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A Comparative Assessment of Environmental Sustainability in Hospitality Industry with a Special Focus on Resource Efficiency and Cleaner Production Indicators

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ABSTRACT

Hospitality and tourism industry is one of the major contributors to the global economy, especially in many developing countries. Nevertheless, empirical research on environmental sustainability approaches in the hotel sector is scarce. The present study attempts to investigate and compare sustainable strategies in selected star-rated tourist hotels by utilizing RECP (Resource Efficiency and Cleaner Production) indicators, in relation to consumption of energy, air emissions, water, material use and waste generation. The study proves that higher luxury levels can increase energy intensity, while imbalances in national grid supply and increasing thermal factor in the grid electricity affect energy productivity and air emissions. Furthermore, hotels that utilize water from the national supply have been more concerned about reducing consumption. Sustainable practices adaptation was at a satisfying level in all hotels investigated, and the more measures were implemented towards energy conservation. Nonetheless, poor record keeping was observed for wastewater and material usage. The study confirmed the RECP approach as an effective tool in assessing and quantifying a hotel's sustainability efforts. Further, cleaner production is identified as a systematic methodological pathway to achieve environmental sustainability and this will be especially beneficial to developing countries and those undergoing economic transition.

Key words: *Environmental Sustainability; RECP Indicators; Resource Efficiency; Pollution Generation; Hotel Sector*

Introduction

Tourism is arguably the world's fastest growing industry (Bramwell and Lane, 2008) and a major pillar in economic advancement in many developing countries. Tourism sector accounted for 10.4% of global GDP and 319 million jobs in 2018 and domestic tourism, has showed the strongest growth in developing nations (WTTC, 2019). Yet global tourism sector is increasingly facing challenges which are linked to environment and society and therefore need rethinking of the "sustainable-growth "of the sector (Mihalič, Žabkar and Cvelbar, 2012).

Tourism is tightly linked to environment and natural resources. Accommodation, transportation, recreation, and catering contribute significantly to natural resource consumption, climate change, and waste generation (Zhang et al., 2019) in tourist industry becoming major contributors to environmental issues.

Tourism is responsible for 5% of the world's carbon dioxide emissions, out of which hotels and other types of accommodation account for 2% (UNWTO, 2020; Buckley, 2012) and contributes to a 3.2% of global energy use (Buckley, 2012). Furthermore, tourism contributes to resource depletion and, had consumed 0.34% of the world's terrestrial land area (Gössling, 2002). According to a review by (Buckley, 2012) tourism industry affects air, water, soil and biota; directly while indirect impacts are mounting on manufacture and transport of material items (Aall, 2011; Charara et al., 2011; Gössling, 2002).

In this context, hospitality industry has been under pressure by policy makers and implementers to implement environmental conservation strategies and thereby reduce its footprint (Font, 2002; Zurburg, Ruff and Ninemeier,1995). As in many other industries, the tourism industry too pays increasing attention now on sustainability practices (Stylos and Vassiliadis, 2015).

Tourism and hospitality sector of Sri Lanka and Developing countries

Tourism has grown into a prime economic importance for many developing countries, in particular for small island states (Gössling, 2000). Sri Lanka, being a tropical island state is also gifted with a wide array of natural resources and scenic beauty which are key opportunities for tourism. Though Sri Lankan hospitality industry is one of the major contributors to the national economy with 4.9% contribution to the GDP (SLTDA, 2018), tourism industry is one of the highest consumers of natural resources of Sri Lanka (Ratnayake and Miththapala, 2011).

As in many other developing countries the hotel industry has also grown with an increased number of tourists visiting the country, consuming nearly 5% of the total energy consumed by all industrial sectors (SLSEA, 2016). Sustainability has now become a priority in development agendas in the country (Perera and Pushpanathan, 2015) and therefore, the concept of "sustainable tourism will no longer be a luxury but the norm (Miththapala, Jayawardena and Mundeniya, 2013).

Furthermore, as a major pillar in economic advancement as in many developing countries the attention of policy makers, public and private organizations, and tourism researchers are high to develop and promote sustainable tourism. Therefore, the governments have a crucial role in encouraging the use of cleaner technologies in the tourism sector and presenting different approaches to achieve sustainability in developing countries (Yfantidou and Matarazzo, 2017).

Yet there is a lack of systematic way of measuring the effectiveness of sustainability practices in Sri Lankan hotel industry and the case is similar for many countries with similar economies. Moreover, owing to the prevailing socio-economic and political conditions in the developing world, implementing principles of sustainable tourism has become an enormously difficult task (Tosun, 2001). Therefore, a proper quantification of the resource use and pollution generation is essential to assess a hotel's environmental sustainability efforts in a methodical way. For that a cleaner production approach would be a very appropriate tool even though there are much less instances where cleaner production approach is utilized in service base systems. In contrary some studies argue that sustainable tourism destinations, being a service based system, may probably benefit more from cleaner production compared to production/manufacturing systems (Lee, 2001).

Resource Efficient and Cleaner Production (RECP) approach

Cleaner production proves to be an approach that improves material utilization and reduces energy consumption and waste emission thus is being positively related to environmental sustainability (Fresner, 1998; Kjaerheim, 2005; Almeida et al., 2013; Severo et al., 2015; Sáez-Martínez et al., 2016). Further cleaner production can be especially beneficial to developing countries and those undergoing economic transition (Gavrilescu, 2004). Resource Efficient and Cleaner Production (RECP) indicator approach is one way to assess resource consumption practices in organizations in a cleaner production point of view.

