

## Following the Carbon Trail of a Umrah Traveler

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### ABSTRACT

Travel is the second largest economic activity in the world accounting to 9% of the world's GDP and 14% of the greenhouse gas (GHG) emissions. Religious tourism is one of the fastest growing sectors in the tourism industry. Umrah or minor pilgrimage to the holy city of Mecca is one of the oldest and largest religious events outside the Christian world. Sustainable destinations principle is fast becoming a popular theme for managing the environmental impacts from tourism activities. Quantifying the environmental impacts of the event is essential for the successful application of 'sustainable destinations' concept. In this paper, life cycle methodology is used to quantify the carbon emissions from the umrah travel from Egypt. The global warming potential impact (GWPI) of Egyptian umrah goes accounts for 26,700 tonne CO<sub>2-eq</sub> per year. This averages to 44.5 kg CO<sub>2-eq</sub> per tourist.day with air travel being the largest contributor responsible for 37% of the total emissions followed by meals and hotel accommodation.

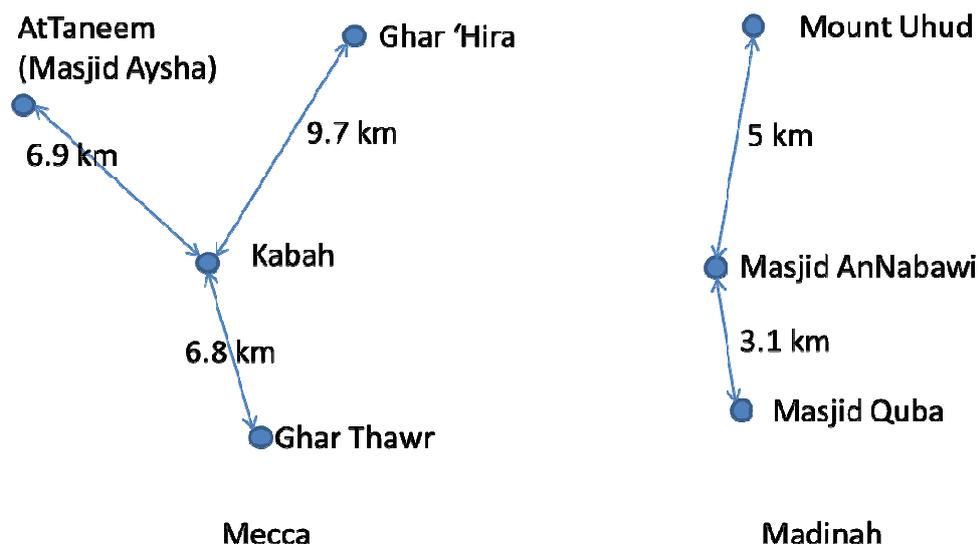
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### 1.0 General Requirements

Travel and tourism is one of the largest industries in the world accounting to 9% of the world's GDP and 8% of the world's total employment in 2010 (MercoPress, 2011). Travel and tourism is also blamed for being the fifth largest pollution source in the world accounting to nearly 14% of the global greenhouse gas emissions (UNEP, 2006). Religious tourism is a form of tourism where people of a particular faith travel to visit places of religious significance in their faith. The World Religious Tourism Association (WRTA) estimates that 300 million people from around the world participate in religious tourism every year (Saltzman, 2010). Hajj and umrah (major and minor pilgrimage to Mecca) are among the oldest and largest religious tourism events outside the Christian world. Every year millions of Muslims embark on a journey to visit the holy city of Mecca in an act of devotion. The events also generate significant economic activities, particularly in the Hejaz province. In 2009, Hajj and umrah related activities contributed \$30 billion to the Saudi economy (Jasim, 2009).

While the main ritual act of umrah is visiting the Kabah (the grand mosque in Mecca), pilgrims also visit other sites of importance around Mecca in what is known as 'zeyarah' or 'religious visit'. In addition, pilgrims visit Madinah, the second holiest city in the Islamic faith. Although, visiting the Grand mosque of Prophet Muhammad (pbuh) is the main feature of the Madinah trip, pilgrims also participate in Zeyarah of various places around Madinah in remembrance of the holy Prophet Muhammad (pbuh). Figure 1 shows the main attractions of Zeyarah in Mecca and Madinah. The distance of the shortest route (one way) from the grand mosque to the destination is also shown.

