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WATER AND SANITATION FOR ALL: PARTNERSHIPS AND INNOVATIONS

Study of water usage in rural areas

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OVER THE LAST decade many rural water supply programmes were implemented throughout the developing world. The overall objective of this was to improve health and living condition of rural population in a cost effective manner on the basis of the felt needs of the communities. Rural water supply and sanitation programmes for Matale and Polonnaruwa Districts in Sri Lanka were funded by Danish International Development Agency and implemented by Kampex-Kruger with community participation. The construction and rehabilitation of several small pipe-borne water supply schemes (generally each for populations less than 1000) is one means of providing improved watersupply, adopted by the project. To increase the service and reduce waste and cost, the project organisation carried out several project evaluation (function, usage and impact) studies. Water usage study was one of them.

Detailed water use study was conducted in three schemes:

- Ukuwela old water supply scheme – The water distribution ran through 17 villages and served a population of about 2800 in 385 households. There were 250 house connections and 6 stand posts.
- Halangoda water supply scheme – The water distribution ran through 2 villages and served a population of about 450 in 100 households. There were 35 house connections and 11 stand posts.
- Haywood Colony water supply scheme C – The water distribution ran about 800 m through a village and served a population of about 79 in 18 households by 4 stand posts.

All three were small gravity schemes which represent the typical rural conditions in Matale district of Sri Lanka. They were old enough so that the consumption pattern is typical. All house connections and stand posts were metered. However, each of these schemes was unique in some aspects e.g. Scheme 1 (Ukuwela) has controlled supply of water to adjust the day peak; Scheme 2 (Halangoda) has a limited water supply during the dry season; Scheme 3 (Haywood) has only stand posts and collection of revenue was not practised.

The objective of this study is to justify the design criteria adopted by project organisation (PO) and National Water Supply and Drainage Board (NWS&DB) by assessing population growth, occupancy, percentage of people served direct by domestic connection and standpost, per capita water consumption in domestic and institutions, hourly peak factor, leakage and wastage, affordability and other socio-economic conditions in the target area.

Methodology

Several approaches were adopted to collect the data. The information regarding the area and the list of people served by the scheme, the pipeline traces, monthly recorded water consumption figures for 12 months, etc., were collected from the maintenance authorities (Local authorities and NWS&DB Sri Lanka).

Questionnaires were devised with objectives in view for each type of users such as domestic (direct connection and stand post), institutions (e.g. schools, medical clinics, religious places, government offices), and commercial establishments (e.g shops and restaurants including and small industries). House to house interviews for filling questionnaires were entrusted to only two field staffs, thus minimising the human error.

The direct field observations consisted of:

- Bulk meter reading at the distribution main of each scheme for consecutive two weeks to assess the total usage pattern and peak factor.
- Meter reading and other observation for each water usage at each stand post for four consecutive days.
- Observation of water use appliance, leaks in plumbing and reliability of meters readings, during questionnaires survey.

The observed water consumption were compared with the questionnaires results and the average was taken as the consumption. Erroneous meter readings (meter broken or malfunctioning for some time during the observation period) and doubtful questionnaires results were eliminated from the analysis.

Results and comments

The findings of this study and the comparison with the values adopted by NWS&DB and PO are given in Table 1.

Domestic Consumption from direct house connection

The average water usage for direct house connection in Ukuwela scheme was 120.4 l/c.day (range from 15-900 and mode 75) Table 1 and Figure 1. The average value for Halangoda scheme is 103.9 l/c.day (range from 15-

Table 1. Summary of results for assessment of water supply design criteria

255, and mode 45). The variations were due to several factors such as occupancy rate, number of taps connected, income, who pays the bill, available alternative water sources, etc.

When the number of occupants per household is high, the per capita consumption tends to reduce (Table 2), mainly due to shared usage (e.g cooking, washing, gardening etc.) and to reduce the water cost.

Generally the norm accepted by the NWS&DB and other developed countries is that the per capita consumption from single-tap is lower than from multi-tap connections. However this study showed that the consumptions for single-tap and multi-tap connections were 126.5 and 118.1 l/c.day at Ukuwala and 126.2 and 83 l/cday at Halangoda scheme. This is contrary to the normally adopted conditions. Unlike the developed countries or cities, in rural part of developing countries number of pipe outlets are not proportional to the water use appliance (e.g. no washing machine or dishwasher). So increasing outlet will not increase the usage.

