

## Measurement of Carbon Di-Oxide Emissions for Ecotourism in Malaysia

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**Abstract:** Tourism sector is one of the main sources of carbon emission. The transportation uses in tourism is the major contributor for energy consumption and carbon emission. Malaysia gives emphasize on ecotourism for tourism development. There are 42 recreational forest areas situated in East Coast Economic Region (ECER) of Malaysia. The aim of this study is to measure the carbon di-oxide emissions from Sekayu recreational forest in Terengganu by tourists. The study highlights the considerable issues and policies of carbon emissions in the forest by ecotourism activities. The study considers only the carbon emissions from transportation sector. The used vehicles of the local tourists have been used to measure the carbon emissions. The study shows that carbon emissions from bus and motorcycles are lower than small car and big car. The study suggests that some initiatives can be taken for low carbon emissions in this ecotourism destination. Those are low carbon technologies, sustainable tourism, Low carbon tourism consumption, paid carbon taxes, government and tour operator initiatives, institutional facilities development and tourism friendly traffic system. The ecotourism destinations, government, tour operator and tourist are trying to reduce carbon emission by improving and changing their transportations use and other service system. Finally, Malaysian government should develop linkage with international organizations for developing low carbon ecotourism in ECER.

**Key words:** Carbon emission • Ecotourism • ECER • Sekayu recreational forest • Transportation

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### INTRODUCTION

The increasing of CO<sub>2</sub> in the environment occur significant climate changes in the world [1]. The use of energy resources is the main cause for CO<sub>2</sub> emissions [2]. Many countries in the world give emphasize on carbon emission from various sectors of their economies. They are adopting various programs for minimum carbon emission from their economic development activities. The researchers in environmental issues give emphasize on quantitative measurement of carbon emission in tourism industry. They [3] explored Life Cycle Assessment (LCA) to measure carbon emissions of tourism on transportation, accommodation and recreation activities. They [4] found that tourists are responsible for 4.4% of global CO<sub>2</sub> emissions and the emissions are increase at an average rate of 3.2% per year up to 2035.

According to the World Trade Organization, tourism is the biggest industry in the world now. [5] 11.5% of global gross domestic product (GDP) is depending on tourism and this sector creates employment for 200 million people. This employment is 11% of the world's total workforce [6]. Tourism sector is one of the main sources of carbon emission. This industry can develop the economy of a country. But at the same time, energy consumption and carbon emission also associated with the industry [7]. The transportation uses in tourism industry is the major contributor for energy consumption and carbon emission. The transportation, shopping, food, entertainment and other services of tourist can increase the carbon emission in an area [8]. They [9] proposed that transportation sector is contributing 65–73% of the total energy consumption in the world. Most of international tourists are visiting tourism destinations by the civil

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aviation. In a report of Intergovernmental Panel on Climate Change (IPCC) estimated that aviation accounts for 2–3% of the world’s total use of fossil fuels, with more than 80% consumed by civil aviation [10].

Ecotourism is one of the boosting and potential tourism segmentation in the world today. Many developed and developing countries build up their economic advancement by using the tourism segmentation [11]. Malaysia has captured 16th position in terms of tourism receipt which is 2% of global market share in 2008. This industry has employed 1.7 million people or approximately 16% of total employment of the country in 2008 [12]. Malaysia gives emphasize to ecotourism for tourism development in the country wide. The country has formulated separate plan for sustainable ecotourism development in the country. The Ministry of Culture, Arts and Tourism has formulated “The Malaysian National Ecotourism Plan”. The Plan was drafted in 1995 and was accepted by the government in 1996. This plan ensures conservation of Malaysia’s natural and cultural heritage with the proper ecotourism development [12].

The East Coast Economic Region (ECER) consists of three states in Malaysia- Kelantan, Terengganu, Pahang and District of Mersing in Johor. The economic region established under an Act of Parliament. There are 42 recreational forest areas situated in this region. These recreational forests are suitable and potential for ecotourism development in the region. Sekayu is the largest recreational forest in Terengganu. The forest becomes famous to the tourists’ for its natural beauties and recreational facilities [13]. The aim of this study is to measure the carbon di-oxide emissions from Sekayu recreational forest by tourists through ecotourism activities. The study also highlights the considerable issues and policies of carbon di-oxide emissions in this recreational forest to develop ecotourism.