**Figure1:** Zeyarah Attraction in Mecca and Madinah (not to scale)



Egypt with a population of nearly 80 million is the most populous Arab nation and the 5<sup>th</sup> country in terms of Muslim population. In the 2012 season, it is estimated that 600,000 people from Egypt embarked on a umrah journey to Mecca (Alrai, 2012). Supporting large numbers of tourists requires the provision of many services which inadvertently places stress on the surrounding environment. Many researchers have emphasised the importance of accurate quantification of the environmental impacts of tourism. Nevertheless, the environmental significance of such activities is rarely comprehensively quantified (Filimonau, Dickinson, Robbins, & Reddy, 2011). This is particularly the case of Islamic religious tourism and more so in the case of Hajj and umrah. Henderson (2011) eluded to the environmental challenges of managing the Hajj event and that the current trends may not be sustainable. El Hanandeh (2013) published the first paper to ever attempt to quantify the carbon footprint of the Hajj event using a life cycle perspective. In his study, El Hanandeh (2013) identified several opportunities for improving the environmental management of Hajj services such as transport, energy use, meal services and education. He suggested devising new programs to extend the environmental conservation mechanisms built-in the traditional Hajj. This paper extends El Hanandeh (2013) study to evaluate the total GHG emissions that result from the activities directly associated with umrah and its supporting services. The paper focuses on the case of umrah from Egypt to illustrate the method; however the results can be easily extended to other countries in the region.

## 2.0 Materials and Methods

### 2.1 Goal and Scope of the Study

The goal of the study is to evaluate the GHG emissions from the activities of umrah travel from Egypt. The study includes emissions from travel, meals, zeyarah and infrastructure provision but excludes ancillary activities such as gifts. The functional unit chosen for this study is 1 tourist.day.

### 2.2 Data

Data was collected from different sources by surveying literature and news articles. Flight distances, fuel consumption and direct carbon emissions from the combustion of aviation fuel are calculated using the International Civil Aviation Organisation (ICAO) carbon calculator (ICAO, 2012). Number of flights operated between Egypt and umrah destinations as well as

number of passengers and average flight capacity is based on a news report by Al Rai newspaper (Alrai, 2012). Distances between Zeyarah attractions are calculated using Google maps. Data used in the study are presented in the following tables (1-5)

**Table 1:** LCI of Flight

Flight		Quantity	Reference
Cairo to Mecca			(ICAO, 2012)
	CO <sub>2</sub> emissions from fuel combustion per passenger (round trip)	237.92 kg <sup>1</sup>	
Cairo to Madinah			
	CO <sub>2</sub> emissions from fuel combustion per passenger (round trip)	210.07 kg <sup>1</sup>	

1 These emissions do not include high altitude impact of CO<sub>2</sub> emissions and do not include other GHG emissions

**Table 2:** LCI Data of bus Travel

Destination	Parameter	Quantity	Reference
Jeddah to Mecca			
	Distance	98 km	Google maps
	Number of seats	40	Estimated
	Fuel type	Diesel	
Mecca to Madinah			
	Distance	540 km	Google maps
	Number of seats	40	Estimated
	Fuel type	Diesel	
Zeyarah in Mecca			
	Distance	47 km	Google maps
	Number of seats	40	Estimated
	Fuel type	Diesel	
Zeyarah in Madinah			
	Distance	16.2 km	Google maps
	Number of seats	40	Estimated
	Fuel type	Diesel	
	Fuel consumption	34.5 l/100 km	(Chester & Hovarth, 2009)

**Table 3:** LCI of Hotel Stay

Parameter	Quantity	Reference
Number of hotel nights	14 days	Umrah visa length
Hotel type	3 star	Assumption
Number of people to a room	Quad share	Average umrah package
CO <sub>2</sub> emissions hotel stay excluding breakfast	7.5 kg per guest night	(Filimonau, Dickinson, Robbins, & Huijbregts, 2011)

**Table 4:** LCI of Meals

Parameter	Quantity	Reference
Number of meals served	25.2 million	Estimated based on 3 meals a day
Diet type	Omnivorous	Muslim/Halal meal
Meal provision	7.4 kg CO <sub>2</sub> per person per day	(Berners-Lee, Hoolohan, Cammack, & Hewitt, 2012)

