AN ASSESSMENT OF WATER USE EFFICIENCY IN SRI LANKA ARMY

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INTRODUCTION

Background of the study. The world's ultimate weapon runs on water. Adequate water is essential to maintaining soldier performance in all environments. Water is just as mission critical as fuel, food and ammunition. For the military, water is a limited strategic resource. Enhancing the beneficial use of water is a challenge for them.

Sri Lankan army is the largest water user of the country. The organization's rapidly growing strength has increased the demand for water. Increasing demand for water will result in the scarcity of the resource. Water scarcity not only results in quantitative or qualitative scarcity, but also in inefficient use and poor water management (Dinar, 2003).

Sri Lanka Army is spending a hundred million rupees per month for water services. This figure describes the ineffectiveness of utilizing water resources with in the organization.

Water budget is an increasing concern in this institution which identified sustainable water usage as the top-ranked financial, environmental and social requirement. Reducing the overall water consumption cost and saving money for the institution will assist to stop the worsening of water situation of Sri Lanka army.

Statement of the problem. Above mentioned situation gives rise to three research questions on the efficiency of water usage in the Sri Lanka Army. They are as appended below:

a) Is the full performance in efficient water use being realized in Sri Lankan Army?

b) Why have the water supply systems achieved/not achieved their potential?

c) Is the present system adequate to make an effective change?

Objectives of the study. The military has many water-related requirements and goals. This study makes the preliminary assessment of water supply systems in six military installations in Central province with a view to find solutions for aforesaid research questions. It was intended to achieve this through meeting the following specific objectives.

a. To assess and compare the per capita water consumption of six military installations in the Central province.

b. To explore the causes for excessive consumption.

c. To suggest measures to reduce excessive consumptions of water.

The present study provides an insight to assess the performance of efficient water use in Sri Lanka Army. It will also contribute to establishment of a data base of comparative information on the water utilization of different army camps.

REVIEW OF LITERATURE

Water usage of the Military. The water needs and usage of the military are extensive and complex. Due to the complexity of the same it is quite complicated to discuss all these issues. Thus, giving due consideration to the day-today usage of water in the Military certain generalizations could be taken as a summary to discuss this aspect.

Soldiers have a much greater need for water for drinking purpose in the field because their job is based on a multitude of physical activities. Comparatively a less amount of water is used for washing purposes in the field rather than being in the garrisons. Higher amount of water is used for washing purposes (i.e. personal hygiene, laundry, general cleaning, and vehicles washing) whist being in the garrison rather than in the field.

Giving due consideration to average demand of fluid for a human being in arid climatic conditions, the soldiers must consume a minimum of 50 liters of water in a day. During hectic periods they may aggregate this amount up to 60-70 liters per day (Gleick,2005) Recently returned soldiers from the Middle East, claim to have drunk an average of twelve quarts (11.55 liters) of water every day. (AWWA,2007)

Per capita consumption of water in garrison (fixed installation) conditions varies from a minimum of about 152 liters to a maximum of about 1520 per person per day (Gleick, 2005). Sweating (primary cooling system of a human body) is the main cause for demanding such an amount of water. Individuals performing "most military activities" (paperwork, planning, regular training exercises) produce more sweat. This rate increases when doing rigorous training exercises (carrying heavy equipment, performing infantry-type missions, fighting and running).

Unless one has experienced the extreme heat of soldier activities, one may not appreciate the amount of water required to cool down the body temperature. This is one example of how planning factors may not actually reflect how soldiers use water on a daily basis.

Water discipline of a soldier. Whether in the field or in the garrison, each soldier is responsible for observing the water discipline. One might understand the 'water discipline' as a measure to control or limit the usage of water, by the meaning of these two words. But, it is to be understood that the 'water discipline' is destined to ensure the good hygienic conditions of a soldier, simply to use the water wisely without wasting. (Michel, 2007). The rules which govern the 'water discipline' are:

a. Drink potable water only.

b. Prevent the waste of potable water.

c. Protect water sources by using good sanitary practices.