## MATERIALS AND METHOD

**Sekayu Recreational Forest:** Sekayu Recreational Forest is situated in Terengganu state of Malaysia. It is the largest recreational forest in this state. The forest site has been selected for data collection in the study. It was established in 1974 and officially launched in 1985. It is located within Hulu Terengganu forest reserve at Kuala Berang of Terengganu. The total area of the recreational forest is 30 hectares.

**Data Attainment:** The study is empirical in nature. Both primary and secondary data have been used in the study. The secondary data have collected from the study site office, documents analysis and published materials on ECER. The primary data have been collected through the questionnaire survey from the local tourists who visit the Sekayu. The survey was conducting during the last week of January on 2011. A total of 110 respondents have selected to collect the primary data for the study.

**Methods:** The study considers only the carbon emissions from transportation sector. The used vehicles of the local tourists have been used to measure the carbon emissions. The vehicles are divided into four portions- motorcycle, small car, big car and bus according to the respondents’ feedback. The following formula has used to measure the carbon emission in the study.

$$CO_2E = \sum_m^n FC \times CO_2co$$

Again,  $FC = TD/ DL$

Here,

$CO_2E = CO_2$  Emission

$FC =$  Total fuel consumption

$CO_2co = CO_2$  Co-efficient

$TD =$  Total Distance

$DL =$  Distance per Liter

$n =$  Type of Vehicle

$m =$  Type of Fuel Consumption

Here, total distance is calculation by the distance between tourist’s home state capital and Sekayu. Distance per liter means the vehicles’ movements by per liter fuel. The  $CO_2co$ -efficient of per liter petrol and diesel are 2.3 kg and 2.7 kg respectively [15].

Table 1 represents the distance between respondents’ home state capital and Sekayu. The distance is highest between Johor to Sekayu and lowest in Terengganu to Sekayu. Table 2 shows the fuel consumption of vehicles used by respondents. Motorcycle, small car and big car use petrol as fuel where bus use diesel. Motorcycle, small car and big car are moving 30, 15 and 10 kilometers distance by one liter petrol. On the other hand, bus is moving 8 kilometers distance by one liter diesel.

Table 1: Distance between respondents' home state capital and Sekayu

State	Sekayu Recreational Forest (Km)
Terengganu	39
Pahang	176
Kelantan	205
Selangor	435
Malaka	450
Kedah	497
Johor	535

Source: Google Maps

Table 2: Fuel Consumption by Vehicles (Per liter)

Vehicle Type	Fuel use	Distance per Liter
Motorcycle	Petrol	30 <sup>e</sup>
Small Car	Petrol	15
Big Car	Petrol	10
Bus	Diesel	8 <sup>e</sup>

Source: Autoworld, 2012; e = Estimated by authors.

## RESULTS

Table 3 highlights the domestic tourist arrival in Sekayu Recreational Forest. The total domestic tourists' arrivals were 134,337 and 203,947 in 2006 and 2010 respectively. The annual growth rate of tourists was 7.1% in 2010.

Table 4 reveals the demographic profile of respondents. Most of the respondents (81.8%) are Malay ethnicity while 16.4% are Chinese and 1.8% Indian. In terms of occupation, 60% respondents are students. On the other hand, 24.5% are job holder and 15.5% businessman. In terms of gender, the distribution of sample is 45.5% male and 54.5% female. 71% of the total respondents are single where 29% are married.

Table 5 shows the use of transportations by the respondents according to their home state. Most of respondents from Terengganu (28%) used motorcycle in their visit period while 13.64% used small car and big car.

Table 3: Domestic Tourist Arrival in Sekayu Recreational Forest

Year	Total Tourists	Annual Average Growth Rate (% per year)
2006	134,337	---
2007	181,000	34.7
2008	181,275	0.2
2009	190,465	5.1
2010	203,947	7.1

Source: Sekayu Recreational Forest Site Office, 2011

Table 4: Demographic Profile of Respondents

Variable	Item	Frequency	Percentage (%)
Ethnicity	Malay	90	81.8%
	Chinese	18	16.4%
	Indian	02	1.8%
Occupation	Student	66	60.0%
	Job	27	24.5%
	Business	17	15.5%
Sex	Male	50	45.5%
	Female	60	54.5%
Marital Status	Single	78	70.9%
	Married	32	29.1%

Source: Primary Survey Data, 2011

Maximum number of respondents (5.45%) from Pahang and Kelantan used big car and bus respectively. The respondents from Selangor used big car (4.55%), bus (4.55%) and small car (.9%). Most of respondents from Melaka and Kedah used small car (2.73%) and bus (4.55%) respectively. Same portion of respondents (2.73%) used small car and big car from Johor.

