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Options for Improvement of Water Consumption, Energy Consumption and Waste Management in Sri Lanka Hotel Sector

Illangakoon, I P G B[1]; Hulugalla. W M N[1]; Dissanayake. D M T P[1]; Ratnayake. Eng Prof (Mrs) N[2]
[1]Undergraduate student, [2]Senior professor
Department of Civil Engineering, University of Moratuwa,
Sri Lanka

***Abstract*--- This study was carried out with the objective of assessing the current water and energy consumption and waste management practices in Sri Lanka hotels, identifying the conservation measures that are being practiced and proposing possible measures in order to reduce the resource consumption by at least 20%. For this study, a sample of tourist hotels where the data was available and the potential for saving could be estimated were selected. Details about the hotel such as types and numbers of guest rooms; electrical fittings; plumbing fixtures; facilities and equipment; occupancy data; and monthly consumption and generation details were used to calculate the potential for savings in water and energy, and reduction in generation of waste and possibility of using alternative resources.**

The study showed that even in the more sustainability-conscious hotels, there is room for improving the situation by better practices as well as better choice of equipment. It was found that on average; about 30% of the water, 20% of electricity and 33% of fuel consumption can be reduced in the three hotels studied. The suggested interventions to achieve such savings would have relatively short payback periods, thus making them worthwhile.

Keywords*--- *Performance indicator, Water conservation, Energy conservation, Green practices, Benchmark,

I. INTRODUCTION

Tourism is becoming a very important sector in the Sri Lankan economic development, with the end of the 30 year conflict situation. It is reported that 8.4% of the GDP of Sri Lanka is contributed by the travel and tourism industry. At the same time, the tourism industry is one of the highest consumers of energy and natural resources and could become a cause of much environmental and social concern if proper conservation measures are not implemented to reduce the drain on the country's resources. It is estimated that the 4-5% of the country's electricity demand is caused by the tourist hotels. Even if the cost of producing the electricity is recovered from the industry, the demand by the anticipated growth of the industry will be a drain on the total conventional energy production capacity of the country, and thus will deprive the other users of electricity. The situation with respect to water is also the same, and management of wastewater and solid waste generated will also prove to create a similar situation, unless conservation measures and sustainable alternatives are enforced to be implemented urgently.

In Sri Lankan hotel sector most of the mid-range hotels are not practicing energy and water conservation methods at the moment. However reducing the energy and water use in buildings is an important means to decrease the energy consumption and the environmental impact from the hotel sector. Therefore in the world faced with the energy and water crisis, there is a growing movement to practice 'Green Practices' that are based on energy and water conservation measures in certain key areas such as lighting, air conditioning, hot water systems, water supply and laundry area, water fixtures and sanitary appliances in guest areas, kitchen and garden.[1]. Implementing a solid waste and waste water management program in a hotel can create significant cost savings in waste handling fees while creating a more environmentally friendly hotel.

The scope of this project is to assess the current water consumption, energy consumption and waste management practices in a cross section of hotels in Sri Lanka to identify the conservation measures that are being practiced and the possible measures that can be introduced in order to reduce the resource consumption by at least 20%, while making final recommendations based on quantitative analysis.

II. STUDY METHODOLOGY

A. Literature Review

Literature survey was carried out in order to identify the current practices and their weaknesses related to water and energy consumption and waste water management in Sri Lankan hotel sector. Another aspect of carrying out a literature survey is to identify the available water, energy conservation methods and waste management practices applicable for the hotel sector, both locally and internationally.

B. Hotel Selection

Several hotels were selected which ware registered under the European Union funded "Greening Sri Lanka Hotels" project to arrange visits and carry out walk through audits, in order to identify the current practices in water consumption, energy consumption and waste management. During the audit,

various weak areas that needed to be improved were observed, such as water fixtures and sanitary appliances, laundry area, swimming pools, kitchen area, garden, lighting systems, air conditioning systems, hot water systems, pumps, water treatment plant, wastewater disposal and garbage disposal. The hotel staff and the engineers of the Greening Sri Lanka Hotels Project accompanied the authors on the site visits.