Defining basic water requirements of water usage

Per capita water consumption in the world

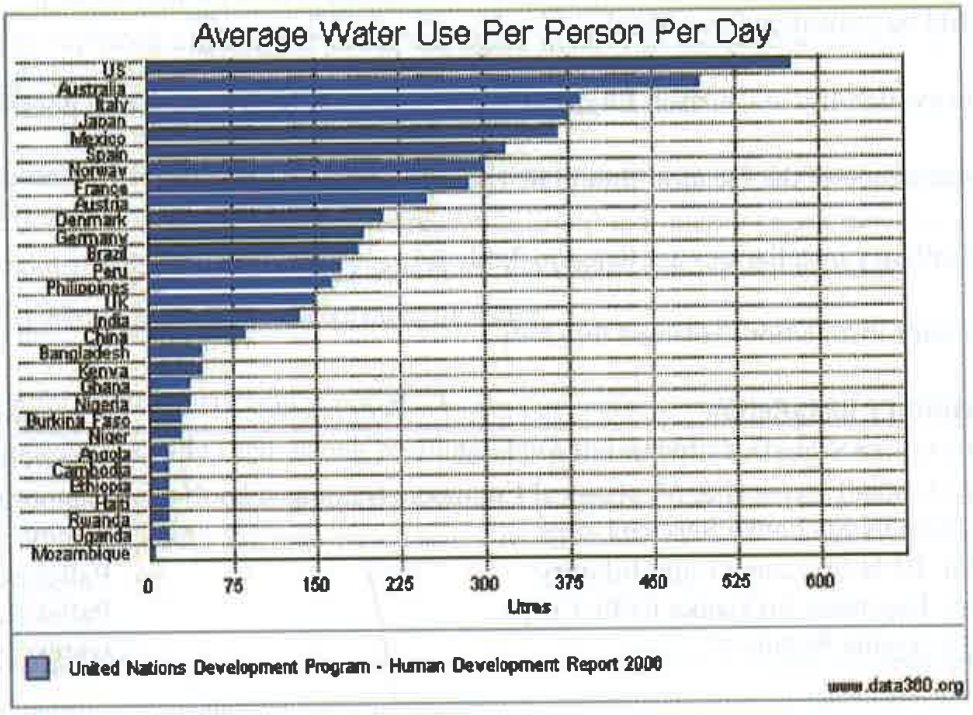

Illustration 01. World average water use per person per day

According to the United Nations Human Development report 2006; average water use per person per day varies between 10 liters to 580 liters.

It is predicted that by 2030 the world will need 30% more available fresh water. Current global per capita water availability of fresh water is steadily decreasing and this trend will inevitably continue with population growth and rising consumption of water.

2.2.2 Per capita water consumption in Sri Lanka

Average per capita domestic withdrawals in Sri Lanka is 31 liters/day, whereas the per capita Basic Water Requirement is 50 liters/day. (Jayasinghearachchi, 1995)

SCOPE AND METHODOLOGY

The purpose of this study is to share information, spread visibility on current efforts, explore the potential of existing, emerging, and future technologies and other options for military installations and potentially identify potential thrust areas where demonstrations and future research can be focused.

Research approach. Assessing and comparing per capita water consumption of six military installations of 11 Division. 11 Division of Sri Lanka Army consists of 48 military installations. Water supply systems of these military installations have widely differing characteristics.

Selection of six military installations for comparing of per capita water consumption comes under and following were considered in this regard.

- Military installations that recorded highest amount of monthly water consumption bill should be considered as critical
- Data availability at Garrison Engineer's station should be considered as possible
- Convenience of the location should be considered as possible

The selected military installations are listed in Table 04.

Table 03: Military installations selected for study

No	Military installation	Location
1	Sri Lanka Signal's Corps training school	Boowelikada,Kandy
2	Sri Lanka Electrical & Mechanical Engineers training school	Gannoruwa,Kandy
3	120 SQN Sri Lanka Service Corps	Kandy
4	5th BLN Sri Lanka Light Infantry	Pallekele
5	1st Regiment Sri Lanka Riffle Corps	Pallekele
6	7th Gajaba Regiment	Ukuwela,Matale

Details related to Water consumption data of above mentioned military installations were gathered from January 2006 to April 2011.

Per capita water use is calculated by dividing the total public supplied water in liters per day by the population who served in each camp.

Basis of case study selection. Military installation that recorded highest water use per capita (2006-2001) was selected as the case study for further examination.

SLSC training school is selected as the case study of this research.

There methods were used to explore the causes of higher water consumption of the camp.

1. Questionnaire survey
2. Observation
3. Documentary evidence

Suggest measures to reduce higher consumption. Water audit is done to inventorize all water use on site and to assess the water use efficiency. Water audit software Version 4.2 downloaded from the official web site of American Water Works Association (www.awwa.org).Input data was gathered using the results of questionnaire.

Cost benefit analysis was done to appraise the suggested water efficiency measures and to find the cheapest way of rectifying the issues.

RESULTS AND DISCUSSION

SLSC School is the highest water user of the region. Since 2006 they recorded the highest per capita water usage. In 2010 their level of consumption reduced in half but the cause is due to a meter error. NWS&DB has replaced a new water meter and again in 2011 SLSC school accounted for the highest water use per capita.