**Table 5:** Infrastructure Embodied Emissions and Waste Management

Parameter	Quantity	Reference
Road travel	63% on top of end of pipe emissions	(Chester & Hovarth, 2009)
Air travel	31% on top of end of pipe emissions	(Chester & Hovarth, 2009)
Hotel stay	1.1 kg per guest night	(Filimonau, Dickinson, Robbins, & Huijbregts, 2011)
Solid waste	1.55 kg per person per day	(Aziz et al., 2007)

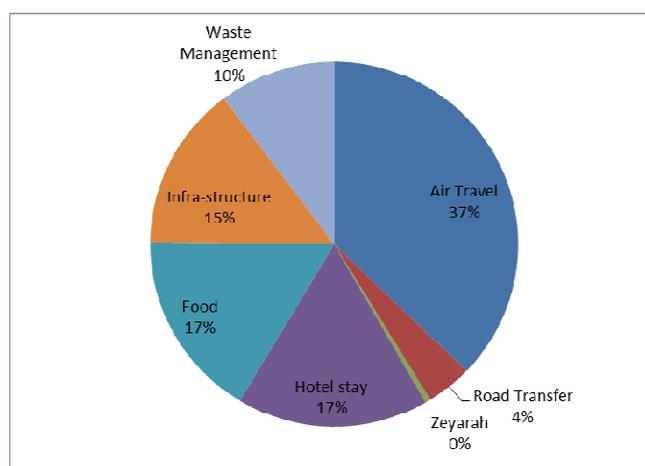
### 2.3 Assumptions

In this study, it is assumed that all flights for umrah originate from Cairo, the capital city of Egypt. The impact of internal travel between Egyptian cities and Cairo are not included as there is not sufficient data to include them in the model.

## 3.0 Results and Discussions

The results suggest that on average 44.5 kg CO<sub>2</sub>-eq per day per person are emitted as a result of umrah related activities. The largest contributor to GHG emissions is air travel which accounts to 37% of the total release. Hotel stay and meals both ranked second in terms of their contribution to GHG release. Ironically, the actual acts of umrah do not contribute directly to the GHG emissions as it only involves manual activity. Zeyarah activities contribution to the GHG emissions is negligible as it only represents 0.5% of the total emissions per person.

**Figure 2:** GHG Emissions Contribution by Activity.



The 2012 umrah season, from Egypt alone, will result in the emissions of 26,700 tonne CO<sub>2</sub>-eq. As the number of people performing umrah is expected to grow, these emissions are also expected to increase annually.

The use of more efficient airplanes, in the future, may contribute to reducing the GHG emissions from air travel and in turn lower the GWP of the overall umrah. However, this is outside the influence sphere of individual pilgrims. On the other hand, it is worthy to note that hotel stay, meals and waste management combined make up 44% of the total emissions. These are factors that are, at least partially, influenced by and under the control of the pilgrim. For example, reducing air-conditioning use whenever possible, reducing hot water use, making appropriate food choices and including vegetarian meals as a part of their diet as well as reducing waste and recycling can contribute positively in reducing the overall footprint of each pilgrim. Therefore, pilgrim education on the environmental impacts of their choices, especially when presented from a religious perspective may play vital role in achieving a more sustainable umrah travel.

The result is easily transferable to pilgrims from other countries as the activities are by far similar except for the travel from the country of origin to destination. For example, the majority of people from Jordan travel to umrah by coach. Their journey includes a stopover in Madinah first before continuing to Mecca thus eliminating the need for transfer between Jeddah and Mecca. The total round trip distance covered in the journey is 3276 km which is comparable to that covered by Egyptian pilgrims (air + road transfers). The travel emissions per passenger from Jordan are around 106 kg CO<sub>2-eq</sub> including road infra-structure provision compared to 313 kg CO<sub>2-eq</sub> (not including other aviation impacts, for more discussion the reader is referred to El Hanandeh, 2013) from Egypt. The carbon emissions incurred by a person performing umrah of the same duration from Jordan by road is 29.7 kg CO<sub>2-eq</sub> per tourist.day. Therefore, whenever possible alternative travel modes other than air travel should be encouraged.

#### 4.0 Conclusions

Life cycle methodology is used to assess the carbon emissions associated with umrah travel from Egypt. On average, 44.5 kg CO<sub>2-eq</sub> per tourist.day are directly related to umrah tourism. Air travel is the biggest contributor at 37% while meals, hotel stay each account for 17% and waste management account for 14% of the total emissions. Zeyarah and road transfer between destinations was found to contribute less than 5% of the total carbon emissions.

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