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The Impact Of Climate Change On Malaysia Tourism And Economic Sectors: An Input-Output Analysis

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Abstract : The Tourism Sector Has Been Undeniable Contribute To Economic Growth. Income Generated From The Tourism Sector, Contributions To Other Sectors And Employment Opportunities Created Are Potential Evidences By The Development Of The Tourism Sector Which Is Valuable To Ensure That This Sector Stays To Grow. Nevertheless Tourism And Socio-Economic Activities Are Dependent On And Vulnerable To Climate Change. The Potential Impacts Of Climate Change In Malaysia Could Be Sea Level Rise, Decreasing Crop Yields, Increasing Forest Diseases, Loss Of Biodiversity, Shoreline Degradation, Increased Flood Intensities, Coral Reef Bleaching, Tidal Floods, Reduced In Water Supply And Droughts. Attentive To The Threat Of Climate Change On Tourism Sector, This Study Aims To Analyse The Impact Of The Tourism Sector To Other Sector In Comparison In The Period Of 2010 And 2015. The Analysis Will Identify Sectors Stimulated By The Tourism Sector And Sectors That Receive Negative Impact From Tourism Sector Fluctuation. Using Input-Output Method, The Impact And Relationship Of Tourism Sector With Other Sectors Were Determined. It Can Be Concluded That The Impact Is Significantly Serious In Some Sectors With Some Negative And Positive Consequences Due To Climate Changes.

1. INTRODUCTION

Tourism sector is stimulated by various natural and cultural attractions which attract the tourists all over the world to a destination. This attraction significantly linked to the climate and any changes in the climate bring serious reflection of the industry. Although the tourism industry has an optimistic predictions, it facing a high tension from the climate change (Farahani, 2010). Ranade(2009) claims there are six consequences of climate change consist of which are temperature, sea temperature, ocean acidification, sea level rise, rain fall storm activity and snow are factors that connects climate change and tourism industry directly. As the tourism sector contributes a lot to the country's income, information related to the environment that supports the tourism sector is a priority. The main reason of this study is to enhance the current knowledge oftourism sector in Malaysia as the threat receive by tourism sectorand the linkages of other sectors which closely correlates which boost the revenue

generate for the economy. Besides that, tourism sector also interdependent with other sectors while requiring the sectors to be functioning efficiently as well as benefiting the sectors.

1.1 Malaysia Tourism Sector an Economic Growth

Over the last few decades, tourism has become an important sector contributing main source of income for the GDP and it also continued to build country's prominence as s world-renowned tourism destination. In the first half of 2018, Malaysian tourism has attracted 12.73 million tourists which brought in contribution of RM39 billion to national income. Malaysian tourism is the third biggest foreign earner where it accounts for over 7 percent of the country's economy. As the tourism sector is rapidly expanding, Malaysia government has established this sector as National Key Economic Area (NKEA) as the part 11th countries economic planning and strategy (Economic Planning Unit, 2016-2020). The benefits of tourism sector to the economy in terms of both macro and microeconomic growth is acknowledge by the government.

It has been long proved that tourism stimulate impact on the economic activity (Dwyer et al., 2004). The growth of tourism industry has usually known to provide a positive contribution to the economic growth (Lee & Kwon, 1995; Oh, 2005).The rapid growth of tourism causes an increase in the household income and government revenues via the multiplier effects. Brida & Risso(2010) stated that tourism development has both direct and indirect effects on economy such as expansion of industrial and agriculture production, encourages international trades, upgrades the service sectors such as transportation, telecommunications, banking and financial services. The earnings from the tourism industry can also be invested in capital goods and this shows the significant role in developing more investments in new infrastructures in the host country.

1.2 Climate Change and Tourism Sector in Malaysia

Climate change and global warming are widely regarded as the major global threat that has devastated human living environments and the eco system, as proven by the melting of snow and ice, the rise in sea levels and the surge of greenhouse gas (GHG) emission that causes the global temperature to rise (Halim, 2009; Pongkijvorasin and Chotiyaputta, 2013). Moreover the climate-induced environmental changes that will indirectly impact the tourism industry at destination and regional level. The predicted changes are water availability, biodiversity loss, reduced landscape aesthetic, changes in agriculture production, more natural disasters, coastal erosion and inundation, damage to infrastructure and increasing incidence of vector-borne disease (Cabrini, 2010).

