Environmental Conservation, Clean Water, Air & Soil (CleanWAS)

International Conference Proceedings 26-28 August, 2016, China

IWA PUBLISHING

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Published by

IWA Publishing
Alliance House
12 Caxton Street
London SW1H 0QS, UK
Telephone: +44 (0)20 7654 5500
Fax: +44 (0)20 7654 5555
Email: publications@iwap.co.uk
Web: www.iwapublishing.com

First published 2017

British Library Cataloguing in Publication Data
A CIP catalogue record for this book is available from the British Library

ISBN 9781780408156 (Paperback)
ISBN 9781780408163 (eBook)

Evaluation of carbon reduction through integration of vertical and horizontal landscape design for hotel premises

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ABSTRACT

The excessive reliance of fossil fuels and carbon production from daily appliances especially in tourism accommodation premises could cause detrimental impact to the surrounding environment. This is due to the increase of carbon emissions which is one of the major contributors for greenhouse effect especially in urban areas. In order to alleviate the carbon footprint by those premises, one of the promising methods to reduce carbon dioxide emission to the atmosphere is by selecting an appropriate plant species as well as optimization of spatial organization of plant materials. Besides character of the plant materials, criteria such as locality, age, diameter and height are very much influenced the carbon sequestration rate. This study established that even with limited green space areas for tourism accommodation premises such as hotel, the carbon sequestration rate can be further increased with the right selection of plants, at the right place with the right design. Therefore this study aimed to monitor, calculate and predict how much carbon can be absorbed by proposed plant species at certain period of time. The significance outcomes of this study will be green approach to monitor and sequester carbon toxicity using plant species also a novel landscape design approach to neutralize carbon emission which is cost effective and environmental friendly.

Keywords: Carbon emission, carbon sequestration, greenhouse effect, plant materials, accommodation premises

1 INTRODUCTION

The purpose of this paper is to discuss the strengths and weaknesses of the current carbon calculator methodology, to point out review key findings for improvement of the research and to suggest potential calculation and modelling system applications to a specific Tourism Accommodation Premises (TAP) building. As projected by the Intergovernmental Panel on Climate Change (IPCC), the global

temperatures would rise between 1 and 6°C by the end of this century (March *et al.* 2010). Global warming is causing climate changes that are foreseen to have severe consequences to humanity and environment quality (EPA 2013).

Global warming is the current main threat to the environment which if it is not treated cautiously will cause severe environmental impact. Between 1984 and 2004, carbon dioxide emissions in the whole world have increased by 43 percent, with an average annual increase of 1.8 percent (Peréz-Lombard *et al.* 2008). IPCC recognized that the building sector has the greatest economic mitigation potential for reduction of GHG emission as these buildings are dominant energy consumption particularly in developed and developing countries.

Carbon audit, is a life cycle assessment tool which can be used for revealing the major sources and amounts of GHG emissions, thus it can identify appropriate targets and opportunities for reducing the emissions from buildings (European Commission, 2009). Research and guidelines have been developed worldwide for promoting carbon footprint and audits, but an extensive review of their key features is not available yet. Among the research explored are the determination of carbon emissions based on simulated building energy consumptions (Kneifel, 2010); a modeling approach described by Pekala (2010) for optimal planning of energy systems subject to carbon and land footprint constraints; and preliminary comparison of the carbon footprints of 12 metropolitan areas (Sovacool & Brown, 2010). Studies which investigate into carbon emissions based on in-depth field data of individual buildings, on the other hand, could not be found from the open literature (Joseph *et al.* 2012).

Recently, public interest in climate change and environmental issues has increased due to current ecological phenomena. These distresses has alarmed the management team of each specific industry. Singapore and Hong Kong, hotels are among the energy-intensive building categories (Deng & Burnett, 2000; Lai & Yik, 2008; Priyadarsini *et al.* 2009). The predicted amount of carbon emissions due to energy use in the hotel industry is significant (Chan & Lam, 2002). Carbon footprint report and audit for specific hotel building is still an ambiguous phase among these hoteliers. Deficient of such crucial information, hoteliers and managers are not alert if the carbon emissions from their facilities has already reached hazardous rate. Carbon sequestration is defined as the process of capture and long-term storage of atmospheric CO_2 (Sedjo & Sohngen, 2012). This is an important mitigation option to reduce the largest portion of GHG (Green House Gasses) emissions (such as CO_2) (). The role of plants and trees in carbon sequestration in urban area is probably best understood and appears to offer the greatest opportunity as a carbon sink (Mandlebaum & Nriagu, 2011). The role of plants and trees in carbon sequestration in urban area is probably best understood and appears to offer the greatest opportunity as a carbon sink.

As this paper aims to explore the role of plant materials in TAP carbon neutrality, therefore literature reviewing towards previous studies and research of carbon offsetting within the hospitality industry will be conducted. Current carbon sequestration rate and emission calculator methodology deficient from the review will be the main research gap. Prior to the research knowledge gaps in view, suggestions and further recommendation will be listed in order to assist the hoteliers and all stakeholders in managing their TAP carbon emission rating.