RECP is a preventive, enterprise-level approach to improve resource use, reduce environmental pollution and finally contribute to sustainable industrial development.

The United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) introduced RECP indicators in 2009 with the aim to advance sustainable industrial development through sustainable consumption and production in developing and transition countries (UNIDO and UNEP, 2010).

Although CP as a strategy mainly applies to environmental aspects, its general approach based upon the principle of "prevention" has powerful impacts even in social and economic terms, as most of the environmental effects also have social and economic impacts, and vice versa (Lee, 2001). RECP builds upon cleaner production and related practices and entails the constant application of preventive environmental strategies to processes, products and services in order to upsurge efficiency and reduce risks to humans and the environment. Further RECP addresses the three pillars of sustainability individually and synergistically (Figure 1).

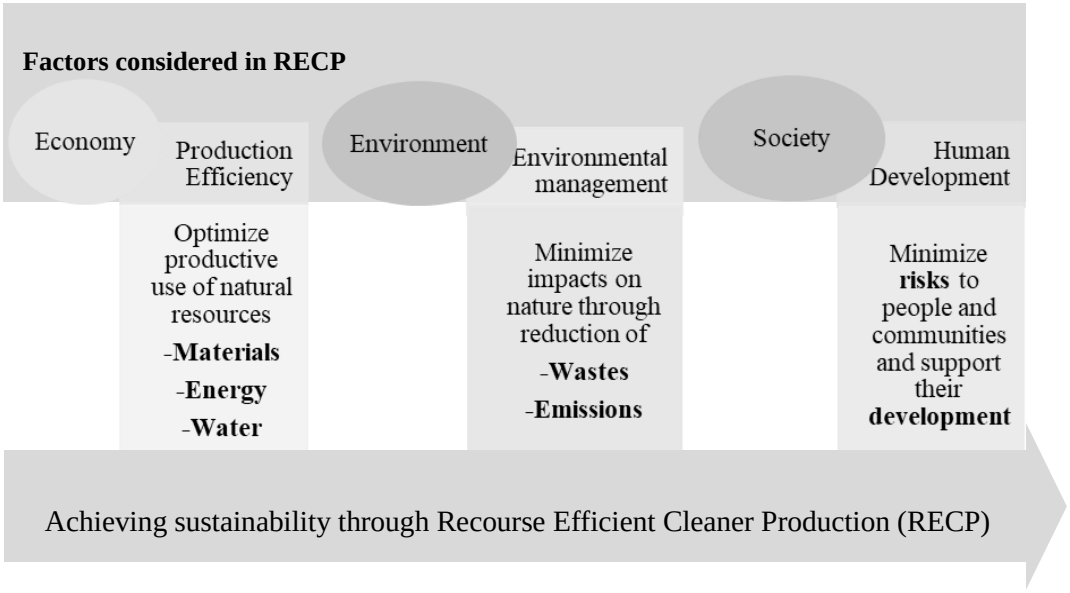

Figure 1: Connection between sustainability dimensions addressed by RECP approach (Source: UNIDO and UNEP, 2010)

This approach guides the companies to determine where and how the waste and emissions are generated and resources are used inefficiently and allow the companies to quantify their own resource productivity and pollution intensity, to track the results over time by establishing RECP profiles. They can be applied to products and various services provided in the society and can be used to compare the performances at different time scales within a company and also to compare performance in different

companies at the same time (benchmarking), (UNIDO and UNEP, 2010) which is the primary focus of this study. Due to the possibility of rapid growth of hospitality industry in the country, adopting resource conservation-oriented sustainability practices carry a significant value. Nevertheless, studies on resource efficiency in the tourism sector are scarce and mostly poorly reported in many developing and transition countries. In this context, the present study focuses on assessing environmental sustainability and cleaner production; in six selected hotels of Sri Lanka. For that a comparative assessment of process technologies from a cleaner production point of view are analyzed, together with Resource Efficient and Cleaner Production (RECP) indicator system of the involved stakeholders.

Methodology

The present study investigates environment sustainability of hotels using following methods.

- RECP (Resource Efficiency and Cleaner Production) indicators
- Secondary information: Semi structured interviews, Annual reports / Sustainability reports / Web articles of the institutes

RECP indicator system comprises six absolute indicators, three for resource use (energy use, materials use and water use) and three for pollution generation (air emissions, wastewater and waste) and one reference indicator (product output). Absolute indicators measure basic data in a given time frame (Figure 2).