Explore the causes for higher water consumption. Awareness of the water supply source and support of efforts to conserve Water. This research found that ninety seven percent of respondents are aware about the main water supply source of the camp. But Ninety seven percent respondents weren't aware about the cost per meter cube of water.

This research found that this camp is not practicing any water conservation effort such as reusing or recycling of water. Despite their strong feelings about the importance of water conservation, very few respondents are aware of water conservation practices. Ninety seven percent of respondents didn't work on it. However Seventy five percent of respondents believe that this camp is utilizing water efficiently.

When asked about the highest water consuming activities fifty seven percent respondents believe that they are using more water for bathing. Twenty three percent of respondents think hygienic uses consume more water and twenty percent respondents consider grading and cleaning of vehicles consume more water. When considering about the amount of water use for personal hygiene, eighty eight percent respondents use water tanks for personal hygiene while twelve percent respondents use water showers.

Ninety seven percent respondents directly consume pipe borne water for drinking.
Thirty five percent of respondents have noticed leakages of main water supply line with in last three months while sixty five percent respondents didn't noticed such an incident.

All key informants indicated that the most water being wasted is due to leaking reported from deteriorated supply line, water taps and toilet cisterns.

This camp didn't receive prompt maintenance of the water supply system regularly.

There are not any water saving measures used in this camp.

All key informants indicated that following aspects of the water supply system of the camp have to be improved.

- Maintenance of the system
- Metering
- Alternative water source

Measuring the leakage and overflow quantity Measuring of leakages from the main supply line

The following section of the report illustrates the measurements of leakages and overflow rates from the water supply line of the camp.

Table 13. Measurements of leakages from main water supply line

Date :27/02/2011			Date :28/02/2011		
Pipe Line diameter : 2 inch			Pipe Line diameter : 2 inch		
Time	Meter reading	Water waste	Time	Meter reading	Water waste
23.00 PM	0799		23.00 PM	12992	
23.30 PM	0940	141	23.30 PM	13211	219
00.00 PM	1147	207	00.00 PM	13379	168
00.30 AM	1319	172	00.30 AM	13517	138
01.00 AM	1489	170	01.00 AM	13678	161
01.30 AM	1630	141	01.30 AM	13827	149
02.00 AM	1809	179	02.00 AM	14139	151
02.30 AM	1971	162	02.30 AM	14296	161
03.00 AM	2138	167	03.00 AM	14436	157
0330 AM	2308	170	0330 AM	14601	140
Average water waste per hour = 138 X 2 = 276 liters					
Average water waste per day = 6624 liters = 6.6 units					
Average water waste per month = 198720 liters = 198 units					

2 inch diameter pipe line has recorded 1 liter water leak per hour. Here we ignored that amount because it will not affect much on the final count.

Measuring the overflow rate from storage tanks. According to the observations made by the researcher overflowing from water supply line happens daily. Time of overflow runs between 05-07 minutes.

Table 14. Overflow rate from storage tanks

Volume of the tank	Number of tanks	Refill time	Overflow rate	Total quantity of water wasted
500 L	3	10 mins	833 ml/S	1666 ml/S
1000 L	2	15 mins	1111 ml/S	2222 ml/S
1500 L	1	25 mins	1000 ml/S	1000 ml/S
2000 L	2	42 mins	793 ml/S	1586 ml/S
4000 L	1	68 mins	980 ml/S	980 ml/S
8000 L	1	90 mins	1481 ml/S	4040 ml/S
Overflow rate from main storage tank				4000 ml/S

Total quantity of water wasted due to overflowing from storage tanks (if all tanks tend to overflow at ones)	15494 ml/S 15.4 L/S
If assumes overflow at one time as 5 mins; Total water waste Total water waste per day Total water waste per month	15.4 X 60 X 5 4620 L 138600 L

Measuring water leaks from storage tanks

The camp has 10 water storage tanks. All tanks are in good condition and no water leak reported at the time of this survey.

