Poster Session Paper

SUSTAINABLE WATER SUPPLY MANAGEMENT SYSTEM FOR PANAGODA ARMY CANTONMENT

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Abstract - Sustainable water management is identified as an important strategic approach to minimize unnecessary costs and for proper utilization of water resources. The Panagoda army cantonment was established five decades ago and current water supply system has deficiencies to cater the demand of water users. Due to malpractices of users massive wastage of water supply has been observed. This study focused on the identification of the status-quo of the water management system in the cantonment. Then to be identified the customer's perspective on the current water management system in the cantonment and identified proper way to improve current water management system. The high value of water invoices and electricity invoices were received for the monthly usage. By introducing new water management, it will be possible to reduce the cost of water usage and cost of electricity usage that use for the pump operation. There are 4 Directorates, 7 Regiments, 31 Units, Army Base Hospital and Army Physical Training School operating at the cantonment and data has been collected from selected 19 establishments which are consist with higher no of staff. During the study qualitative and quantitative data was collected by using the questionnaire and evaluate the quantitative data by using Statistical Package for the Social Sciences (SPSS) software version 23. Both descriptive and inferential statistics were determined. According to the qualitative data, current status of the water management system was evaluated and recommendations were formulated. The conceptual framework consisted of sustainable management approaches such as environmental Sustainability, Affordability, Quality, Health and Safety, Reliability, and Responsibility of the operation. Those five independent variables were correlated with the dependant variable of customer satisfaction. Each independent variable was gathered in two perspectives such as customer expectation and the satisfaction of the aspect. Each factor was plotted to identify the gap area. It is recommended to carry out in-depth study to minimize loss and improve the current system to the sustainable way.

Keywords: Environmental Sustainability, Affordability, Quality, Health and Safety, Reliability and Responsibility.

I. INTRODUCTION

The Panagoda army cantonment consists with the various corps and residential area where as seven regiments and thirty-one units. Because of higher water demand of different units and other establishments, daily water consumption is about 4000 m3 and 50% of the consumed water is released as wastewater in a an appropriate way to the environment. This situation had led to environmental pollution in and around the cantonment area. Therefore, it is very much essential to treat the wastewater and efficiently utilized for nondrinking requirements at the army cantonment such as watering, washing, etc.

As per the observation made by the Garrison Engineer of Panagoda, the army is paying approximately Rs 6.5 million to National Water Supply and Drainage Board per month. There is a considerable gap can be observed when it is compared with the number of water consumers and the consumption of water per month. That emphasis the usage of water is higher than the requirement.

II. OBJECTIVES OF THE STUDY

a. To study the status-quo of the water supply management system of Panagoda army cantonment through a consumer survey.

b. To identify the areas for improvement of the water supply management system of Panagoda cantonment.

c. To identify the consumer satisfaction on each factor of the water supply management system and develop the suitable system to uplift the current system.

d. To propose practical and sustainable system to existing water supply management system of Army cantonment of Panagoda.

III. RESEARCH QUESTION

The research question of this study was based on how to improve the water supply management system of the Panagoda army cantonment in a sustainable way. Therefore, it is necessary to implement under mentioned factors:

a. Reduction of energy cost.

b. Treating of waste water and efficient use of treated water.

c. Cost- Benefits of Investment for the sustainable water management should be analysed.

IV. LITERATURE REVIEW

A. Sustainable Water Management

The sustainability is expressed as the involvement of all stakeholders to achieve better consumption with their involvement for maintenance, recovery, continual support to deliver high-quality service for all (Carter et al., 1999). Sustainability of the water supply is identified as a critical aspect throughout the world. Sustainability was defined as a vital factor in water infrastructure management activities and focused not only on maintenance cost but also on customer satisfaction as essential to implementation and smooth functioning of it (Han et al., 2015).