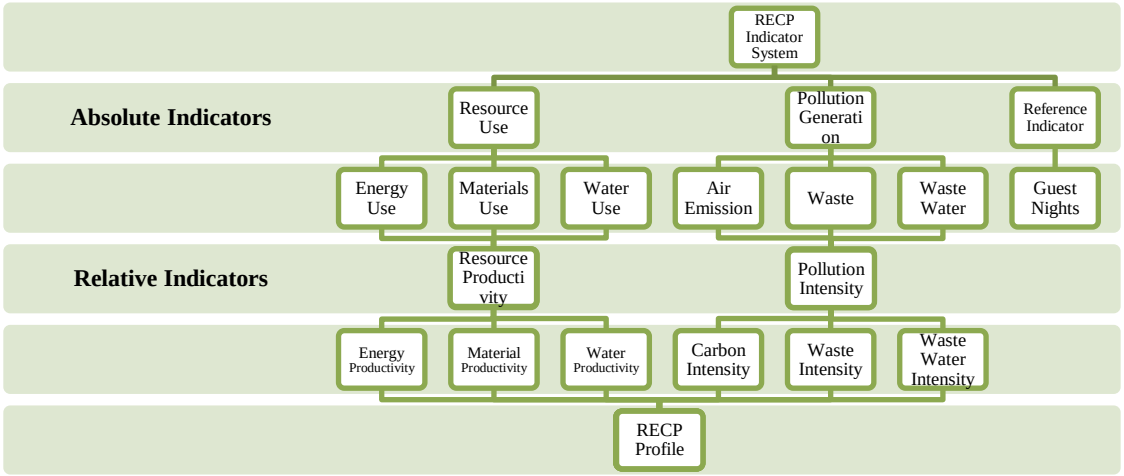

Figure 2: Application of RECP Indicator system

These absolute indicators are used to calculate three resource-productivity indicators (product output per unit of resource consumption) and three pollution-intensity indicators (emissions or waste generation per unit of product output). Relative indicators measure how productively resources are utilized to produce the desired products and/or services (UNIDO and UNEP, 2010). "Guest night" was used as the product output which reflects service provided. Guest night refers to a night spent in a tourist hotel, rest house or guest house approved by the SLTDA as being suitable for occupation by foreign visitors (SLTDA, 2018).

The study covered activities within the geographical premises of hotels. Year 2014 was used as the baseline year and performances of the next four years were compared against the baseline using the same units. The principal authors visited hotels under investigation several times during the study period and gathered information using different sources such as data inventories, internal data sheets from different sections of the hotel, annual reports, sustainability reports, bills and receipts. These data sets were gathered from different divisions of the hotels such as the engineering division, housekeeping, food and beverages, front office, the sustainability division and the kitchen. Data was collected in different subcategories for ease of understanding and analysis. These absolute measures were then utilized to calculate the relative indicators which then constitute the enterprise level RECP profile.

Calculating Resource Productivity and Pollution Intensity

Resource productivity was measured by dividing the product output (Number of guest nights) by the amount of resource used.

$$\textit{Productivity Ratio} = \textit{(Product Output)/ (Resource Use)} \qquad (01)$$

Then the changes were compared against the baseline to track changes. When the baseline ratio is (Y) and the follow up ratio is (X) then the percentage change (Z) would be

$$Z\% = (X\text{-}Y) / Y \times 100 \qquad (02)$$

Then enterprise- level RECP profile was constituted and it is constituted jointly, by the changes in the above mentioned six relative indicators. These changes were analyzed along with the green implementations of the hotels in order to track their progress and to identify and quantify the involvement of such practices for hotel sustainability. The differences in RECP indices for each hotel category were also investigated.

For indicator energy, various energy sources measured in different units, were converted to kWh. Since these data sets were also used for benchmarking, it was crucial to apply the same conversion factors therefore factors provided by the (SLSEA, 2017) was used in the study. For all the unit conversions, the "Energy unit conversion calculator" recommended by UNIDO and UNEP, (2010) was used. Other than that under indicator Air emissions, to calculate CO_2 equivalent guide lines by Gómez *et al*., (2006) and Climate Change Secretariat Ministry of Mahaweli Development and Environment (2016) were used. Emissions factors from Gómez *et al*., (2006) and Global warming potentials from the IPCC 5^{th} assessment report were used in calculations.

All the hotels under the study purchased electricity from the country's grid supply. Therefore, average yearly emission factors and annual fraction of thermal energy in the grid electricity was obtained from the Sri Lanka energy balance 2017 (SLSEA, 2017) for each year.

Semi structured interviews were conducted covering different industry professionals including chief engineers, assistant engineers, maintenance engineers, sustainability executives and managers, maintenance supervisors, garden supervisors, waste treatment plant operators, executive chefs and housekeeping officers. They were inquired about the commonly used green practices in the service sector, actions and special strategies taken to reduce resource use and pollution, policies they are implementing, information about the monitoring processes, difficulties in implementation of such strategies and about the progress in green reporting. Furthermore, their awards, certifications appreciations were recorded. Lastly, secondary data and calculated indicators were utilized in the final comparison of hotels.

Description of the hotels under the study

The study covered six hotels in major tourist destinations of Sri Lanka. Categorization of hotels follows specification by SLTDA. To refrain from mentioning the real trade name of the hotel, we have used letters A to F (Table 1).

Table 1: Hotels under the study

Hotel	*Star Category (SLTDA categorization)*	*Region (SLTDA categorization)*	*Age of the hotel*	*Room Capacity*	*Certifications*
A	5 star	South coast	39	152	ISO 14001 ISO 50001
B	5 star	Ancient Cities	24	160	ISO 14001 ISO 22000 ISO 50001 Green Globe
C	4 star	Up country	89	50	ISO 14001
D	4 star	South coast	23	129	ISO 140001 ISO 180001 ISO 140001 working towards ISO 500001
E	3 star	South coast	36	179	-
F	5 star	Colombo City	35	501	ISO 22000 ISO 14001 ISO 18001 ISO 22000 Green Globe

ISO 14001 - Environmental management system, ISO 18001 - Occupational health and safety, ISO 22000 - Food and safety management system, ISO 50001 - energy management through management systems

Results

The information on energy, water and material use & air emissions, waste water and waste generation for the past five years of the six hotels are presented below.

Energy

The RECP profile provides a snapshot view on how the hotels had performed in energy utilization throughout the considered time frame, against the baseline. None of the hotels had performed a continuous progress towards increasing the energy productivity and there has not been much deviation in the total energy consumption with respect to any hotel. Hotel B had the highest intensity of energy use and lowest productivities (Figure 3).