Table 6 highlights the vehicles use by the respondents according to their income level. Motorcycle and bus used by the respondents who are in below RM 500 income level. Highest number of small car (16.36%) used by below RM 500 income level respondents. 13.64% and 10.91% of respondents used big car under RM 501-2000 and RM 2001- 4000 income level respectively. Again, motorcycle (28.18%) and

Table 5: Use of Transportations by the Respondents According to their Home State

State of Respondents	Transportation use by Respondents				Total
	Motorcycle	S. Car	B. Car	Bus	
Terengganu	31 (28.18%)	15(13.64%)	15(13.64%)	-	61(55.45%)
Pahang		2 (1.82%)	6 (5.45%)		8 (7.27%)
Kelantan		-	3 (2.73%)	6 (5.45%)	9 (8.18%)
Selangor		1 (.9%)	5 (4.55%)	5 (4.55%)	11 (10%)
Malaka		3 (2.73%)	2 (1.82%)		5 (4.55%)
Kedah		4 (3.64%)	1 (.9%)	5 (4.55%)	10 (9.09%)
Johor		3 (2.73%)	3 (2.73%)		6 (5.45%)
Total	31 (28.18%)	28 (25.45%)	35 (31.82%)	16 (14.55%)	110

Source: Primary Survey Data, 2011

Table 6: Use of Vehicles by the Respondents according to their level of Income

Level of Income (RM)	Use of Transportation				Total
	Motorcycle	S. Car	B. Car	Bus	
> 500	31 (28.18%)	18(16.36%)		16(14.55%)	65(59.09%)
501- 2000		7 (6.36%)	15 (13.64%)		22 (20%)
2001-4000		3(2.73%)	12 (10.91%)		15(13.64%)
4001-7000			5(4.55%)		5(4.55%)
7001-10000			3(2.73%)		3(2.73%)
Total	31	28	35	16	110

Source: Primary Survey Data, 2011

Table 7: Vehicles Use by Respondents According to their Occupation

Occupation of Respondents	Transportation use by Respondents				Total
	Motorcycle	S. Car	B. Car	Bus	
Student	31(28.18%)	19(17.27%)		16(14.55%)	66 (60%)
Job		7(6.36%)	20(18.18%)		27(24.55%)
Business		2(1.82%)	15(13.64%)		17(15.45%)
Total	31	28	35	16	110

Source: Primary Survey Data, 2011

Table 8: Occupation of Respondents According to Home State

Occupation of Respondents	State of Respondents							Total
	Terengganu	Pahang	Kelantan	Johor	Malaka	Selangor	Kedah	
Student	42(38.18%)	2(1.82%)	6(5.45%)	3(2.73%)	3(2.73%)	5(4.55%)	5(4.55%)	66 (60%)
Job	16(14.55%)	4(3.64%)	1(.9%)	3(2.73%)	0	1(.9%)	2(1.82%)	27(24.6%)
Business	3(2.73%)	2(1.82%)	2(1.82%)	0	2(1.82%)	5(4.55%)	3(2.73%)	17(15.5%)
Total	61	8	9	6	5	11	10	110

Source: Primary Survey Data, 2011

Table 9: CO<sub>2</sub> Emission by the Vehicles of Respondents

State of Respondents	CO <sub>2</sub> Emission by Different Type of Transportation (CO <sub>2</sub> /kg)					CO <sub>2</sub> Emission (CO <sub>2</sub> /kg)
	Motorcycle	S. Car	B. Car	Bus		
Terengganu	185.38	134.55	179.40	0.00		499.33
Pahang	0.00	80.96	323.84	0.00		404.80
Kelantan	0.00	0.00	188.60	138.38		326.98
Selangor	0.00	100.05	667.00	293.63		1060.68
Malaka	0.00	310.50	276.00	0.00		586.50
Kedah	0.00	457.24	152.41	335.48		945.13
Johor	0.00	369.15	492.20	0.00		861.35
Total	185.38	1452.45	2279.45	767.48		4684.76

Source: Estimated by Authors

bus (14.55%) used by the respondents from students. Small car used by the respondents from students (17.27%), job holder (6.36%) and businessman (1.82%). Big car used by job holder (18.18%) and businessman (13.64%) among the respondents (Table 7).

