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A SUSTAINABLE CARBON FOOTPRINT ANALYSIS FOR THE CITY OF KUANTAN, PAHANG MALAYSIA

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Abstract

Carbon footprint is one of the critical elements in assessing the level of sustainability of an urban area or forest area. Cities are a vital contributor to climate change with 75 percent of global carbon emissions are from cities. Transportation, buildings and urban activities are among the most critical contributors of greenhouse carbon emission globally. The study aims to identify the current condition of total carbon produced in the study area. Geospatial and observation approaches with social distance and standard operation procedure were used during the data collection and fieldwork at the study area. Mapping analysis and survey were used to analyse the activities conducted and the carbon consumption level by visitors of the area. Preliminaries' findings indicate that the visitors' activities and carbon consumption were high within the existing green area at Esplanade Kuantan, Pahang.

Keywords: Kuantan, Carbon Footprint, Esplanade Recreational Park

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INTRODUCTION

Climate change has been recognised as the most pressing environmental problem the world will face in the 21st century (Tangang et al., 2012), including in Malaysia. The most affected areas are cities and urban areas with various human activities and rapid physical development that contributed to the rise in global warming and increase in the greenhouse gas emissions. Cities are responsible for 75 percent of global CO_2 emissions, with transportation, concrete buildings and human activities among the most critical contributors (UNEP, 2020). The article will describe the various programmes and initiatives undertaken in the city of Kuantan, situated in the state of Pahang, in addressing the carbon usage in the city. Pahang is the third largest state in Malaysia, with a population estimated at 7.1 million people, and the City of Kuantan is the capital city of the state. According to the State Pahang government (2020), the Kuantan City population was estimated at 341,000 people and the City Council administrative physical area covered around 341 km square with four Mukim, namely Kuala Kuantan, Ulu Kuantan, Beserah, and dan Sungai Karang (MBK, 2021). Kuantan was gazetted as a city status on 08 August 2019, many initiatives and programmes were carried out to minimise the carbon footprint of the city with the provision of green areas as one of the main initiatives undertaken by the local authority.

RESEARCH BACKGROUND

Carbon footprint is defined as the demand for biocapacity required to sequester (through photosynthesis) the carbon dioxide emissions from fossil fuel combustion (ScienceDirect, 2013). Controlling carbon footprint is an essential aspect nowadays with some countries using this approach to ensure urban development's sustainability. The carbon footprint levels of a city can be controlled and minimised with the planting of certain trees or plants and the increase of planned green spaces in the area. However, there is a limited open space in Kuantan city which can be a challenge to reduce the carbon footprint of the area. Certain plants and trees that can control carbon absorption have been increasingly popular in residential areas, which can improve air quality and reduce air pollution and greenhouse gases (Franek & Jarský, 2021; Shishegaran et al., 2020). For Kuantan, air quality has become one of the most crucial elements in improving the city's image as a sustainable city in Malaysia. Therefore, a simple indicator yet practical approach is by identifying existing planted trees around the city in terms of CO_2 absorption ability.

Generally, table 1 indicates CO_2 absorption ability according to the individual plant. Samanea saman is known as 'hujan-hujan', with a daily CO_2 absorption of 28,448.39 at the highest daily absorption compared to other plants. The CO_2 absorption by the plant will be used as the primary approach in the estimation of the calculation of air quality in the study area.

Table 1: CO_2 Absorption Ability According to the Plant

No	Scientific Name	Local Name	CO_2 Absorption Capacity (Kg/Tree/Day)
1	Samanea saman	Trembesi (Hujan-Hujan)	28,448.39
2	Cassia Cassiasp	Cassia (Golden Shower)	5,295.47
3	Canangium odoratum	Kenanga	756.59 4
4	Dysoxylum excelsum	During	720.49 5
5	Ficus benyamina	Beringin	535.9
6	Fellicium decipiens	Dlium Kerai payung	404.83
7	Pornetia pinnata	Longan	329.76 8
8	Swettiana mahagoni	Mahagoni	295.73
9	Adenanthera pavoniana	Saga	221.18

Source: Nurul Akmar & Mastura, (2017)

METHODOLOGY

Quantitative research methods with Geospatial and survey analysis were used to identify the CO_2 status in the study area. In terms of Geospatial analysis, calculation was made based on the trees covered area which indicates by the green space provision. As for the ground survey data collection method, visitors' form was used to calculate the volume of visitors daily from 8.00 am to 10.00 pm. Visitors' presence was crucial for the study, as each visitor can contribute to the calculation of CO_2 emissions. According to Grey & Deneke (1978) and Idris et al. (2017), the carbon produced by the respiration of the population in each zone can be calculated based on the assumption that the production of CO_2 by humans are the same, which is 0.3456 tons of CO_2/human/year. Fitting the study that emphasises people who visit the park, the formula modification made to the name of the variable as shown below:

$$P = J_p \times C_{visitor}$$

Where,

P = Total CO_2 emissions from the population (tons/year)
J_p = Total population (visitor)
$C_{visitor}$ = Total CO_2 produced by humans which is 0.3456 (ton/human/year)

While the CO_2 absorption capacity is based on Table 2 as indicated by (Prasetyo, Do, & Do 2002) and agreed by Idris et al. (2017) with three types of plants with CO_2 absorption ability, namely tree, bushy and meadow.