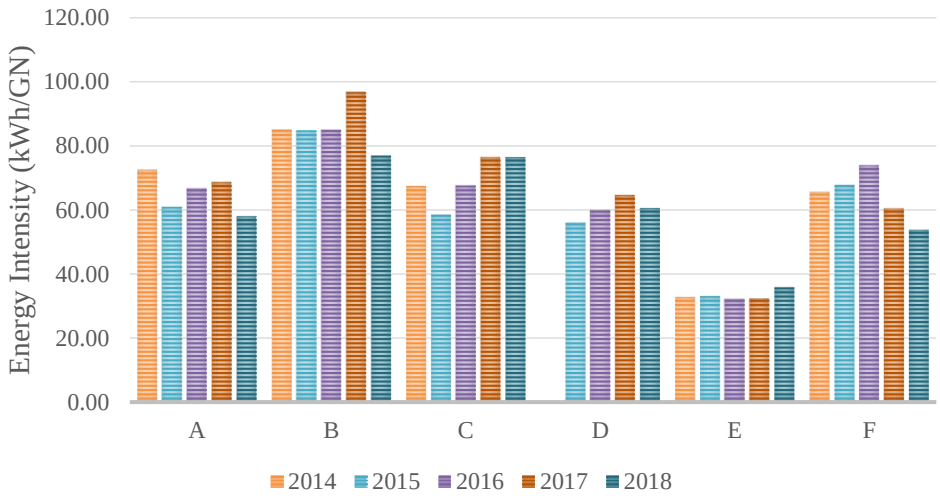

Figure 3: Energy use – Intensity ratios

Energy consumption by sources

There are different energy sources utilized to meet the energy demand. Major sources of energy used in the hotels are grid-supplied electricity, diesel for electricity generation, furnace oil for steam boiler operation and liquefied petroleum gas (LPG) for cooking. Some hotels use furnace oil for boilers and biomass for gasifiers. Figure 4 presents a summary of percentages of energy usage by type.

Figure 4: Percentages of energy usage by sources

The greater portion of energy use was the grid electricity in many hotels except for hotel B and C where biomass is a significant source of energy. In year 2017 there has been a sudden increment in the generator usage in hotel A and B. None of the hotels use biogas produced from waste. Biomass is the only renewable energy source used.

Water

Hotels consume a significant amount of water for various activities (Figure 5). Hotel F has obtained a continuous progress towards water productivity and significantly low water intensities (see also Figure 8). Water consumption details were not available in hotel E.

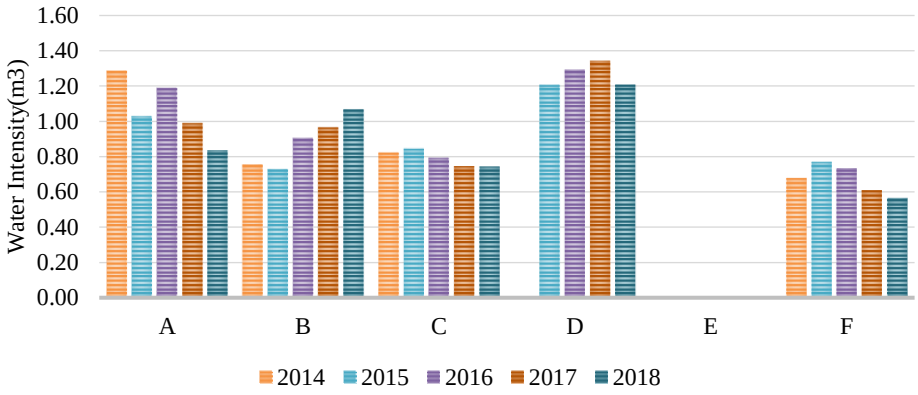

Figure 5: Water use Intensity ratios

Water withdrawal by Source

There were two major sources of water for hotels: Government water supply by National Water Supply and Drainage Board (NWSDB), and ground water from their wells Ground water is a major source of water for most hotels. All the hotels except hotel F (which totally depend on government supply) had at least two wells. Hotels A, B and C totally fulfilled their water requirement by ground water resources while hotel D and E partially depend on ground water. None of the hotels consume surface water for their activities. Rainwater harvesting is present in some hotels for gardening purpose.

Material usage

Data on material usage was identified as the most information deficient area. Hotels had very poor record keeping discipline on materials usage. Data under this category mainly falls to cover kitchen and housekeeping departments. The major constrains include informal gathering and recording of data and most importantly the reluctance of the management to disclose information. Therefore, under these circumstances industrial level RECP profiles were not created for martial usage.

Air Emissions

When comparing the absolute emissions, hotel F contributes to a huge amount of emissions while hotel C marks the least. But when intensity ratios are considered,

hotel C still keeps the lowest pollution intensity while most of the others perform at a similar level (Figure 6).

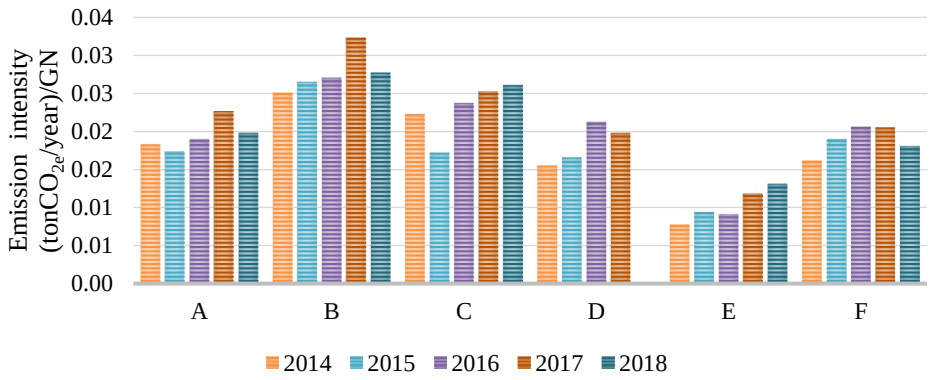

Figure 6: Emission pollution intensity ratios

Significantly RECP profiles (also see Figure 8) reveal that during the study period all the hotels have increased pollution intensities compared to benchmark except for two instances (Hotel A in 2015 and C in 2015).