In Asia, tourism is also particularly vulnerable to climate change as many businesses and destinations heavily rely on natural resources such as coral, islands, trees, alpine areas and beaches (Cruz et al., 2007; Simpson et al., 2008). Nature and culture play a significant role attracting tourist worldwide and these factors have also directly affected of climate change. Despite all the positive projections in tourism growth, the industry is experiencing considerable tension from climate change (Farahani, 2010). The Intergovernmental Panel on Climate Change (IPCC) assessments records that climate change has a significant impact on human life in general and on various industries that related to climate in Malaysia (Bindoff et al., 2007). Malaysia is particularly exposed to changes in weather patterns, rainfall variability and intensity (MOSTE, 2000).

MOSTE (2000) reports that the Malaysian temperature is rising and could experience temperature changes from 0.7 to 2.6 degree Celsius and that an average annual sea-level rise has been around 1.25 millimetres on the south coast of Malaysia. Hassan, Kumarenthiran& Kumar (2008) predicts weather will continue to intensify and the temperature in Malaysia will be warmer at the middle and the end of century. Additionally there is a strong projected decrease in monthly rainfall in West Coast and a rise in monthly rainfall across the North-East coast of Malaysia. In terms of the flows of rivers, multiple watersheds were simulated in East Coast Malaysia in accordance with the historical levels in hydrological extremes.In the western regions of Sabah and Sarawak, more substantial annual rainfall improvements are expected by the end of this century (Tiong et al., 2009). Mild natural disasters such as flood, sea level rise and drought are recorded to be happening quite frequently lately. Halim (2009) also predicted the potential impacts of climate change in Malaysia could be sea level rise, decreasing crop yields, increasing forest diseases and loss of biodiversity, shoreline degradation, increased flood intensities, coral reef bleaching, tidal floods, reduced in water supply and droughts. Furthermore, the outdoor recreation tourism businesses are sensitive to climate change such as Malaysia (Azam, Alam, and Haroon Hafeez, 2018). Hamilton, Maddison, & Tol (2005) have also discussed the tourist made travelling decisions taking into consideration the climate. The shifts in temperature and precipitations patterns is also proven to changes the destinations choices by the tourist. The outdoor activities such as fishing and hunting may be also disrupted due to extreme weather conditions. High sea level may also give negative impacts on the snorkelling and scuba diving water activities due to changes in coral reefs. The bird watchers, hunters and wildlife enthusiasts' recreational activity may be effect as the season migratory bird population will also be affected.Halim (2009)state about 1200 kilometres in Peninsular Malaysia will be submerged due to tidal inundation and the mangroves will be lost if the sea level rises at the rate of 0.9 cm per year.

The tourism industry is one of the biggest contributors to the nation's economic development. However, the contribution of this industry to other industries in the national economy is still not accurately measured. In addition, the impact of the spill over on the tourism industry on other industries and the extent to which the strength of the linkages between the tourism industry and domestic industries can be identified in this study. In addition, researchers have used quantitative research methodologies to collect and analyse data to meet the needs of this study. This paper aim to analyse the impact of climate change on Malaysia's tourism sector and other sectors by estimating the impacts of climate change on the effects of industrials' output and income.

1.3 Hamburg Tourism Model

This model explain global tourism affected by climate change, but the impact is not as significant compared with other changes in the industry such as population growth and increase in per capita income.Several steps are taken under this tourism model: the first step is to estimate the total demand for tourism and it is measured via population data and per capita income of each country. Then, domestic to international tourist ratios are calculated using per capita earnings as well as the land area, the length of the coast and temperature. The next step is to evaluate the destination of international tourists. For this step, a matrix of bilateral tourist flows was developed and calculated. Final step is to sum up all tourists arriving to each country and quantify their expenses and duration of stay.

1.4 Empirical Review on Climate Change and Tourism

The primary focus of this research is on identification and evaluation of impact of climate change on tourism industry. According to Hamilton, Maddison, & Tol, (2005a)and Scott, McBoyle & Schwartzentruber (2004; 2007a; 2007b) large number of studies based on the development of models of tourist arrivals and departure in relation to climatic variables: precipitation and temperature, environmental variable: coastal length, biodiversity, and socio-economic variables: population, tourism cost and GDP, have been carried out. Agnew & Palutikof, (2006) and Hamilton and Tol, (2007) discussed about the impact of climate change on international tourist arrival and departures and domestic tourist flows.

