RAINWATER HARVESTING: AS A MEANS OF WATER SECURITY

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ABSTRACT

Adequate Good quality water is a scarces commodity to most parts of rural Sri Lanka. Often the rural water supply options have failed to achieve its potential due to technical, financial or management reasons. Rainwater harvesting as a rural water supply option was introduced in 1996 under the CWSSP in Badulla. Rainwater, as a source of domestic water was successfully accepted in areas where other water supply options failed due to various reasons. Since the introduction of rainwater harvesting, water security (assurance) of the beneficiary community has improved. However, improving water security has increased the demand for water. Hence, they use more water as a result of the project. Though water security of the rainwater tank beneficiaries have increased, it is still far below the required "design achievement" level. Thus, the future for rainwater harvesting would be to further improve water security through research and development and create a greater awareness among the general public.

Introduction

In Sri-Lanka, the present level of water supply coverage stands at 89% in urban areas while the rural water supply coverage is 60% (Minnatullah, Hewawasam and Gross 1998). The objective of the government of Sri-Lanka is to provide good quality drinking water to all by year 2010. However, provision for safe and adequate water supply is becoming a challenging task with drying-up of water resources, pollution of water sources, growing conflicts among users and growth of demand for water. On the other hand providing treated pipe borne water is becoming an expensive affair

considering the high level of investments and operation and maintenance costs. Hence, it has become a national importance to explore low-cost and alternative simple options which could be managed easily at community level.

Sri-Lanka receives a mean annual rainfall of 1200 mm. Thus, the country has an abundant supply of water. However, there are number of locations in the wet zone and intermediate zone where rural communities lack good quality water for consumption. In some parts of the dry zone the situation is worse, with people not having adequate and good quality water. In both the situations, people have to either trek steep terrain or long distance in search of good quality water. Though most of rural Sri-Lanka are supplied with tube wells and dug wells for domestic water use, often these facilities are non functional or vandalized. Under these conditions, rural people could hardly satisfy their domestic water needs. They have to survive with what they can physically transport. Often these quantities are inadequate and fetching more water takes more time. In desperate situations people can also fetch poor quality water from close proximity to save time. This situation suggests that there is lack of water security with respect to adequate, quality water for most of the rural people in Sri-Lanka.

Water Security

This is a preliminary attempt to define water security at domestic level. Hence, in a broader sense, water security can be defined as;

"To have adequate domestic water supplied, so that the livelihood of rural people will not be unnecessarily burdened". This preliminary attempt is further refined as follows;

Definition 1 - Absolute Security

- Water security as a concept means adequate water, reliably supplied to perform culturally normal life = W1

- Water security as a measure (WS) = $\frac{\text{Water Available}}{\text{W1}}$

WS should be averaged over several years or fraction of time that water is available at level W1.

Definition 2 - Design Achievement

- Water security as a concept means reliable supplying the designed daily amount = W2

- Water security as a measure (WS) = $\frac{\text{Water Supplied}}{W2}$

WS should be averaged over several years or fraction of time that water is available at level W2.

The second definition, "Design Achievement" was tested for domestic water security with rainwater in Dematawelihinna, a village located in a hilly terrain in Badulla district. There are about 200 households in the village and most of the villages had to depend on natural spring water sources located at the foot hills. Women in Dematawelihinna carry water from these sources and atleast 6-10 trips per day is a common occurrence.

In 1996, under the community water supply and sanitation project (CWSSP) this village was provided with 146 rainwater harvesting tanks. The tanks were given on a "demand led approach" with 80% subsidy and 20% equity.

During the study, the author monitored the water usage pattern of 10 Rainwater tank beneficiary households. A 14 days detail record keeping exercise was conducted to ascertain the water usage pattern for drinking, cooking, washing face, toilet purposes, washing cloths and other activities. The other activities include, home gardening, feeding cattle and Goats and sometimes house building etc. The per capita daily water consumption of the beneficiary households prior to project commencement is given in Table 1.

TABLE 1: PRE-PROJECT PER CAPITA WATER CONSUMPTION OF BENEFICIARY HOUSEHOLDS

Household No.	A	B	C	D	E	F	G	AVE.
Per Capita Consumption (lpcd)	57	35	34	43	31	73	27	39
Ave. design lpcd.	← 140 →							
% achievement of design lpcd.	41	25	24	31	22	52	19	28

Source : Monitoring Data 1998.