Sustainable water management was defined as avoidance of losing social welfare in the use of water, and efficient use was the way to achieve sustainability as well as proper pricing scheme identified as a useful method for practical use of water (Bithas, 2008). Shortages in water supply in droughts were critically observed and not enough to meet water demand due to shortfalls in precipitation and stream flows in addition to lack of quality water to consume (Werick and Whipple, 1994). Water consumption in future will be faced to more complex and dynamic situation, and sustainable water management strategies are involved to identify through effect analysis on the vulnerability and adaptation possibilities in future (Haasnoot et al., 2011)

B. Water As A Basic Need For A Human Resource Of The Organization

Water is the basic need of the living creatures, and mainly humans are consuming water for maintaining the biological reactions happen in the body. Also, water is consumed for the cleaning purposes like bathing and washing, and it is highly required for the maintaining health of each person. The primary water requirement is expressed as a fundamental right and supported by the international law (Gleick, 1998).

C. Sustainable Water Supply Approaches

Army water security strategy was published in 2011 by United States Army Environmental Policy Institute stated that significant goal areas as sustainability, reduce the demand of water, maintaining infrastructure integrity and security (Koch and Kodack, 2012). Growth of populations and uncertainties in climatic changes will create intense demands on water resources in the future and holistic approaches and integrated management principles will be necessary to develop sustainable systems and prevent disasters (Bouwer, 2000).

Rainwater harvesting was neglected by the policymakers due to lack of awareness and also not popularized due to high initial cost for average households. However, it is a sustainable way to maintaining and operation of the system to fulfill the drinking water standard through proper awareness programs (Ariyananda, 1999). Rainwater harvesting systems were operated around 15,000 units at Sri Lanka, and improvement of the system was explored (Ariyananda, 1999; Fenghua, 2006). Rain water harvesting is the simple process. However, it can be harvested from any clean roof surface and should be purified or not before consumption due to the hygiene of the system, including the collecting surface, pipelines and tanks (Ntale & Moses, 2003).

D. Importance Of Renewable Energy Usage

Sri Lanka is a ideal country to use solar energy. The average annual of solar radiation in Sri Lanka was estimated as 4.5 - 6.0 kWh/m2/day and cost for power generation was determined as Rs 22 - 25 /kWh (Keswani et al., 2017).

Copmpratively captital investment to be beared for the installation of solar system is higher than the prevelant expences of Coal (Rs. 9 -15 / kWh) which will be reduse in the future due to the advancement of the process thorugh scientific inventions. (Keswani et al.,2017). However after intallation of solar sytem, recurrent expenditure is lower than the prevelant expenses of Coal.

IMPORTANCE OF PERSPECTIVE OF WATER CONSUMER'S VIEW

The current management practices are based on human-centric approaches, and consumer service is playing critical concern on disciplines of marketing, quality management, and sustainable management approaches. The essential requirement of safe, reliable, affordable and accessible water supply is not achieved in developing countries (Hunter et al., 2010).

Water demand management is identified as a critical subject, and economical pricing is needed to the satisfaction of consumers as well as covering up the relevant cost of the operation. Water pricing is also found as the trade-off between the purpose of financial sustainability through cost recovery and consumer satisfaction (Savenije and Van Der Zaag, 2002).

V. METHODOLOGY

Conceptual frame work as shown in fig 1. below is compatible with the literature review

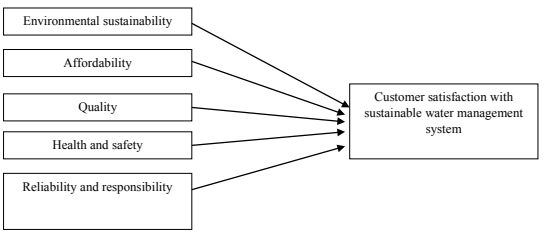

Fig .1 Main factors which affect customer satisfaction

VI. FORMULATION OF EMPIRICAL MODEL

$$Y_i = f(X_{1i}, X_{2i}, X_{3i}, X_{4i}, X_{5i},) \text{ err}$$

where

Y = Vectors of productivity

X_{1i} = Vectors of Environmental sustainability

X_{2i} = Vectors of Affordability

X_{3i} = Vectors of Quality

X_{4i} = Vectors of Health and safety

X_{5i} = Vectors of Reliability and responsibility

i = Organization

err = error factor

VI. SAMPLE PROFILE

There are many army establishments which are functioning under Panagoda army cantonment and questioner was distributed among the selected establishments by considering the higher strength. Accordingy 193 quetioner were collected among 300 distributed quetioners as the sample.