Table 2 extrapolate the significance of grid electricity supply for the total emissions. And with the years as emissions from the grid supply increases this effect has been more significant.

Table 2: Contribution to air emissions by energy source (2018)

	Energy source - Air emissions ($tonCO_{2eq}$/year)						
Hotel	**Grid Electricity**	**Generator Diesel**	**Boiler Fuel oil**	**Gas LPG**	**Boiler Diesel**	**Gasifier Wood**	**Gen + Boiler Diesel**
A	1,141,886.88	26,909.00	493,063.40	61,247.40	N/A	N/A	N/A
B	1,297,954.44	83,474.20	N/A	80,291.00	473,059.60	751,609.50	N/A
C	253,162.82	34,752.90	N/A	72,782.30	119,736.50	210,739.10	N/A
D	802,795.90		N/A	111,704.60	N/A	N/A	388,581.60
E	952,315.69	25,877.80	N/A	84,488.20	N/A	N/A	N/A
F	4,454,613.41	28,037.60	1,575,161.60	469,031.60	N/A	N/A	N/A

Wastewater

Total water consumption and return flow or the water received and its use, directly affects the wastewater level. None of the hotels have proper measurements on wastewater amount generated by their activities. Most of the time amount of wastewater is given as a factor of total water consumption. Hotels A, B, C, D and E had their own water treatment plants while Hotel F sent their wastewater to a common municipal council treatment plant after a basic chemical treatment.

Waste

Solid waste from all hotels consists of two categories, dry and wet waste. Wet waste consists of food waste from main kitchens, staff kitchens and restaurants. For dry waste there are different categorizations followed by different hotels. As no proper way of recording and categorizing wastes in all hotels, gathering data has been a difficult task. Getting measurable data was tough as waste utility bills does not always depend on quantity, charges have been based on the volume of waste.

When looking at the RECP indicators (see also Figure 8) it was evident that hotels A and B were performing well under the indicator waste compared to baseline year. But in hotel B the pollution intensity level has increased with time as the negative percentage of change has decreased (Figure 7).

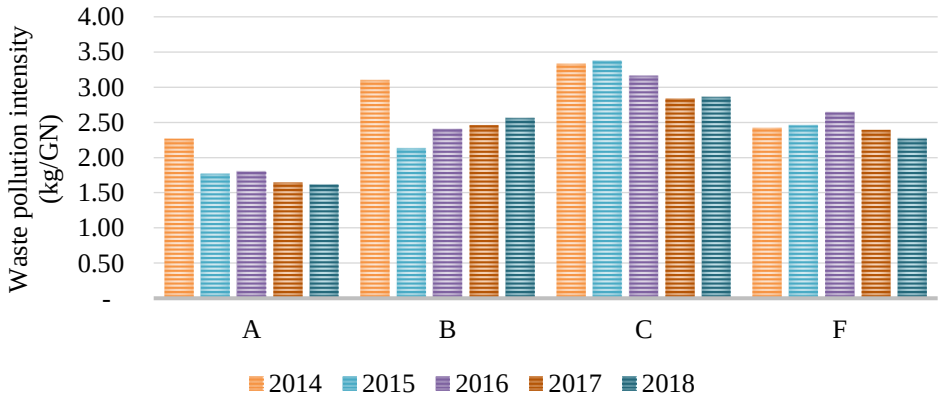

Figure 7: Wet waste generation- intensity ratios

Complete RECP Profile for Each Hotel

Extended complete RECP profile for hotel units are shown in figure 8.

Figure 8: RECP Profiles – Extended

Utilization of Green and Cleaner Production Practices

Key areas of sustainability practice adaption were identified as energy, water, material or waste and social activities. A detailed table on practice adaptation is provided in (Appendix A).

Discussion

Environmental Sustainability practices of hotels are more than a trend and should be considered as an essential element in saving the environment, serving the world and moving towards social responsibility. In this context, the main contribution of the current research lies on generating information on energy, water and materials usage of star level hotels. Although a large body of work on environmental sustainability of hotel industry is available at the global level, investigations focusing on Sri Lankan situation are scarce. Moreover, this study attempted to identify the areas that need attention of the hotels to improve sustainability.

Energy and Air Emissions

The absolute values prove that all hotels have a very high energy usage. As per Zografakis *et al.*, (2011) energy consumption in hotels is among the highest in absolute values in the non-residential building sector. Moreover, the habits of the occupants are contributing to this high consumption (Abeydeera, Hewage and Karunasena, 2019). When comparing the intensity ratios hotel E had a significantly low energy intensity. This may be due to several reasons: Firstly, it is the only three-star hotel surveyed in the study. With the increasing luxury level, the energy intensity tends to increase due to high comfort levels provided, despite the efficiency measures taken. Thus, only hotel E does not utilize a boiler for their activities. When looking at the percentages of energy usage by source (Figure 4), diesel or fuel oil fired boilers used for heating purposes consumed around 25 % from the total energy usage.