Study carried out in colder country by Hamilton and Tol (2007): United Kingdom, Germany, and Irelandto analyse the effect of development and climate change on tourism. The finding shows that the domestic tourism may be double in colder countries and it can fall by at least of 20% in warmer countries (relative to the baseline without climate change) and the international tourism may treble whereas for others it may cut in half. The international tourism also plays an important role compared to the domestic tourism in colder places and vice versa in warmer places. Therefore, in most countries the impact of climate change is smaller compared to the impact of population and economic growth. Agnew and Palutikof (2006) centralized the research in the United Kingdom and used an empirical statistical model to investigate the sensitivity of UK tourism to climate variability. This study used a set of climate indicators to explain the current climate fluctuations, while tourism demand is described by a dataset comprising domestic (monthly number of tourist per nights) and international (annual numbers of trips abroad) tourism flows. The UK was used to illustrate the possible impact of climate change in the anomaly warm year 1995. The findings of this study shows that the warmer and drier seasons in UK in year 1995 had benefited the domestic tourism industry.

Most of the studies are examines the impact of climate change on a number of future scenarios, usually adopts the projections by the Intergovernmental Panel on Climate Change (IPCC). Hamilton, Maddison, and Tol (2005b) carried out a study analysing the effect of climate change on international tourism. The Hamburg Tourism Model (HTM) was used to model international tourist flows between 207 countries and the model analysed how the existing trends could shift under uncertain scenarios such as population growth, economic growth and climate change. The findings show that tourist from temperate climate would prefer to choose to spend their holidays in home countries and the effects of climate change are smaller compared to the population and economic development baseline.

Lise and Tol (2002) carried out a study analysing the impact of climate change on tourist demand conducted on OECD tourist destinations and a factor-regression analysis on Dutch tourist's holiday activities to sought optimum temperatures for various tourist and tourist destination. The cross-sectional analysis indicates that the OECD tourist generally choose their holiday destination for a 21 degree Celsius (average hottest month of the year) which shows that tourists spend their vacation in different places under the scenario of gradual warming than they currently do. Whereas, the factor-regression analysis indicates that climate preference in tourist destinations vary between age and income like the younger and richer people prefers different activities during their holiday compared to the poorer and older people.

Number studies available based on the variables in climatic and environmental variables which creates indicators (TCI "Tourism Climate Index"). The primary objective of these studies are to establish indexes to clarify and forecast tourist flows. Matzarakis (2006) used a

thermal comfort index to identify areas of Greece with strong thermal tension similarity and Scott et al., (2004) used the climatic index to analyse the impact of climate change on city tourism. Both these studies analyse the tourism demand and flows and changes in tourist's preferences for specific North American cities.

Scott et al., (2004) examined the spatial and temporal distribution of climate resources for tourism in North America in two different climate change scenarios using the tourism climate index (TCI) for the 2050s and 2080s. The analysis shows that the number of cities in USA with ideal TCI ratings in winter months are predicted to increase and the winter sun holiday travellers would face high competition. In contrast, city like Mexico with lower TCI ratings could become less competitive as a winter sun holiday destination. It also found that a longer and improved warm-weather tourism season may enhance its competitiveness in the international tourism marketplace. Therefore, such circumstance studies generally show that the conditions can vary considerably based on the location, which will also decide the choice of destination, the season and the length of the stay.

The specific impacts of climate change on tourism industry such as direct economic effects such as tourism prices Shih et al., (2009) and tourist opinions Schmitz et al.,(2007). Shih et al., (2009) analysed the impact of weather on downhill ski lift ticket sales using conceptual econometric model with independent variables such as weather, prices, economic conditions, and leisure time. The results suggest that the statistical increase of downhill ticket sales is simply the impact of environmental conditions such as moderate to low temperatures, snow depth and wind chill. Schmitz et al.,(2007) carried out a spatial analysis of visitor preferences in the outdoor recreational niche of Mediterranean cultural landscapes. In this study, the visitors were categorised by surveying their visit preference. Uyarra et al., (2005) also researched the ways of various environmental factors to explain tourist preferences and opinion's on how the enjoyed their holidays in Bonaire and Barbados.