2 RESULTS AND DISCUSSION

2.1 Case study at Empayar Muzafar hotel, Melaka

Table 1 shows the vegetation details of Empayar Muzaffar Hotel plant materials. The carbon sequestration value for each species of the vegetation was identified. After calculate the sequestration value of each plant species and categories, a graph that combined the finding value for further evaluation has be made. Graph below indicate the relationship between plant categories and total carbon that can be sequestrate by them.

Table 1 List of plant materials and carbon sequestration value of Empayar Muzaffar Hotel, Melaka.

Species	Overall Height/feet	Total Diameter/inch	Age	Quantity	CSR/tCO_2e
Tree					
1. Baekea frutescen	6.56	11.81–27.56	28 year	11	5.95
2. Bucida molineti	6.56–9.84	11.81–19.69	20 year	32	13.24
3. Dalbergiacochinchinensis	6.56 – 9.84	19.69–27.56	28 year	26	21.09
4. Plumeria alba	6.56	19.69–27.56	28 year	5	2.70
Palm					
1. Cocos nucifera	9.84	3.94–7.87	8 year	18	1.98
2. Livistoniarotundifolia	9.84–13.12	3.94–5.91	6 year	11	0.68
3. Roystoneaoleracea	9.84–13.12	3.94–5.91	6 year	40	2.49
Shrub					
1. Muraraya paniculata dwarf	0.66	0.59	1 year	2190	0.09
2. Phyllanthus myrtifolius	0.66	0.79	1.5 year	2320	0.17
3. Cyathealatebrosa	3.28	0.59	1 year	58	0.01
4. Jasminummultiflorum	1.31	0.39	1 year	650	0.02
5. Philodendron selloum	1.31	0.47	1 year	525	0.03
6. Thunbergia grandiflora alba	0.66	0.79	1.5 year	150	0.01
7. Wrightiaantidysenterica	1.31	0.79	1.5 year	750	0.09

From Fig. 1, it can be depicted that the highest value that can be sequestrated is from the tree categories. Total carbon sequestration that occurs among tree species at this hotel is 42.98 tCO_2e. The number is extremely high if compared to the palm and shrubs categories which are 5.15 tCO_2e and 0.43 tCO_2e respectively. At this particular premise, the reason trees is the dominant CSR agent is because the trees specification such as age, diameter and height proposed are very much influencing their CSR ability as they have a higher specification compared to other species. This research outcome proved that the diameter and the height of the plant materials are playing the important roles in this premise CSR. From the analyzed data above, it can be concluded that although built up area is higher than green area, the total carbon sequestration is still high and is needed in a tourism premises. All the total carbon sequestration that occurred at the hotel are sequestrated among the existing plant materials that contained in the green area of the hotel.

2.2 CSR by plant materials with application of horizontal and vertical landscape design

The findings suggest that, more percentage of green areas in the hotel, the total CSR for the hotel will be much greater. In addition, when more varieties of vegetation types are proposed, the CSR is will increase. Besides character of the plant materials, criteria such as the diversity of plant materials age, diameter and height are very much influenced the carbon sequestration rate. Interestingly, Empayar Muzaffar Hotel's most CSR is done by trees which sequester approximately 43 tCO_2e.

The variance between the ability of different types of plant materials to sequester carbon differs greatly although when referring back to Table 2 there are similarities in CSR of some of the trees, palms and

shrubs species due to different grades the plant materials are. As the trees are older, the greater carbons are being absorbed by it and stored in the matured and bigger tree trunks and branches. The shrub selection for landscape design in Empayar Muzaffar Hotel specifically using the first grade shrubs in their hotel allowing the optimum rate of SCR to be achieved.

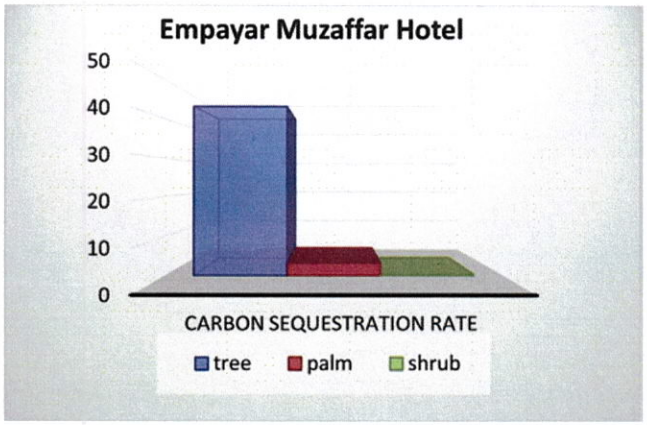

Figure 1 Carbon sequestration rate based on types of plants.

Table 2 Distribution of carbon sequestration rate by types of plants.