Table 8 reveals the occupations of respondents according to their home state. Most of respondents (38.18%) from Terengganu state in student categories. Highest number of respondents (14.55%) from

Terengganu state among the job holders. Big amount of businessman came from Selangor (4.55%) within the respondents.

Table 9 highlights total carbon emission of the respondents by their vehicles. Highest amounts of emission come from big car (2279.45 kg). On the other hand, lowest emissions come from motorcycle (185.38 kg). The carbon emissions from bus and small car are 767.48 kg and 1452 kg respectively. According to state, the

respondents from Selangor (1060.68 kg) are emitting highest carbon and lowest emitting from Kelantan (326.98 kg).

## DISCUSSION

Sekayu recreational forest is one of the famous and suitable ecotourism destinations to the local visitors as well as foreign tourists. Every year the domestic tourists' arrival is increasing in this forest area. The recreational forest is attracting the tourists by its unspoiled and environment friendly situations. Among the domestic tourists, students are visiting this forest for educational purpose. On the other hand, professionals are visiting for recreation and site seeing facilities. Most of student tourists from Terengganu are using motorcycle as transport to visit the destination. Moreover, the professionals are using small car and big car during their visiting period according to their income levels. Again, some students and low income tourists are using bus as their transport that comes from very far distance. Carbon emissions from bus and motorcycles are lower than small car and big car.

Environmental pollution and sustainability are the concerning issues for ecotourism development in any areas. Because, the main focus of ecotourism is minimum negative impact and long term sustainability. Many ecotourism destinations in the world become hazardous and polluted due to environmental degradations. High carbon emissions can one of the unsustainable and polluted situations for ecotourism development in the Sekayu recreational forest. The following steps can be adopted for the low carbon emissions in Sekayu as well as sustainable tourism development.

**Low Carbon Technologies:** Carbon emissions should be reducing by low-carbon technologies. In Sekayu, low-carbon technologies should be applied to the tourism facilities and services.

**Sustainable Tourism:** Maintain sustainability is the main concerning point for any ecotourism destination. Low-carbon emission is prerequisite for sustainable ecotourism development in Sekayu. This destination can ensure sustainability by minimum carbon emissions from all tourism related activities.

**Low Carbon Tourism Consumption:** In Sekayu, carbon offset program can be introduced to visitors for low carbon consumption. The forest authority can be

introduced tree plantation program for the tourists which reduce the carbon emissions from the visitors.

**Paid Carbon Taxes:** The local authority can apply tax payment program for carbon. For example, United State Continental Airlines has launched this program cooperate with International Travel Organization of Sustainable Development on 2010 [16].

**Institutional facilities development:** The government, tour operators, local communities and tourists are working together to reduce the carbon emissions in Sekayu. The local government should make mechanism for low carbon emissions tourism and other involve parties can implement the plan effectively.

**Government Initiatives:** The government has a vital role for low carbon emissions in ecotourism destinations. In this connection, Malaysian government takes special agenda in five- year development plan to reduce carbon emissions from the tourism destinations. Government can formulate laws and regulations, allocate fund for low carbon ecotourism development and ensure other facilities in this regard.

**Tour Operators:** Tour operators can operate low carbon tourism and develop low carbon vehicles for the tourists. They can encourage the tourists to use bus and other big vehicles instead of personal vehicles.

**Tourism Friendly Traffic System:** Tourism friendly traffic system can reduce carbon emissions in Sekayu recreational forest area. Low carbon advocate buses, electric cars, bicycles and other carbon free transportation mode can operate for reducing carbon emissions. The alternative fuels, mainly bio-fuel is helpful for saving energy and reducing carbon emission.

## CONCLUSION

Carbon emission is one of the concerning matter for the ecotourism destinations in the world now. The ecotourism destinations and related parties are trying to reduce carbon emission by improving their transportations and other service system. The tour operators can aware the tourists regarding carbon emissions and environment friendly travel. Tourists are the main contributors for low carbon ecotourism development. They can give priority to bicycle, bus, rail and other low-carbon transportations to reduce emission.

Tourists are promoting low carbon ecotourism development by changing their transportation use. Government should develop low carbon appraisal system for ecotourism development, encourage tourism transport and energy conservation and support tourism organizations for low carbon ecotourism development. The campaign and advertisement to promote low carbon ecotourism is helping for carbon emission in this sector. Finally, Malaysian government should develop linkage with international agencies and organizations for developing low carbon ecotourism in ECER and reducing carbon emission from ecotourism destinations.

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