RECP profiles display that none of the hotels had acquired a continuous progress towards energy productivity. But every hotel had undertaken several measures to reduce consumption levels during the study period even though it's hard to identify the exact level of implementation. Given the poor record keeping it's difficult to analyze exactly how different measures have contributed to the reductions. Yet, hotels have undertaken a huge effort to reduce energy usage owing to the high cost of energy, and the cost savings they can make by the interventions. It is estimated that the energy costs constitute 18 % of the total operational costs of the hotels (Ratnayake and Miththapala, 2011).

All six hotels had energy saving light bulbs LED or CFL, even though percentage of the application was different. Proportion of energy efficient bulbs used in a hotel determines the efficiency. Occupancy sensors didn't seem to be a popular measure and key cards were utilized by all hotels except hotel B. However, the contribution of each practice towards energy savings depends on the intensity of adoption.

The only renewable energy type utilized at mass scale was biomass for gasifiers. Solar power was utilized in some hotels but yet facing several issues related to the use. According to maintenance officers one major reason was damages caused by stray animals such as monkeys. Situation is worse in hotels, such as hotel B and C, close to forests and related ecosystems. Further they claim solar panels reduce the beauty of a site. Further due to high capital investment and maintenance costs hotels are reluctant to go for these practices.

Energy in Sri Lanka is produced from various sources: hydro power (20.5%), thermal power (68.7%), new renewable energy (9.8 %) and other (1 %). In 2017 there was a sudden increment in energy consumption in many hotels under the study this is mainly owing to the decrease in hydro power generation warranted by low rainfall and power cuts that prevailed throughout the country (SLSEA, 2017).

It was visible that, huge quantity of the air emissions was due to electricity usage, and within the five years, this intensified with the increasing thermal factor in the grid electricity supply. The total amount of electricity generated during 2017 was 15,004.2 GWh out of which 69% was from thermal plants, mainly owing to the decrease in hydro power generation warranted by low rainfall (SLSEA, 2017).

Despite the attention of global researchers on the impacts of climate change, carbon emissions of the hotels in developing countries remain to be a less explored domain (Abeydeera, Hewage and Karunasena, 2019). A case study for Carbon emissions of hotel operations in five hotels in the Colombo suburb also indicated the use of purchased electricity as the dominant source of carbon emissions (Abeydeera, Hewage and Karunasena, 2019). Dalton, Lockington, and Baldock, (2008) report that GHG emissions produced by hotels can be reduced by adopting different methods including implementation of energy efficiency measures and production of power by renewable energy supply initiatives and technologies.

Water and wastewater

Hotel F has the lowest water intensity and a continuous progress against the baseline even though it has the highest absolute values. F is the only hotel which depends

solely on national water supply for the water requirement and they are being charged at the commercial tariff for water utilities even though it is a comparatively low price. However, hotels that acquire water from ground sources have higher water intensities. It is perceived that water comes to them at a zero price, when extraction and treatment costs are omitted, even though they are indirectly paying for the water by the use of electricity and chemicals/consumables for water treatment (Ratnayake and Miththapala, 2011).

Hotel E, the only three-star hotel under the study did not have any water records, given that they have very old underground pipelines which are difficult to access. Most of the hotels do not maintain monthly records for water consumption. Situation is more prevalent when source of water is ground water (Wickramasinghe, 2016). Further this remains a barrier in taking necessary water management decisions. Sub-metering of water usage dedicated to each unit could have been an ideal way of collecting data for different sections of a hotel which could help identifying problem areas. Hotel B and D had covered almost 85% of sub-metering yet has not achieved full coverage.

The analysis of water consumption in hotels shows different correlations between hotel characteristics and water consumption. Luxury level, climate and even the no of employees can affect a hotel's performance. No two hotels, even if they are classified together, will therefore be the same (Charara *et al.*, 2011).

Being in the tropics, Sri Lanka is blessed with adequate water resources, yet with issues related to quality. However, expansion of tourist hotel industry has been identified as a culprit to overconsumption of ground water (IFC, 2013). Water consumption, per guest, in a hotel can be around three times that of the average consumption of a person staying at home (Barberán *et al*., 2013). One strategy that the hotel sector could follow, but currently is not evident too frequent is to check on water footprint. Water conservation practices including rain water harvesting, dual flush toilets, low flow showers and taps, paddle and sensor taps were available in many hotels under investigation, but level of the application differed. In some hotels water conservation measures were limited for public areas, while hotel A, B and D has these in guest rooms as well. These practices will not reduce the satisfaction of guests as the feeling of the water on the body and not the actual quantity of water provides the satisfaction (Ratnayake and Miththapala, 2011). Yet a detailed water audit should be carried out to judge the level of application. In order to conserve water, linen and towel reuse policy is practiced in most hotels. But during the visitor surveys some guests complained that even though they were asked to place a card

marking their preference on reusing items the towels were replaced regularly. Some guests indicated that they were not even given such a choice. In majority of cases water conservation programmes were not popular among guests and/or not adhered by the staff. However, hotel F demonstrated some innovative practices, one being collecting left over water and ice from the restaurant then feeding it to fish tanks.

Proper investigations on influent and effluents of sewage treatment plants were not available in any hotel. Only three hotels reused their wastewater for irrigation purposes, which is a positive sign that hotels are at least conscious about water. Hotel B used wastewater for toilet flushing. In the treatment process hotels had mixed their grey and black water together causing mildly contaminated water from laundry and shower areas to get mixed with highly contaminated kitchen water. Some hotels use oil traps to remove lipid contents. None of the hotels had efficient treatments plants, and even if present most of them were built over ten years back. The amount of water used directly influences the amount of wastewater generated and treated. Therefore, reducing consumption, using separate treatment methods for each wastewater type and sub metering can be suggested as measures to reduce the burden of wastewater treatment.