TABLE 2: POST-PROJECT PER CAPITA WATER CONSUMPTION OF BENEFICIARIES

- Beneficiary Households	A	B	C	D	E	F	G	H	I	AVE.
- Spring/well water consumption lpcd	50	17	40	12	03	27	08	41	09	23
- Rainwater tank consumption lpcd	34	12	39	40	17	-	28	57	30	29
- Total	84	29	79	52	20	27	36	98	39	52
- AVE. design lpcd	← 140 →									
- % achievement of design lpcd	60	21	56	37	14	19	26	70	28	37

Source : Monitoring Data 1998

lpcd : liters per capita day

Table 1 indicate that prior to the project, beneficiaries could achieve only 39 lpcd which is 101 lpcd less than the standard rural per capita consumption, which is 140 liters. Thus, only 28% of water security could be achieved with respect to design achievement. This could be due to the distance they had to travel to get water and high demand from the rural community on limited sources of water. Dematawelihinna, though situated close to the Badulla town, experiences a dry spell from May to August. During this time most of the spring water sources either dry-up or get reduce to a trickle leaving the people to stand in water lines for long time.

Per capita daily consumption of water in the post project situation appears to be an improvement to the pre-project situation. What is important in this situation is that Rainwater tank beneficiaries use rainwater only as a partial source to satisfy their water needs. The other part of the water is collected from natural springs and dug wells. Table 2 indicates the water usage pattern of Rainwater tank beneficiaries over a 14 days period.

Table 2 indicates that, since getting Rainwater harvesting tanks, the average per capita consumption has increased to 52 lpcd. This is an increase of 23 lpcd from the pre-project situation. The increase per capita consumption has elevated the percentage design security from 28 in the pre project situation to 37 in post project situation. Thus the Rainwater tank beneficiaries are 9% more secure with respect to water availability.

The average water consumption pattern of Rainwater tank beneficiaries are presented below.

- Average per capita water consumption of the beneficiaries	52 lpcd	A
- Average per capita water consumption prior to project	39 lpcd	B
- Average spring water collection by beneficiaries (post-project)	23 lpcd	C
- Increase consumption of beneficiaries (A - B)	13 lpcd	D
- Quantity of spring water not brought due to Rainwater use (B-C)	16 lpcd	E
- Total Rainwater usage (D+E)	29 lpcd	

The above calculation indicates that 74% of the beneficiary water needs prior to project has now been satisfied by Rainwater.

$$\frac{\text{Total per capita Rainwater usage}}{\text{Per Capita Water Consumption Prior to Project}} \times 100 = \frac{29 \times 100}{39} = 74\%$$

This leaves beneficiaries with only 10 additional liters (39-29) to be brought to satisfy their pre project water demand. However, the current spring water collection of beneficiaries is 23 lpcd. Indicating that they bring 13 liters per person in addition to their requirement.

This can be attributed for two reasons.

a. The beneficiaries were using less water than required in the pre-project situation or

b. The beneficiaries are using more water since getting Rainwater harvesting tanks. In other words increased water security has increased the demand for water.

According to the water use behavior pattern of the beneficiaries the second attributory reason can be more valid than the first reason.

Water use behavior of the beneficiaries after project can be further strengthened by analyzing the pattern of water collection from natural springs.

TABLE 4: WATER USE PATTERN OF BENEFICIARIES FROM, NATURAL SPRINGS AFTER PROJECT ESTABLISHMENT

Household No.	Water Fetched Before tank Establishment (liters/day)	Water fetched after tank Establishment (liters/day)
A	600	202
B	300	187
C	325	25
D	70	40
E	240	21
F	75	107
G	180	42
H	400	215
I	140	36

Source : Monitoring Data 1998

TABLE 5: TIME SPENT ON FETCHING WATER

Household No.	Before RW Tank Establishment (min)	After RW Tank Establishment (min)	Time Saved
B	180	115	65
C	120	80	40
D	210	120	90
F	90	130	-40
H	180	90	90
I	180	45	135

Source : Monitoring Data 1998

Time spent on collecting water before and after Rainwater harvesting tanks show a significant saving on time.