Type	Value/tCO_2e
Trees	42.98
Palms	5.15
Shrubs	0.43

Factors influencing the total CSR of the hotels are most probably due to:

a) The specs of vegetation (tree height, diameter, and age)
b) The choice of plant materials in landscape design
c) The quantity of prominent vegetation type which sequester the most.
d) The percentage of allocated green area for the premise
e) The landscaping design of the premise

3 CONCLUSION

This research suggests that a hotel and resort that implementing environmental strategies can increase business for hotel industries. To sustenance the research aim, among major contribution of this research are it refine and upgrade existing calculations which only focuses on the field specialist to make accessible to laymen with no professional background. Thus, this research also will address the above mentioned gaps by developing

manuals for new carbon sequestration rate assessments at the regional and local level. This validate that the carbon sequestration modelling system is a must have tool for all TAP managers. The suggestions given on how the research gaps can help conduct smoother and more proper TAP carbon audits in future. When more plant materials audit results are made available, a database of carbon emission benchmarks can be established. Future direction of this research should bring plant materials based on landscape design as a key performance indicator of facilities management at TAP. These key performance guidelines will assist facilities managers in increasing green spaces at their TAP buildings to ensure they comply with the sustainable building development policy.

4 ACKNOWLEDGMENTS

The authors would like to thanks Ministry of Higher Education (MOHE) and International Islamic University Malaysia (IIUM) for the Research Grant NRGS13-002-0002.

5 REFERENCES

Chan W. W. and Lam J. C. (2002). Prediction of pollutant emission through electricity consumption by the hotel industry in Hong Kong. *International Journal of Hospitality Management*, **21**, 381–91.

Deng S. and Burnett J. (2000). A study of energy performance of hotel buildings in Hong Kong. *Energy and Buildings*, **31**, 7–12.

European Commission (2009). Carbon footprint – what it is and how to measure it. See http://lct.jrc.ec.europa.eu/ (accessed 10 October 2009).

Future Climate Change. (2013). See http://www.epa.gov/climatechange/science/future.html (accessed August, 2013).

Intergovernmental Panel on Climate Change (2007). Climate Change 2007: Synthesis Report, Intergovernmental Panel on Climate Change, Geneva.

Joseph H. K., Lai Francis W. H. and Yik C. S. Man (2012). Carbon audit: a literature review and an empirical study on a hotel. *Facilities*, **30**, 417–431.

Kneifel J. (2010). Life-cycle carbon and cost analysis of energy efficiency measures in new commercial buildings. *Energy and Buildings*, **42**, 333–40.

Lai J. H. K. and Yik F. W. H. (2008). Benchmarking operation and maintenance costs of luxury hotels. *Journal of Facilities Management*, **6**, 279–89.

Mandlebaum S. and Nriagu J. (2011). Carbon sequestration and agriculture. *Encyclopedia of Environmental Health*, **1**, 198–504.

Marsh R., Larsen V. G. and Kragh M. (2010). Housing and energy in Denmark: past, present, and future challenges. *Building Research & Information*, **38**, 92–106.

Pekala L. M., Tan, R. R., Foo, D. C. Y. and Jeżowski, J. M. (2010). Optimal energy planning models with carbon footprint constraints. *Applied Energy*, **87**(6), 1903–10.

Pérez-Lombard L., Ortiz J. and Pout C. (2008). A review on buildings' energy consumption information. *Energy and Buildings*, **40**, 394–8.

Priyadarsini R., Wu, X. and Lee, S. E. (2009). A study on energy performance of hotel buildings in Singapore. *Energy and Buildings*, **41**, 1319–24.

Sedjo R. A. and Sohngen B. (2012). Carbon sequestration in forests and soils. *Annual Review of Resource Economics*, **4**, 127–144.

Sovacool B. K. and Brown M. A. (2010). Twelve metropolitan carbon footprints: a preliminary comparative global assessment. *Energy Policy*, **38**, 4856–69.

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As we embark into the 21st century, we need to address new challenges ranging from population growth, climate change, and depletion of natural resources to providing better health care, food security and peace to humankind, while at the same time protecting natural ecosystems that provide the services which allow life to flourish on Earth. To meet those challenges, profound changes are required in the way that societies conduct their everyday affairs, ways that will lead to better preservation, protection and sustainable management of natural resources with long lasting impacts.

The aim of CleanWAS 2016 is to provide productive opportunities for academics and practitioners from interdisciplinary fields of Environmental Sciences to meet, share and bring expertise and ideas in related disciplines.

The CleanWAS conference was first organized in the year 2012. It is an annual event organised by the International Water, Air and Soil Conservation society (INWASCON) and is supported by various Malaysian (UKM, UMS, UIAM) and Chinese universities (CUG, NKU, SYSU).

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ISBN: 9781780408156 (Paperback)
ISBN: 9781780408163 (eBook)

ISBN 978-1-78040-815-6
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9 781780 408156