Water bills represent less than 5% of the annual expenses of all hotels. Low levy for water is one major reason that the hotels pay less attention to water conservation compared to energy saving. In competitive business climate, record keeping on resource use such as water gets low priority and in all hotels investigated water usage is handled by the engineering department. But in Sri Lankan context most of the small hotels have no such department neither any commitment towards record keeping or reducing consumption. This was clearly recognized in the preliminary stage, when choosing hotels to carry out the research.

Material usage and waste generation

The information under this category was gathered from semi structured interviews with house-keeping officers. Some highlighted that branding requirements and hygienic issues complicated the situation; for example, some guests are not satisfied with having amenity dispenses rather than their own bathroom kits. Separate toiletries, disposable cutleries are causing much burden. Even guests leave bedside slippers provided to them which cannot be reused though they were in good conditions and just being added to the waste. Some hotels go for paper straws or no straws campaigns which can create huge behavioral changes with a little effort.

Sustainable purchasing policies of hotels were analyzed, and they all promote buying from local suppliers, buying green products and recycling materials. Interestingly Hotel B had a paper recycling center inside the property where they used to recycle newspapers and office papers along with elephant dung to create writing pads to be used in guest's rooms. This has caught a lot of guest attraction and appreciation.

Every hotel categorizes their waste and have composting in their sites as well. Growing and raising organic food was also seemed as a very positive trend. Only hotels A, B, C and F had continuous data on waste segregation and especially on wet waste which is mainly food refuse. Every hotel sends their food waste to piggeries. Hotels A, B and C had demonstrated their efforts towards achieving sustainable waste management practices.

Conclusion

RECP approach was proven to be an effective tool in assessing and quantifying a hotel's sustainability efforts. The study reveals that energy intensity can increase with luxury (star) level. Imbalances in national grid supply can affect the energy productivity and air emission intensities of hotels. Air emissions have been attributed heavily by electricity usage, which is intensified with increasing thermal factor in the grid electricity. Hotels that utilize water from national water supply for a tariff are more "water-conscious" than hotels using ground water. In all hotels, the highest number of measures was adopted towards energy conservation due to the high cost factor. Record keeping on wastewater and material usage was very poor in all hotels. In this context, a national level appropriate benchmarking and adequate record keeping are of prime importance in order to attain sustainability and inclusive development in the hospitality sector. Further cleaner production is identified as a systematic methodological pathway to achieve environmental sustainability. The findings of this study could be transferable to many developing countries and countries that are undergoing transition as this approach is specially developed focusing the advancement of sustainability practices in the above mentioned context.

References

Aall, C., 2011. Energy use and leisure consumption in Norway: An analysis and reduction strategy. *Journal of Sustainable Tourism*, *19*(6), pp.729-745.

Abeydeera, U.W., Hewage, L. and Karunasena, G., 2019. Carbon Emissions of Hotels: The Case of the Sri Lankan Hotel Industry. *Buildings*, *9*(11), p.227.

Almeida, C.M.V.B., Bonilla, S.H., Giannetti, B.F. and Huisingh, D., 2013. Cleaner Production initiatives and challenges for a sustainable world: an introduction to this special volume.

Barberán, R., Egea, P., Gracia-de-Rentería, P. and Salvador, M., 2013. Evaluation of water saving measures in hotels: A Spanish case study. *International Journal of Hospitality Management*, *34*, pp.181-191.

Bramwell, B. and Lane, B., 2008. Priorities in sustainable tourism research. *Journal of Sustainable Tourism*, *16*(1), pp.1-4.

Buckley, R., 2012. Sustainable tourism: Research and reality. *Annals of tourism research*, *39*(2), pp.528-546.

Charara, N., Cashman, A., Bonnell, R. and Gehr, R., 2011. Water use efficiency in the hotel sector of Barbados. *Journal of Sustainable Tourism*, *19*(2), pp.231-245.

Climate Change Secretariat Ministry of Mahaweli Development and Environment. 2016. *A guide for carbon footprint analysis.*

Dalton, G.J., Lockington, D.A. and Baldock, T.E., 2008. A survey of tourist attitudes to renewable energy supply in Australian hotel accommodation. *Renewable energy*, *33*(10), pp.2174-2185.

Font, X., 2002. Environmental certification in tourism and hospitality: progress, process and prospects. *Tourism management*, *23*(3), pp.197-205.

Fresner, J., 1998. Cleaner production as a means for effective environmental management. *Journal of cleaner production*, 6(3-4), pp.171-179.

Gavrilescu, M., 2004. Cleaner production as a tool for sustainable development. *Environmental Engineering and Management Journal*, *3*(1), pp.45-70.

Gómez, D.R., Wattersson, J., Americano, B.B., Ha, C., Marland, G., Matsika, E., Namayanga, L., Osman, B., Saka, J. and Treanton, K., 2006. Stationary combustion. *Energy, 2006 IPCC Guidelines for National Greenhouse Gas Emissions Inventories*, Intergovernmental Panel on Climate Change, Geneva.

Gössling, S., 2000. Sustainable tourism development in developing countries: Some aspects of energy use. Journal of sustainable tourism, 8(5), pp.410-425.

Gössling, S., 2002. Global environmental consequences of tourism. *Global environmental change*, *12*(4), pp.283-302.

International Finance Corporation. 2013. *Ensuring Sustainability in Sri Lanka's Growing Hotel Industry*.