Berrittella et al., (2006) concluded that the complex relationship between climate change and tourism has considerable economic consequences and they both require serious attention. Nonetheless, it is important to stress that not all activities, regions or destinations are impacted by the same economic effects (Shaw and Loomis, 2008). Due to the importance of moving against climate change, many existing studies outline a set of recommendations that the governments, institutions, companies and individual tourist should undertake to reduce the emissions which includes avoiding the risks and taking advantages of opportunities of changing climate (Cashman et al., 2013; Schmitz et al., 2007).

A study by Latiff et al., (2020) conduct to determine sectors influenced by the tourism sector in Malaysia. The study uses the input-output method from 2010 input-output table issued by the Department of Statistics Malaysia. Analysis of forward linkage and backward linkage of each industry found that the non-NKEA industry and financial services are the industries that receive the strongest growth influence from the growth of the tourism industry.

Studies have been carried out in Malaysia and other countries relate to impact of climate change and tourism industry. Nevertheless the studies only focus in specific sectors such as agriculture sector and the adaptations and mitigation measures that should been taken in order to overcome the issues in the specific sector. There are very less studies focusing on the more detailed impact of the spill over effects on the growth of tourism sector to other sectors, employing I-O approach and current data.

Overall, past studies have focused on the impact of climate change on tourism industry itself and not much research has been conducted on the contribution of this tourism industry to other industries in the country.This study conducted to identify the true contribution of the

tourism industry to other industries, do comparison between years in further to understand how strong the link between the tourism industry and other industries in the economyin terms of profitability. The findings of this study are expected to provide a basic guide and more relevant information to tackle the alarming issue of climate change on tourism sector and other sectors.

2. METHODOLOGY

The methodology section explain data used in this study to achieve the objectives stated in followed by input-output approach as tools of analysis. The quantitative data for this study retrieved from the Department of National Statistics (DOSM), which is the Input-Output 2010 and 2015 table and the aggregation of 124 economic sectors is explained in the Leontief inverse matrix analysis structure. Then, Leontief matrix is used to calculate the two multipliers in this study also to determine the linkages between the sectors.

2.1 Sources of research data

The research conducted is a quantitative study in which all data and information used for the study are obtained from secondary sources. Researchers used data from the Department of National Statistics (DOSM), which is the Input-Output 2010 and 2015 table. In the 2010 and 2015 Input-Outputtable, there are 124 economic sectors to be aggregated into 11 x 11 economic sectors related to the tourism industry based on the industry classification proposed in the ETP by Performance Management and Implementation Unit (PEMANDU, 2015).

2.2 Input-Output Table

The Input-Output (I-O) table represents statistics in the form of a matrix that will show the process of transactions that occur in the use of goods and services among various economic activities. The quantitative methods used in the I-O table provide an overview of the regional economic structure that includes output and value-added for each related sector. Key transactions in the use of goods and services between the manufacturing sectors, the provision of goods and services from domestic and foreign production, as well as the demand structure of goods and services by other sectors including demand for investment purposes and export of goods abroad are known as input structures.

2.2.1 Structure of Input-Output Transaction Tables

Table I-O is displayed in a two-dimensional matrix format with rows and columns. The row represents output for each sector while the column represents input for each sector.

i. **Horizontal line interpretation**
   The figures in the row shows that during the year, there was one output of the sector sold to the same sector, other sectors, output to the final demand and total output

ii. **Vertical line interpretation**
   The figures in the column can be interpreted as one purchase of inputs from the sectors involve directly, the value-added sector and the total input purchases.The columns in the two-dimensional matrix format are very useful for understanding the structure of each industrial sector because the numbers we see in the columns represent all the input required. The numbers at the end of the column show the total number of inputs for this sector, over a year period.This table is also known as a

transaction table because it records all transactions that took place over a year. The transaction table is the first table of the I-O series table to be created in sequence.