Table 4 indicates that, besides "household F" all others collect less water from Natural Springs than prior to project initiation. The "household F" collects more water than what they use to collect prior to the project. The reason for this situation is at the time of the study, the underground Rainwater tank of "household F" was leaking and had no water. However, as they were use to a larger quantity of water due to increased water security, in the absence of rainwater from the tank, they try to supplement by bring additional spring water. This situation is reflected in Table 5 where "household F" spends an additional 40 minutes in collecting water from springs, while the rest of the households save time between 40-135 minutes per day.

This study was conducted during the dry month of August. During the period of study there were only two days of average rainfall. Three months prior to August was also dry, hence the results obtained is specific to a dry season water consumption pattern.

Therefore, the water security mentioned under these conditions can change during the wet season. It can be safely assumed that water security can improve during the wet season, with increased availability of rainwater. Water security under the same existing conditions can be improved if another tank can be constructed or the roof area can be increased with polythene extensions.

Strength and Draw backs of the Rainwater harvesting Technology

Storage tank design in Rainwater harvesting is a proven technology world over. Both the Ferro-cement tank and the Brick-dome type tank has been well accepted and implemented without any major technical problem. However, there has been reported instances of leaks in brick-dome type underground tank in Dematawelihinna village in Badulla. This apparently is not a fault of the technology but a faulty masonry work.

At present the rainwater tank distribution in Sri-Lanka is as follows.

Location	No. Tanks	Status
Badulla	3000	Completed
Matara	1000	Completed
Suriyawawe (Hambantota)	3	Completed
Muruthalawa (Kandy)	5	In progress
Siyabalanduwa (Monaragala)	16	In progress
Ranmuduwawe (Hambantota)	3	In progress
Mundal (Putlum)	1 (school)	In progress

Construction of rainwater tanks are done by village masons initially trained by the project. However, with increasing demand for tanks, number of other skilled persons from villages have been trained by the project trained masons. Due to this secondary type of trainees, at times the quality of construction had suffered. However, a more serious type of a problem is mosquito and other insect breeding in rainwater tanks. The main reason for this situation is the poor management of rainwater harvesting units by householders. Most tanks built in Dematawelihinna, lack a proper cover to rainwater tanks. Unfortunately, this component was not included in the project subsidy, hence, beneficiaries too did not take much interest in constructing a cover, though it only cost Rs. 250-300. Instead it is a common sight to observe, polythene sheets, old fertilizer bags, pieces of tin sheets, asbestos being used as covers.

These covers do not securely protect water from external contaminants and insect-vector breeding. Badly maintained gutters is another cause for contamination of water. Some underground tanks were seen with frogs inside. During the dry season frogs enter these tanks through the over flow pipes of the underground tanks. Thus, the poor quality of water in rainwater tanks is directly related to poor maintenance by beneficiaries. Poor maintenance is a cause of lack of awareness on how to maintain these systems. Lack of awareness is a cause of the typical "project approach" adopted in implementation. In other words the project was only concern about the hard ware component leaving the much important soft ware (management) component to be handled by the beneficiaries.

Future of Rainwater Harvesting in Sri-Lanka

The sustainability of rainwater harvesting as a supplementary source of domestic water depends largely on the cost of rainwater harvesting units. Hence, one of the important aspects in the future would be to conduct research to reduce the cost of storage tanks.

While the cost aspect will influence the rural users, nationally, more awareness have to be created among the general public with regards to importance of rainwater harvesting.

The public campaign should also address the potentials of rainwater harvesting in urban areas. Part of the campaign should be to introduce dual water use systems in urban households.

As mentioned earlier in this paper, rural design water security during a typical dry period in Dematawelihinna was only 37%. If future research can reduce the cost of storage tanks, people may be able to construct more than one tank per household, if so, it may be possible to improve the water security level from 37% to a high proportion.

Finally, what would be most important is to incorporate rainwater harvesting as an option for rural water supply in the National Water Supply Policy in Sri-Lanka. The final sustainability of the technology lies with formal acceptance of rainwater harvesting as a policy option.