Table 2. Water usage data for house connections in Ukuwela and Halangoda schemes (All figures are in l/c day)

Figure 1. Domestic water consumption from house connection

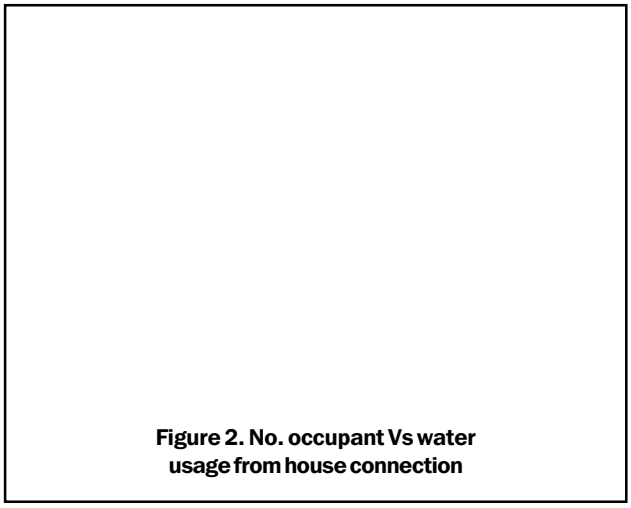

Figure 2. No. occupant Vs water usage from house connection

On the other-hand single tap connections had high wastage, as they had high usage and people do not bother to close the tap between different usages. Also as taps are normally installed outside the house, wastage (dripping and leakage) was not of such concern as in the case of internal pipes. It was observed that all single-tap households had a low level storage tank (drum) without any float valve. When the supply was intermittent, and specially at night, the tank was prone to overflow. there was more chance of undetected leakage and open tanks needed frequent cleaning. Unlike using showers, the bathing habits of rural people (who use wells) continues unaltered with ground level tanks and encourages more use of water.

Some other interesting observations were also made in this study. The per capita consumption was higher when the occupants do not pay the bill (e.g boarding houses and government quarters). Unauthorised transfer of water from domestic connection to nearby commercial property in order to overcome the high tariff payment also increased the per capita domestic consumption from direct connection.

About 38.7 per cent customers in Ukuwela scheme and 85.7 per cent in Halangoda were using alternative source for non-potable uses such as bathing, washing or potable use such as drinking and cooking. About 26.8 per cent in Ukuwela and 8.7 per cent in Halangoda use additional sources such as private and public wells (shallow & deep), stand posts and rivers for reasons of unreliable supply, unsatisfactory quality, for financial reasons and for pleasure, throughout the year.

Instrumental errors (possible defects in the meters) and methodical errors (the assumption made that the number of occupants were constant during the entire period of study) can limit the accuracy of the results.

Domestic consumption from standpost

The average water usage from standpost in Ukuwela scheme was 19 l/c.day (the range was from 5-55). The average value for Halangoda scheme was 18.5 l/c.day (the range was from 5-55). The average water usage from standpost in Heywood colony scheme was 54.2 l/c.day (the range was from 15 to over 110) Figure 3 illustrates these results.

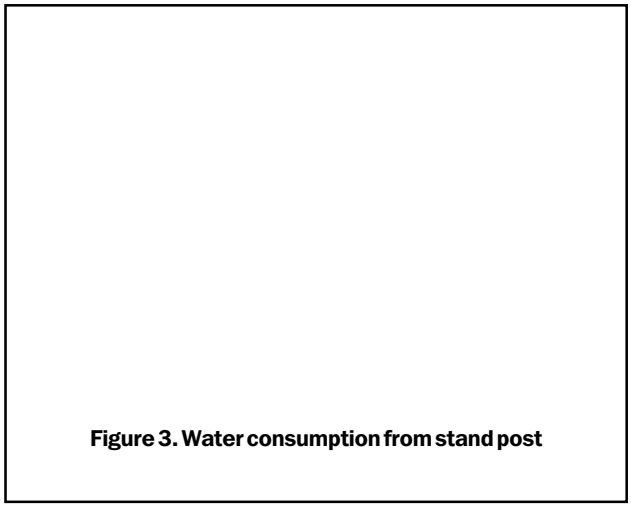

Figure 3. Water consumption from stand post

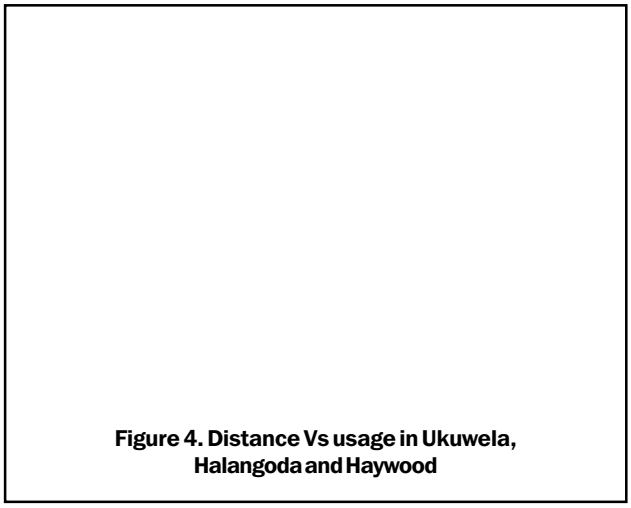

Figure 4. Distance Vs usage in Ukuwela, Halangoda and Haywood

Table 3. Water usage data from standposts (All figures are in l/c day)

The variations in usage were due to several factors. The distance involved in carrying the water from stand posts was one of them. The study indicated that the average distance from the standpost to the users in Ukuwela was 350m, in Halangoda it was 270m and in Heywood colony it was 200m. As the distance increases the per capita consumption tends to reduce (Figure 4).