Water use behavior of the camp. Measuring the average personal water use of the camp (per person per day)

Table 15. Average personal water use of the camp

Water use	Quantity used
Bathing	100 l
Hygiene	172 l
Drinking	2.15 l
Washing	25 l

Source: Questionnaire survey

Measuring the water consumption for upholding activities (per person per day)

Table 16. Water consumption for upholding activities

Water use	Quantity used
Cooking	5325 l /144 = 36.97
Cleaning and Gardening	1300 l / 144 = 9.02 l

Source: questionnaire survey

Compare the average amount of water used for hygienic purposes. (For the shower or bath,)

Table 17. Average water used for hygienic purposes

Water tank with 4 L bucket			Shower (shower head flow rate : 10 L/min)		
Frequency	Number of buckets used	Total water used within a month	Frequency	Duration	Total water used within a month
5 times a week	25	2000 L	5 times a week	08 mins	1600 L
Water saved from showers /Per month. Per person					400 L

Total water saved per month	400L X 150
	60000 L
(here we considered 88% the total water saved since 12% is already using showers)	52800 L

Water Audit

Table 18. Water Audit information

Month of data gathered	April 2011
Population of the month of April 2011	144
Water consumption of the month	1,829000
Per capita water usage	423.38 l/p/d

For the water audit inventorization we have used water consumption data of the month of April 2011. Questionnaire survey of the research was conducted with in the second week of the month. There fore we have directly used the water consumption data gathered from questionnaire survey for this inventorization.

DISCUSSION

Our results confirm that per capita water consumption of SLSC School is higher than tthat of any other military installation in Sri Lanka. This level of supply is four times higher than the standard level for basic water requirements for domestic purposes.

Falkenmark water stress indicator considers 100 l/p/d is sufficient to provide minimum acceptable quality of life. While Gleick (1996) suggested a minimum level of 50 liters/person/day for domestic use. The present per capita domestic withdrawals of most army camps are higher than this level.

Findings of this research have revealed that high water consumption per capita is due to three main causes.

a) Leaking from main water supply line
b) Overflowing from water storage tanks
c) Water use behavior of the people

According to the exposed results; leaking from main water supply system and overflowing from water storage tanks is identified as more critical. Zone "A" of the camp is experiencing vast amounts of water loss.

Our findings confirm that leakages from main water supply system together with overflowing from water storage tanks have a significant impact on water budget of this camp. It will collectively account for 1/5 of monthly total water consumption.

Analysis of water use behaviour also revealed that soldiers of this camp have much greater need for water in drinking and hygienic purposes than other uses. Since this is a training school, soldiers are engaged with more physically strenuous activities.

But, when considering water requirements for hygienic purposes, this camp has been using more water than 20 times of WHO standards. This is due to usage of water buckets instead of pour plush

sewer system. It is expected that water use for baths and toilets will be substantial in Sri Lanka, even in the future, according to past trends of usage rates. It is probably difficult for people to reduce water usage for bathing from a hygienic point of view. On the other hand, reducing water used in the toilet might contribute to reducing the level of per capita water use in the future.

Bathing as one of the major water using activity accounts for ¼ of average water use per capita of the camp. This is due to usage of tank/bucket system instead of using showers.

Water required for food preparation in this camp is 5 times higher than the standard water usage. Chefs and assistants in the kitchen are not using basins, sinks, storage tanks and other water saving appliances for cleaning and washing.

Our findings confirm that deteriorated water infrastructure and water fixtures are the main causes of water waste of this camp. There fore zone "A" of water supply system of SLSC School has to be restored rapidly.

Regular maintenance of water fixtures is a necessity and the system should comprise with leak detectors. Installation of level instrumentation of water storage tanks (floating valves, ball cocks, ball valves) reduces the overflow rate by ninety percent.

When considering the water use for hygienic purposes, shifting to water showers from concrete tanks has a great impact to the total water budget. It will save nearly 1/5 from the water bill. It was considered that the amount of water used for flushing toilets would be substantial even in the future. The replacement of a conventional toilet with a water-saving-type toilet is hence one effective solution for reducing per capita water use in the future.
Capacity building and training of staff on water matters are vital to achieve a behavioral change.

This research suggests the necessity of alternative water sources to the camp.Through an alternative source, the camp can save 1/5 of their monthly water budget and it will also be needed in the times of water scarcity.

Results of the Cost benefit analysis confirmed that we are able to recover the total cost of efficiency measures within 06 months and are able to save 442,656/= rupees annually for the organization.

CONCLUSION

The greatest water challenge for Sri Lankan Army is the water cost. This research has confirmed that 2/5 amount of water use in this camp is due to water waste. Therefore, we can clearly see that full performance in efficient water use has not been realized by this camp.
Full performance of the water supply system has not achieved their potential because of three reasons. Deterioration infrastructure and failure of level instrumentation, not getting regular system maintenance and water use misbehaviors of soldiers are the three causes behind that.
Alternative sources of water are not being used or used effectively. Use of alternative sources needs to be integrated into base camp planning and design.
Present water supply system is not adequate to make an effective change. Full system renovation is essential to reduce the water waste and stopping the worsening of water situation of Sri Lanka army.

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