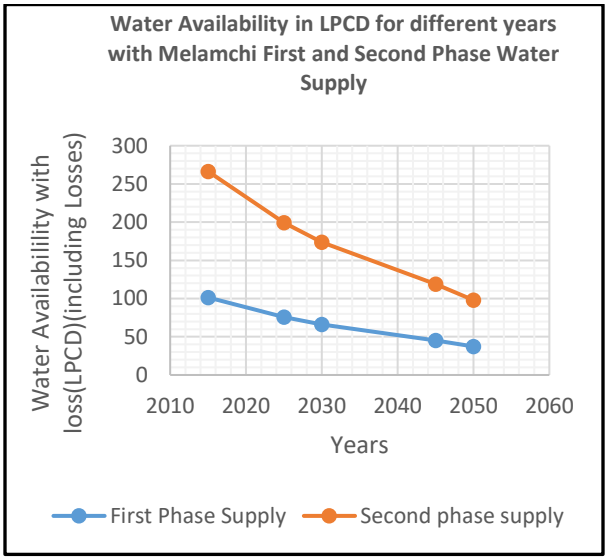

Figure: Graph showing water availability for different years

The water availability in liters per person per day will be 83.05 LPCD including losses by 2022 from first phase water supply of Melamchi project. This amount of water will not sufficient to meet the average demand of 96 LPCD even if there will be the implementation of demand side strategies (using water efficient fixtures). Thus, 24*7 water supply is not possible with Melamchi first phase water supply.

3.5 Demand for different years by using water efficient fixtures with different losses

In the above section reduced demand from the water efficient fixtures was projected. The reduced demand in MLD projected for different years with different losses is shown in the graph below:

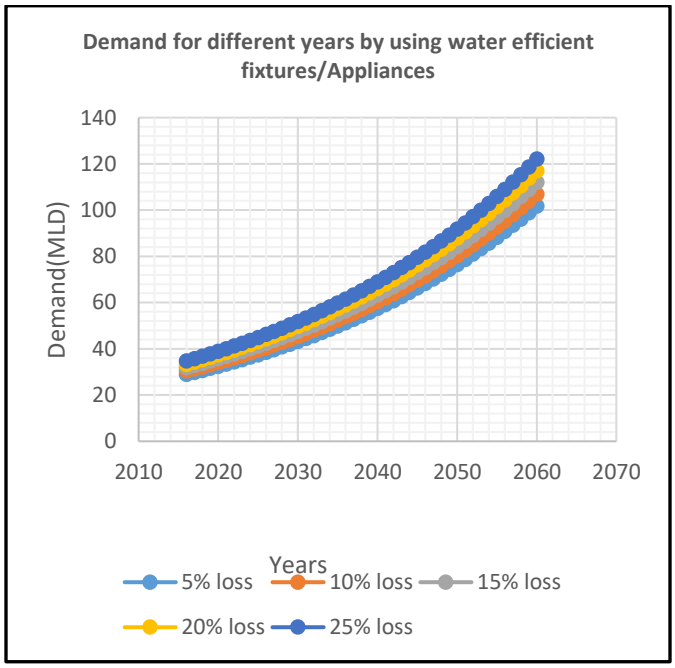

Figure: Graph with projected reduced demand for different years

Graph with projected reduced demand for different years with different losses. Allowable losses calculated by PID/KUKL in the new water distribution system of Kathmandu valley water improvement project was below 3%. So, reduced demand was calculated considering minimum of 5% loss in new the distribution networks in Khumaltar service area. It is projected that available water from the second phase Melamchi water supply project will meet the average demand of year 2049 ,2047,2046,2044 and 2043 for maintaining 5%, 10%,15%,20% and 25% of loss of water

respectively. Graph shows that more the loss control, longer the duration of supply water meets the demand of the study area.

CHAPTER FOUR: CONCLUSION

The study shows that 24*7 water supply is not possible with Melamchi first phase water supply even if demand side management using water efficient fixtures is adapted. Supplying Melamchi first phase water supply at once in whole area of old network, water reaches in only 11.11% of nodes due to undersize distribution pipes. If the first phase Melamchi water is supplied in three hydraulically isolated area for different intervals a day, water reaches in only 61.78 % of total nodes of overall network. The water use behavior is different from person-to-person. Thus, actual results of water saving through behavioral change can't be realized. The study also shows that water consumption can be reduced to 96 lpcd by using water efficient fixtures. It is projected that reducing the water consumption to 96 lpcd, Melamchi second phase water supply will meet the daily average demand up to the year 2049,2047,2046,2044 and 2043 for maintaining loss of 5%, 10%,15%,20% and 25% respectively with new distribution system.

REFERENCES

1. Abu-Madi, M., and Trifunovic, N. (2013). Impacts of supply duration on the design and performance of intermittent water distribution systems in the West Bank. *Water International*, *38*(3), 263-282. doi:10.1080/02508060.2013.794404

2. Beal, C. D., Gurung, T. R., and Stewart, R. A. (2016). Demand-side management for supply-side efficiency: Modeling tailored strategies for reducing peak residential water demand. Sustainable Production and Consumption, 6, 1-11. https://doi.org/10.1016/j.spc.2015.11.005

3. Capital investment and Assets Management Program (2010), TA 4893-NEP: Kathmandu Valley Water Supply and Wastewater System Improvement

4. Carey Doberstien(2008).Demand Side Management of Residential Water use in Vancouver. *Masters Thesis*.

5. Laspidou, C., Spyropoulou, A., and Charalambous, B. (2017). Introduction. Dealing with the Complex Interrelation of Intermittent Supply and Water Losses, 1-4. https://doi.org/10.2166/9781780407074_001.

6. Charalambous, B., Janssens, J., and Liemberger, R. (2017). Transitioning from IWS to continuous 24 × 7.

7. Dekker, P.D. (2017). Strategy to Transition from an Intermittent to a Continuous Water Supply Using a District Metering Area Approach. Master Thesis. Delft University of Technology.

8. EPA, Water Sense (2017). Water Efficiency Management Guide Residential Kitchen and Laundry

9. Farley, M., Wyeth., G., Ghazali, Z., Istatandar, A., Singh, S. (2008) The Manager's Non-Revenue Water Handbook: *A Guide to Understanding Water Losses*

10. Kathmandu Upatyaka Khanepani Limited , Annual Report ,2075

11. Matto, M., Jainer S., Kumar, M., Sharda, C. (2015). EFFICIENCY WATER AND CONSERVATION IN URBAN INDIA. *Environmental Science and Technology*..

12. Samir, N., Kansoh, R., Elbarki, W., and Fleifle, A. (2017). Pressure control for minimizing leakage in water distribution systems. Alexandria Engineering Journal, 56(4), 601-612.

13. Simukonda, K. , Farmani, R., and Butler, D (2018) Intermittent water supply systems: causal factors, problems and solution options..*Urban water Journal.* 15:5. 488-500.the West Bank.*" Water International 38 :3, 263–282*

14. Water Management Team,Center for Science and Environment,New Dehli(2010),. Rating System for Water Efficient Fixtures: *A Way to Sustainable Water Management in India*

15.https://www.epa.gov/watersense/wat ersense-products.