VII. DATA COLLECTION METHOD

The questionnaire was prepared and distributed to the consumers at army cantonment, Panagoda. As a pilot study 30 copies of a questionnaire were distributed and final questionnaire was streamlined accordingly. Then 300 copies of the questionnaire were distributed to different corps and institutions established in the cantonment. All questions were based on a Likert scale 1 to 5 (Strongly agree =1, Agree =2, Neutral=3, disagree = 4, Strongly disagree = 5) and data were entered to Excel sheets before analyzing using SPSS.

VIII. DATA ANALYSIS

The regression method was used to analyze the relationship between the independent variables and the dependent variable. Descriptive and inferential statistics were used to analyze the data. Collected data were statistically analyzed, using the SPSS version 23. Representations like tables and charts were used to ensure smooth and quick interpretation of data.

IX. RESULTS AND DISCUSSION

A. Results

Table 1: Overall satisfaction with the water supply management system rated by the respondents.

Satisfaction			Percentage
	Total	Male	Female
Highly dissatisfied	2.11	1.58	0.53
Dissatisfied	8.42	7.89	0.53
No idea	17.37	16.32	1.05
Satisfied	61.05	54.21	6.84
Highly satisfied	11.05	11.05	0

A relatively higher number of respondents stated that the water supply system operated at a satisfactory level and no difficulties were encountered. However, some of the respondents genuinely stated that there are unresolved issues in the system. A major lapse of the current system was the insufficient amount of supply and the few respondents had faced difficult situations as some times they don't have water for the fulfillment of basic needs.

Irregular water supply was observed mainly after 1700 hrs to 2000 hrs on working days. Hence most of the people living in the cantonment faced a critical situation in fulfilling their basic needs. They stated that the supply pressure of the water is lower and not up to the satisfactory level. They also observed that several issues on the current system and have to introduce the remedies. Stated issues of the current system given as follows and need to get necessary actions to improve the current water supply system.

i. Not sufficient number of storage tanks in cantonment, no water tanks to collect water for bathing purposes, and water distribution pipelines are not up to the standard.

ii. Continuous water wastage occurred due to water leakages of old cast iron pipes, fittings, valves and taps.

iii. Delaying of taking actions to repair the water supply at the breakdown of supply.

iv. Mud and particulate matter in water.

v. Irregular water supply.

B. Discussion

Considering the statements of respondents and the personal observation at the army cantonment, following suggestions are produced to improve the current water supply system.

i. New storage tanks to be established.

ii. Repair the current pipeline and replace the old cast iron pipes.

iii. A continuous supply of water.

iv. Introduce water showers for bathing purposes and mitigate water wastage at bathing.

v. Quick actions on repairs on the breakdown.

vi. Using quality fittings.

vii. Introduction of tube well and efficiently distribution.

viii. Water supply at peak hours of usage in the sufficient volumes.

ix. Improve the water pressure and uninterrupted supply.

x. Knowledge dissemination and new rules enforcement to minimize water waste and sustainable usage to the consumers.

xi. Water supply with control measures.

xii. Daily inspection and maintenance.

X. CONCLUSION

a. The current water supply system should be improved for the perspective of sustainable manner. The current cast iron pipelines should be replaced by the PVC pipes and fittings.

b. Wastage of supplied water was observed in the bathing and cleaning operations and it is recommended to use gate-valves for the bip-taps. Therefore conserve water in the tap closing operations.

c. Further it is recommended to demolish ground water tanks which is built for bathing purpose and introduce water showers for bathing for all personnel.

d. Effluent treatment should be carried out in an appropriate manner. Wasting of the water and other resources should be identified and mitigate unnecessary waste and leaks.

e. The satisfaction of the consumers of the water supply system should be improved more with respect to affordability and health and safety aspects. Those aspects are considered as basic needs and dissatisfaction of the consumers may happen when not meeting their requirements. However, all five aspects had high negative gaps. Consumers are expecting more and satisfied less on all five aspects. Therefore, need of improvement of the system is identified. Customers are satisfied with the status-quo of water supply system. however, they seek more improvement.

f. Harvesting of solar energy and rainwater harvesting are identified as feasible alternatives for sustainable water management approaches and have comparable significance on the improvement of the current system as well as minimizing the unnecessary public expenditure.

g. It is recommended to have a deep study to minimize loss and improve the current system to the sustainable way and analysis the cost benefit.

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