It was observed that the number of households per standpost (e.g. 24 households per standpost in Ukuwela and 4.5 households per standpost), collection of revenue, water use restriction (no bathing, cloth washing or irrigation), operation and maintenance and location of stand post were affect the usage. For example Heywood colony, being in very rural setting far from O&M authorities and with standposts closer together and less crowded, may be subject to unauthorised hose connection for irrigation during dry nights. Weather pattern (during rainy times fewer people go out to fetch water) and reliability of supply, quality, personal preference and availability of alternative water sources also influence the usage (Table 2).

Another interesting result was the water usage by occasional users as a percentage of total stand pipe usage. It had been observed that 3.8 per cent in Ukuwela, 7.2 per cent in Halangoda and 3.9 per cent in Haywood colony is used by occasional users (passers by) and for occasional usage (vehicle washing or festival usage). This showed that a certain allowance has to be made in addition to normal consumption.

Figure 5. Hourly usage pattern

The field observation of stand post usage was well planned and allowed the users to become accustomed to observation and to participate (meters were fixed two weeks ahead, consumers were identified, and a trial day was chosen for each stand post for acclimatisation, when observations were not considered for analysis). The quantity of usage was then measured for 4 consecutive days, yet there were some limitations. A significant factor that might had affected the results may be possible suspicion and caution in usage during observation (some people were under the impression that observations were made to detect any misuse and disconnection of the stand post, while some others thought that they would get more standposts if they show more usage).

Hourly peak factor for distribution system

Hourly usage observations taken over two weeks were averaged, plotted on a graph and compared with the hypothetical consumption pattern recommended in the NWS&DB design guides.

Figure 5 indicates that, for Haywood colony scheme, the peak usage time was 7-8am and the peak factor was 2.85.

It is almost similar to the hypothetical peak time (6-7am) of NWS&DB curve and gave a similar peak factor. A slight delay in the early morning peak and a shift in the late evening (night) peak towards early evening in Haywood were typical characteristics of stand post usage. The results indicate that for Ukuwela and Halangoda scheme 8-9am was the peak usage time and 1.4 and 1.3 were the peak factors. These peak values are lower than the design value.

Several factors might account for this flattened consumption pattern and lower peak factor.

- The intermittent supply and low pressure in the systems seem to have lead the people to have a storage tank (e.g. 81.6 per cent and 94.3 per cent of domestic connections in Ukuwela and Halangoda had over-head or low-level storage tanks) which would tend to reduce the peak flows through the system.
- The possible high system leakage during the night, when pressure was high, could increase the night flow.
- Usage of alternative water sources can reduce the day peaks.

Table 4. Household use of standposts for different purposes

This peaking factor study may have some limitations, different seasons may give different values.

Leakage

The system leakage for Haywood colony schemes was 13 per cent of the water delivered. This was lower than the value (20 per cent) adopted by the PO, possibly because the Haywood colony scheme was relatively new, small, and had fewer joints and connections (no house connections at all).

The leakages for Ukuwela and Halangoda schemes were 30 per cent and 32.1 per cent, and were higher than the value adopted by PO. These results may have been affected by the following:

- The meter readings were assumed to be correct.
- The assessment was based on average figures from a small sample.
- All consumption for unmetered usage was estimation.
- Possible illegal connections were accounted as wastage.
- Any wastage and leakage within premises was accounted as consumption.
- Seasonal variations in leakage were not accounted for.

Conclusion

The above results show that the per capita domestic consumption rate adopted by the PO and NWS&DB are generally higher than the observed average usage figures for rural small gravity schemes at Ukuwela and Halangoda. As discussed, the reasons may be the absence of high water use bathrooms and kitchens, the use of other additional sources due to unreliable and some time unacceptable water supply, and personal preference to use traditional sources for some uses and for financial reasons.

Peak factors for these schemes are lower than the typical value and showed a flattened usage pattern. Availability of storage tanks and leakage can be the reasons for this pattern.

The scheme (Haywood) that was relatively new, small, remote and only had standposts, showed a high per capita consumption, low leakage and a similar peak factor to that assumed by the PO and NWS&DB.

However, it is felt that further studies in more schemes are necessary before arriving at conclusive figures to be used as design guidelines.

Reference

National water supply and drainage board, Design Manual- Urban water supply and sanitation, Sri Lanka, March 1989.

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