2.2.2 Structure of Leontief Inverse Matrix Analysis

i. Process in Matrix Format

In simple matrix notation, X is used to represent the output volume and Y is used to represent the final demand. Thus, X is composed of intermediate goods AX where 0 <A <1. The equation is as follows:

$$AX + Y = X \quad (1)$$

(Intermediate Goods + Final Demand = Total Output)

Intermediate goods (AX) are inputs used to produce other goods and are also part of the total output in the industrial sector. Therefore, A is greater than 0 but smaller than value 1. Based on equation (1), the sign on AX will change from positive to negative when AX is moved to the right of the equation. For an example,

$$Y = X - AX \quad (2)$$

(Final Demand = Total Output - Intermediate Goods)

X will withdraw out and made as follows when there is a regular X to the right of the equation. Accordingly, the I-matrix is considered as 1 in ordinary algebra.

$$Y = (1 - A)\,X \quad (3)$$

(Final Demand = Apart more than total output used for intermediate goods)

Both sides of the equation will be divided by (I - A) because the equations will hold as long both sides of the equation are divided by the same factor.

$$\frac{Y}{(1-A)} = \frac{(1-A)X}{(1-A)} \quad (4)$$

Both the numerator and the denominator of the fraction to the right of the equation will subtracted (I - A).

$$\frac{Y}{(1-A)} = X \quad (5)$$

(Final demand divided by surplus portion used for intermediate goods = Total output)

Apply algebraic rules to inverse notation: $1/a = a^{-1}$in equation (5)

$$(1 - A)^{-1}\,Y = X \quad (6)$$

The last two details will be added to this equation. The first is Δ where it can be read as Δ = changes, so that this equation can be made into more relevant to I-O economic impact analysis. Second, $(I - A)^{-1}$ the section is read as Leontief's inverse matrix, so:

$$(I - A)^{-1}\,\Delta Y = \Delta X \quad (7)$$

The Leontief inverse matrix will be obtained and subsequent analysis of the effects after taking all these steps.

ii. Implementation of the Leontief Inverse Matrix Process Matrix

a) Standardization

In the standardization process, the required inputs in the transaction table will be standardized by placing them in relative terms throughout each column. Thus, each input required in each column must be taken to be divided by the

number of columns (i.e., the number of inputs).All transaction amounts converted to relative inputs for each sector's total inputs can be expressed in relative terms when the calculation is completed.

b) Forming the 'A' Matrix

Only the inter industry matrix will be selected after the standardization process is completed to obtain a square matrix or known as matrix -A (that is, a matrix where the number of rows equals the number of columns. In order to obtain this Matrix -A, each transaction volume is standardized as the required input in terms of the input volume and leaves only the part that has the elements of the inter-square matrix.

2.2.3 Matrix Element Notation

Because the intersection between the agricultural sector row and the manufacturing sector row, the first row and the second column are long, the subfolder ending at the bottom can be used to display relevant locations in the matrix in the order of rows and columns. Thus,*ij* is commonly used to represent relative locations in rows and columns even though r and c as rc may be used. The standardization process can be expressed as below notation:

$$a_{ij} = z_{ij} / x_j \quad (8)$$

Equation (1) shows that for each standard element in the A-matrix, thea_{ij} is calculated by having the same element in the transaction matrix, the *zij* is divided by the corresponding column number (i.e., the number of inputs) *xj*where *zij*represents each element in the transaction table which is the actual transaction amount recorded.

a) Matrix - I

A square matrix that functions like 1 is called an identity matrix (Matrix-I). Matrix-I looks like a square matrix that has all zeros of its elements except diagonal elements from top left to bottom with a value of 1. Therefore it is a square matrix where a_{ij} = 0 except when i = j then a_{ij} = 1.

b) Subtraction of matrix-A from matrix-I

The result will be given in matrix (I - A) when the subtraction of matrix-A from matrix-I occurs.

c) Calculating Leontief Inverse Matrix

The Leontief inverse matrix will be estimated using manual inverse matrix calculation process.

d) Use Leontief Matrix to Calculate Multiplier Analysis

The multiplication method in an algebraic matrix such as a square (n x n) matrix can only be implemented when the number of rows of matrices to be multiplied is equal to n. Thus, the inverse Leontief matrix multiplied by the final demand change will produce a change in the output volume and is as follows:

$$(I - A)^{-1} \Delta y = \Delta x \quad (9)$$

(Leontief inverse matrix x changes in final demand = changes in output volume)

By introducing the concept of additional change, the model can be provided through changes in final demand, also known as shocks, initial shocks, direct shocks, direct effects or direct effects to see how the economy reacts to its output. This

matrix is called a column vector or more specifically the final demand column vector because it has only one column.

The Leontief inverse matrix can be estimated after this process and the final calculation of multiplying the Leontief inverse matrix $(I - A)^{-1}$ with certain changes in the final demand ΔY expressed in the column vector will give a change in the total output ΔX.