After the completion of walkthrough audits, three hotels were selected, based on the level of their operation, main priority being given to the worst hotels that appeared to have opportunities for improvement. Also the data availability was considered since some of the hotels were unable to provide primary data that are necessary in the analysis.

C. Identification of Indicators

The performance indicator for water and energy consumption in hotels was chosen as cubic meters of water per guest night and energy usage per guest night respectively. Previous studies described that occupancy of the hotel is the main defining factor for water consumption. It was observed that even the small and medium size hotels (main target of this research) have the facility to easily collect guest night information, and therefore, guest nights were used as a proxy [22].

D. Data Collection and Analysis

A questionnaire was used to collect establishment data, monthly data and historical data (monthly data for the past two years) from each of the selected hotels. The establishment data sheet contains the property details about the hotel while monthly data sheets contain monthly consumption and operational details. Potential of water saving, energy saving and waste reduction was calculated considering, the possible reduction in consumption after incorporation of the possible green practices and their present consumption of resources.

III. DISCUSSION OF FINDINGS

A. Water and Energy Consumption

The current water and energy consumption in the hotels A, B, C were taken from the monthly consumption data, and the potential savings were calculated by assuming that interventions to control wastage and improve efficiency as recommended in the walk through audits were implemented in each hotel. These proposed interventions are described in the following sections.

1) Hotel A

Currently they use 40L/min taps and 11L capacity cisterns, for this 8L/min low flow taps and 6L volume cisterns were proposed. After limiting the backwash period for 5 minutes for every three days, the saved percentage is 4.1%. By having effective maintenance work, it is possible to save 5.4% from annual usage. In this hotel water usage per guest night is higher than other hotels that may be due to higher water consumption for ayurvedic activities (Table: 01). Estimated payback period for taps is 6 months and water usage (After the proposals) is 1.30m^3/guest night.

In this hotel, nearly 90 % of halogen and incandescent bulbs are being in use and nearly 12 % from total energy consumption is consumed for lighting purposes. By implementing compact fluorescent lamps instead of incandescent bulbs hotel can achieve nearly 10% of saving from annual electricity bill. Payback can be achieved within 8.5 months after implementing with the 75% of occupancy over the year. By adopting water saving practices, it is possible to reduce the electricity for pumping by 8.7% from annual usage. By enhancing the efficiency of the solar panels by cleaning and proper orientation, it is possible to reduce the electricity by 5.3 %(Table: 02). Since the free space is available for line drying, there is a potential of 23.0% of kerosene reduction by introducing line drying method (Table: 03). With proper maintenance of LP gas usage can be reduced by 27% of its annual usage by adjusting a flame colour yellow to blue and also by introducing bio gas generation, possible reduction in LP gas usage is 35.2% (Table: 03).

2) Hotel B

In this hotel currently they use 15L/min flow rate taps and shower heads, after proposing low flow shower heads (10L/min) and taps (8L/min), reduction is 10.1% and 4.8% respectively with 3.5 month payback period for taps 6 months for shower heads. Most of the toilets are with 11L volume single flush cisterns, after proposing 6L volume capacity dual flush cisterns saving potential is 8.4%(Table: 01),and also per guest night water usage (After the proposals) is 0.51m^3,that is equal to Green Globe best practice in 2006 [9] .

In hotel B, around 20% of halogen and incandescent bulbs are in use and nearly 5-6% from the total energy consumption is consumed for lighting purposes. Since them already using 75% of CFL, nearly 4.5% saving can be achieved for implementing CFL instead of halogen and incandescent (20%). Payback can be achieved within 8.5 months with 75% of occupancy over the year. It is possible to reduce the electricity for pumping by 4.5% from annual usage by adopting water saving practices. By enhancing the efficiency of the solar panels by cleaning and proper orientation, it is possible to reduce the electricity by 3.8 % (Table: 02).

With proper maintenance of LP gas usage can be reduced by 27% of its annual usage, by adjusting the flame colour yellow to blue. By introducing bio gas generation it is possible to reduce the LP gas usage by 33.1% (Table: 03).