Table 2: CO_2 Absorption Ability According to the Type of Plant

No	Type of Plant	CO_2 Absorption Capacity (Kg/Ha/Day)	CO_2 Absorption Capacity (Ton/Ha/Year)
1	Tree	1559.1	569.07
2	Bushy	150.68	55.00
3	Meadow	32.88	12.00

Source: Idris et al., (2017) and Prasetyo, Do, & Do, (2002)

For this study, due to limited time and budget constraints, Esplanade Kuantan, Kuantan River Front Park & Taman Rekreasi were selected as the areas to collect the visitor data and used to calculate the carbon footprint analysis. The areas were selected as this area has been used as a recreational area and many residents of Kuantan were familiar with this area,

ANALYSIS AND FINDING

Table 3 indicates the volumes of visitors to the Esplanade Kuantan measured daily for five weeks. The total number of visitors were approximately 5133 within the period of the study. Week 01 indicated the highest percentage at 22.05, followed by week 05 at 21.96 per cent, and for three other weeks, it is below 20.00 per cent. The weekly average of the visitor at 1,027 persons with an average of 147 visitors using the area daily.

Table 3: Average Visitor Daily (08.00-22.00)

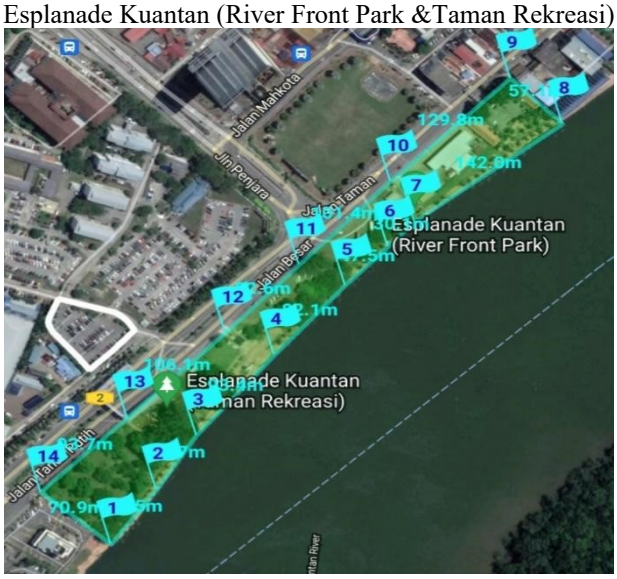
Weekly	The visitor (J_p)	%	$C0_{2/Visitor}$	Total CO_2 (P)
Week 01	1132	22.05	0.3456	391.2192
Week 02	976	19.01	0.3456	337.3056
Week 03	905	17.63	0.3456	312.7680
Week 04	993	19.35	0.3456	343.1808
Week 05	1127	21.96	0.3456	389.4912
Total	5133	100		
Average Weekly	1027		0.3456	354.7930
Average Daily (P_t)	147		0.3456	50.6847

Source: Authors, (2022)

Figure 1 shows the fourteen points of measurement to estimate the width of the study area in hectares. The estimated size for the Esplanade Kuantan

includes River Front Park and Taman Rekreasi. The total area estimate is 2.428 hectares.

Figure 1: Profile Area (2.428ha)
Esplanade Kuantan (River Front Park &Taman Rekreasi)



Source: Author 2022

In terms of geospatial analysis, based on GIS data, the size of the coverage area was identified based on the type of trees planted in the area. Table 4 shows the measurement based on the geospatial map in figure 1 for Esplanade Kuantan. The Estimated covered area is 2.42 hectares, including trees, bushy and meadows. Most of the area covered with canopy trees at 76 percent with CO_2 absorption ability at 1050.09, small trees at 13 percent with CO_2 absorption ability at 17.3602, and 11 percent surrounded by grass or meadow with CO_2 absorption ability at 3.20496.

Table 4: CO_2 Absorption Ability According to the Type of Plant

No	Type of Plant	Area (%)	Area (Ha)	Ability Absorb Co2 (Ton/Ha/Year)	Amount
1	Tree	76	1.84528	569.07	1050.09
2	Bushy (small tree)	13	0.31564	55.00	17.3602
3	Meadow (grass area)	11	0.26708	12.00	3.20496
Total amount CO_2 absorption ability for the area (T_t)					1070.65865

Source: Authors, (2022)

In terms of carbon footprint Analysis, Table 5 indicates the S value is at a lower level and therefore, the CO_2 absorption ability of trees in the study area is considered to be in good condition and considered to be sustainable based on literature review. According to the S values at -1019, the site still has a surplus in visitors at a maximum of 3000 daily.

Table 5: Carbon footprint analysis (S value)

Variable	Description	Total
P_t	Total CO_2 emissions from the population (tons/year)	50.6847
T_t	Total CO_2 absorption ability according to the type of plant (tons/year)	1070.6587
S_{Value}	$P_t - T_t$	-1019.9739

Source: Authors, (2022)

Therefore, the green area provided by the City Council of Kuantan, namely Esplanade Kuantan, is significantly sufficient for the needs of visitors and the surrounding environment.

CONCLUDING REMARK

In general, CO_2 absorption ability needs to be introduced based on policies of the local authority in order to improve the air quality level in the city. For Kuantan City, the esplanade, RiverFront Park and Taman Rekreasi provide ample green spaces that can significantly control or reduce the CO_2 emission with higher absorption capacity. Based on the study, it is recommended that specific trees with prominent leaf characteristics, such as *Terminalia catappa* or 'ketapang' and Samanea saman or Trembesi that have the capacity to absorb high carbon dioxide should be planted in various part of city areas in order to improve the rate of carbon dioxide absorption created by various human activities.

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