Kjaerheim, G., 2005. Cleaner production and sustainability. *Journal of cleaner production*, 13(4), pp.329-339.

Lee, K.F., 2001. Sustainable tourism destinations: the importance of cleaner production. *Journal of Cleaner Production*, 9(4), pp.313-323.

Mihalič, T., Žabkar, V. and Cvelbar, L.K., 2012. A hotel sustainability business model: evidence from Slovenia. *Journal of Sustainable Tourism*, *20*(5), pp.701-719.

Miththapala, S., Jayawardena, C. and Mudadeniya, D., 2013. Responding to trends: Environmentally-friendly sustainable operations (ESO) of Sri Lankan hotels. *Worldwide Hospitality and Tourism Themes*, *5*(5), pp.442-455.

Perera, H.L.N. and Pushpanathan, A., 2015. Green marketing practices and customer satisfaction: A study of hotels industry in Wennappuwa divisional secretariat. *Tourism, Leisure and Global Change*, *2*(1), pp.13-29.

Ratnayake, N. and Miththapala, S., 2011. A study on sustainable consumption practices in Sri Lankan hotel sector. In *Civil Engineering Research for Industry–2011, Department of Civil Engineering, University of Moratuwa, Sri Lanka. Available at: http://www. civil. mrt. ac. lk/conference/raghu/21. pdf*.

Sáez-Martínez, F.J., Lefebvre, G., Hernández, J.J. and Clark, J.H., 2016. Drivers of sustainable cleaner production and sustainable energy options. *Journal of cleaner production*, 138, pp.1-7.

Severo, E.A., de Guimarães, J.C.F., Dorion, E.C.H. and Nodari, C.H., 2015. Cleaner production, environmental sustainability and organizational performance: an empirical study in the Brazilian Metal-Mechanic industry. *Journal of Cleaner Production*, 96, pp.118-125.

Sri Lanka Sustainable Energy Authority. 2016. *Energy Consumption Benchmark Analysis*. Sri Lanka Sustainable Energy Authority, Colombo, Sri Lanka.

Sri Lanka Sustainable Energy Authority. 2017. *Sri Lanka Energy Balance 2017*. Sri Lanka Sustainable Energy Authority, Colombo, Sri Lanka.

Sri Lanka Tourism Development Authority. 2018 *Annual Statistical Report – 2018.*

Stylos, N. and Vassiliadis, C., 2015. Differences in sustainable management between four-and five-star hotels regarding the perceptions of three-pillar sustainability. *Journal of Hospitality Marketing & Management*, *24*(8), pp.791-825.

Tosun, C., 2001. Challenges of sustainable tourism development in the developing world: the case of Turkey. Tourism management, 22(3), pp.289-303.

UNIDO and UNEP. 2010. *Enterprise-Level Indicators for Resource Productivity and Pollution Intensity.* United Nations Industrial Development Organization and United Nations Environment Programme, Vienna, Australia/ Milan, France.

UNWTO.org. 2020. *Hotel Energy Solutions (HES) | UNWTO*. Available at: <https://www.unwto.org/hotel-energy-solution> [Accessed 11 October 2020].

Wickramasinghe, K., 2016. *Adoption of environmental management practices in the hotel industry in Sri Lanka*. South Asian Network for Development and Environmental Economics (SANDEE), Kathmandu, Nepal.

World Travel and Tourism Council. 2019. *The Economic Impact of Travel & Tourism*. World Travel and Tourism Council. United Kingdom.

Yfantidou, G. and Matarazzo, M., 2017. The future of sustainable tourism in developing countries. Sustainable development, 25(6), pp.459-466.

Zhang, H., Zhang, Y., Song, Z. and Lew, A.A., 2019. Assessment bias of environmental quality (AEQ), consideration of future consequences (CFC), and environmentally responsible behavior (ERB) in tourism. *Journal of Sustainable Tourism*, *27*(5), pp.609-628.

Zografakis, N., Gillas, K., Pollaki, A., Profylienou, M., Bounialetou, F. and Tsagarakis, K.P., 2011. Assessment of practices and technologies of energy saving and renewable energy sources in hotels in Crete. *Renewable Energy*, *36*(5), pp.1323-1328.

Zurburg, R., Ruff, D. and Ninemeier, J., 1995. Environmental action in the United States lodging industry. *Hospitality & Tourism Educator*, *7*(2), pp.45-49.

Appendix A - Utilization of basic Green and CP practices

	Green practice		**Hotel**					
			A	B	C	D	E	F
ENERGY	Energy saving bulbs							
	Occupancy sensors							
	Key cards to control	Light						
		A/C						
	Use renewable energy sources							
	Gasifiers to generate energy for laundry							
WATER	Low Flow Toilets	Toilet flushing	Duel Flushing					
		Showerheads	9.5 lpm			10 lpm		
	Faucets		5 lpm	5 lpm		5 lpm		
	Water saving devices							
	Sewage treatment plant for waste water treatment							
	Sheets and towels changed Upon Request Only		Low utility				Low utility	
MATERIAL	Amenity dispensers	Public areas						
		Guest rooms						
	Recycling policy							
	Limited paper-based marketing materials							

	Recycling the materials							
SOCIAL	Recruit & hire local people for Jobs		58%	54%		60%		
	Purchase from local suppliers							
	Use green products for business							
	Grow or raise organic foods							
	Composting of waste							
	Establish Environmental education programmes for visitors							
	CSR projects							
	Hotel building	Green building						
		Retrofit projects						

(lpm – liters per minute)