3) Hotel C

This hotel is presently using taps and shower heads with 15L/min flow rates, after proposing low flow rate shower heads and taps as above, it is able to save reasonable percentage in guest rooms as well as the staff quarters and with payback period of 9.5 months for showers and 7 months for taps respectively. Backwash period is limited to 5minuits for every 3 days. For the laundry, it is assumed 50% linen reduction and 25% towel reduction under well running program, therefore potential for water saving in laundry is

1.3% (Table: 01).Water consumption per guest night is 0.45m^3, that is little below the Green Globe best practice in 2006 [9].

In Hotel C nearly 40% of halogen and incandescent bulbs are in use and nearly 6-7% from the total energy consumption is consumed for lighting purposes. Since they already use 35% of CFL and 25 % of Fluorescent bulbs, nearly 4% saving can be achieved for implementing CFL instead of halogen and incandescent (40%). with 9.5 months with the 75% of occupancy over the year. By adopting water saving practices, it is possible to reduce the electricity for pumping by 4.0% from annual usage. This hotel has a higher saving potential (Table: 02) because currently they are not using solar panel and it has been recommended to use solar panel for generated hot water for guest rooms. By introducing bio gas generation it is possible to reduce the LP gas usage by higher percentage.

Table 01: Potential water saving in hotels

Area	**Saving as a percentage of annual water consumption**		
	Hotel A	*Hotel B*	*Hotel C*
Taps in guest rooms	23.98%	10.1%	20.7%
WC,s	1.6%	8.4%	
Swimming Pool	4.1%		0.4%
Leakages	5.4%		
Showers in guest rooms		4.8%	7.7%
Taps and showers in staff quarters			1.8%
Laundry			1.3%
Potential water saving	35.08%	23.3%	31.9%

Table 02: Potential electricity saving in hotels

Area	**Saving as a percentage of annual electricity consumption**		
	Hotel A	*Hotel B*	*Hotel C*
Lighting	8.7%	4.5%	4.0%
Water pumping	6.8%	2.3%	2.5%
Water heating	5.3%	3.8%	13.0%
Potential electricity saving	20.8%	19.8%	19.5%

Table 03: Potential LP gas and kerosene saving in hotels

Area	**Saving as a percentage of annual LP gas consumption**		
	Hotel A	*Hotel B*	*Hotel C*
Cooking efficiency	27.0%	27.0%	-
Biogas generation	35.2%	33.1%	30.1%
Area	**Saving as a percentage of annual Kerosene consumption**		
Laundry	23.0%		

B. Solid Waste and Waste Water Management

Most of the tourist hotels in the study sample did not have data on wastewater and solid waste in order to produce any quantitative results. However, the study revealed many opportunities for improvement of current practices, which would result in significant reduction in generation of waste.

1) Hotel A

In order to reduce the generation of solid waste, the hotel management should educate the hotel staff as they are not practicing reduction of solid waste generation at the source. Recycling of waste is not practices by the hotel therefore hotel should implement the colored bin program in order to separate waste at the source. Initial cost for the colored bin program can be covered within 1.2 years of time. No bio gas production is doing, therefore, it is recommended to implement bio gas production, and estimated payback for the investment is 1 year.

R.O plant's rejected water, kitchen, bathroom water are discharged to a marshy land nearby. As there spending huge amount of money on an unnecessary treatment like R.O treatment. It is advisable to terminate the treatment process which will reduce the amount of water consumption and waste water generation. Instead of discharging grey water in to a marshy land, it is recommend to go for an activated sludge treatment plant. Effluent water should be checked for water quality parameters before using it.

2) Hotel D

This hotel is doing waste management up to some extent. No waste reduction plans are considered in hotel operations. Therefore, opportunities of potential reductions are

discussed. Though they are doing the separation of waste at the source, it is limited to separation of metal and wet garbage. Therefore, it is recommended for the hotel to go for a colored bin program which will facilitate recycling of generated waste. Initial cost would be able to cover with one year. Bio gas production is recommended as a solution for the wet garbage generated in the kitchen and dining. Initial cost will be covered within one year of time once the construction is started. Common waste water treatment plant is in operation for both grey water and black water which is acceptable.

3) Hotel E

There is no proper waste management is in operation in this hotel .It is recommended to do waste separation as they are not practicing it, and recycling of solid waste will be facilitated if the waste is separated at the source. Therefore, the colored bin program is recommended, calculated initial investment for colored bins can be covered within two years. Bio gas production is recommended as a solution for the wet garbage generated within the hotel. The cost of construction of bio gas plant would be covered within 2 years of time. Hotel is running a conventional water treatment plant for both grey water and black water.

C. Practical Difficulty in Providing Benchmark for the Sri Lankan Hotel Sector

This research is basically done on hotels from coastal area of the island, therefore to develop "per guest night water usage" as a bench mark for the country, it is very important to consider about the climate of that area, sample size, property size of the hotel, classification/star category and type of the hotel etc. This will be a good area for further researchers.

IV. CONCLUSIONS AND RECOMMENDATIONS

A. Summary and Recommendations for Water Consumption

- By installing low flow taps while maintaining the flow rate at 8L/min in guestrooms, public and employee bathrooms, it can save from 10% to 20% of water usage of the hotel
  It has a payback period of 4 to 7 months.
- By Installing low flow showerheads while maintaining the flow rate at 10L/min, it can save from 4% to 8% of water consumption in the hotel. It has a payback period of 6 to 9 months.
- By using dual flush 6L cisterns instead of 11L capacity cisterns, it will save 2% to 9% of water from the total water consumption.
- Introducing well-running towel and linen reuse program for laundries, it is possible to save from 1% to 4% of water from the annual water consumption.
- By limiting the duration of the filter backwash step in swimming pools on the quality of water discharged from the filter rather than on a fixed length of time; normally it will take 4 to 7 minutes, it can save from 1% to 4% of water.
- It is possible to save about 5% of water by practicing a good housekeeping program to reduce the water wastage due to malfunctioning equipment and fixtures.

B. Summary and Recommendations for Energy Consumption

- By implementing energy efficient lamps electricity consumption can be reduced by 4% to 9% of hotel electricity usage and implementing cost can be recovered within 7 to 9 months.
- By implementing new water saving appliances and practices electricity consumption can be reduced by 2% to 7% of electricity consumption of hotel.
- By implementing solar hot water system, energy usage can be reduce by 12% to 14% and implementing cost can be recovered within 18 months.
- By increasing the efficiency of existing solar hot water system, energy consumption can be reduced by 4% to 6%
- By adopting line drying it is expected to reduce the fuel consumption by 20% to 25%. Since this is a qualitative measure, the saving percentage depends on the availability of space and sunlight.
- By adjusting LP gas furnace and increasing the furnace efficiency, 27% of LP gas saving can be achieved.
- By generating bio gas, it is expected to reduce the LP gas consumption by 30% to 35%.

C. Summary and Recommendations for Solid Waste and Waste Water Management

- Reduction of waste generation and reuse of generated waste are the first things which has to be considered.
- Separation of waste at the source will facilitate most of solid waste management methods.
- Colored bins can be use to separate waste at the source and the cost of initial investment can be covered within one or two years of time.
- Bio gas plants can produce more than 50% of the L.P gas requirement of the hotel.
- Initial cost for a bio gas plant can be covered within 2 years after implementation of operations.
- Garden waste can be used to produce compost.
- Activated sludge treatment plant is the best method to treat both grey and black water.
- In septic tank designs, seepage beds and soakage pit cannot be used in areas where water table is high.

D. Conclusion

Based on the results obtained from the calculations carried out in this work, it has been discovered that, there is potential for improving the situation by better practices as well as better choice of equipment (Green Practice). Potential of resource saving amount is above 20%, that is 30 % of water, 20% of electricity and 33% of fuel from the annual consumption as an average for the hotels in coastal area of the country.

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