2.3 Output multiplier

Changes occurring in various endogenous variables as a result of changes in one or more exogenous variables will be described by the multiplier matrix in the input-output table. The degree of dependence of several sectors of the economy is determined by multiplier analysis in the input-output table. Thus, the sector with strong ties to other sectors will have a large coefficient multiplier.

Changes that occur if there is an increase in final demand in a sector can be studied through output multiplier in multiplier analysis. Assume that sector i will have additional effect on the output of the sector. Accordingly, the various meanings will be given by the value of the multiplier obtained and the value of the multiplier can be an indication of the effects of the changes in a sector that will adversely affect the economy as whole. The output multiplier notation written in the form of an equation is as follows:

$$O_j = \sum_{i=1}^{n} b_{ij}$$

2.4 Income Multiplier

Changes in household income in the event of a change in the final demand for goods and services which in turn will increase the output of the economy sector are calculated by the analysis of income multiplier. There are two stages of improvement that will include the increase in output obtained from the output multiplier analysis and the increase in household income derived from the multiplier analysis.

Salaries or wages provided by an economic sector of the workforce are included in household income where their income is based on the output produced by that sector. The increase in the amount of household income involved in the wage or wage payment provided by the economic sector will be influenced by any increase in output. The multiplier notation written in the form of an equation is as follows:

$$H_j = \sum_{i=1}^{n} a_{n+1,i} b_{ij}$$

3. RESULT AND DISCUSSION

The impact analysis is carried out based on I-O Table 2010 and 2015. The table consists of 124 x 124 industries which is aggregated into 11 x 11 economic sectors. The process of aggregation was carried out by including few sectors in the economy that generally depend on the objectives of the study to be achieved. In this study, there are thirteen sectors are analysed which are agriculture, mining and quarrying, manufacturing, utilities, construction, wholesale & retail trade, accommodation, food and beverage, transportation, arts, entertainment & recreation and services. The analysis is carried out assuming the climate change gives an overall impact of 15 percent to the tourism industry in Malaysia and the changes in every thirteen sectors is precisely analysed based on this assumption.

3.1 Output Multiplier

Assuming climate change gives an overall impact of 15 percent to the tourism industry in Malaysia, the output multiplier in this study will explain the changes in total value of production in the 13 sectors aggregate in the economy that is necessary in order to satisfy one ringgit's worth of final demand for tourism industry's output. The output multiplier in the I-O table used to determine the level of interdependence of other sectors in the economy on Malaysia's tourism industry. Hence, table 1 and 2 will precisely explain every value of output multiplier for the 13 sectors for the year 2010 and year 2015.

Table 1 and 2 show the output multiplier for the 13 aggregated sectors for year 2010 and 2015 respectively. In year 2010, tourists have a total expenditure of RM166, 572, 588 million and RM219, 852,121 million contribution mainly from four sectors which are wholesale and retail trade and motor vehicle, accommodation, restaurants, transportation and amusement and recreational services. From the figure shown in tables 1 and 2, the tourist expenditure has increased steadily from year 2010 to year 2015. Tourists had the highest expenditure in wholesale & retail trade and motor vehicle with RM98 million and RM117 million for both years. The transportation sector in year 2010 shows the second highest amount followed by restaurants, amusement & recreational services and lastly accommodation. In contrast for year 2015, the food and beverage sector show the second highest amount for tourist expenditure which is RM 44 million followed by transportation, arts, entertainment and recreation and accommodation. The tourist expenditures did not cover all the 13 aggregated sectors, there are minimal changes in the output. Overall, it can be said that the climate change has given a negative impact on all the 13 sectors in year 2010 and year 2015.

Assuming climate change has an impact of 15 percent in tourism industry in Malaysia in the year 2010 and year 2015, the sector with highest impact shown in Table 1 is amusement and recreational services sector while in Table 2 is arts, entertainment and recreation. In year 2010, this sector has shown a 14.67 percent decrease from the initial output which is from RM15 million to RM13 million while in year 2015, the output decreased 13.91 percent (RM20 million to RM17 million). Most of the recreational activities requires the tourist to engage in outdoors and extreme weather conditions such as high temperatures and urban heat island effect may be detrimental for the tourists. Besides, climate change is likely to worsen in extreme weathers such rainstorms, rising sea levels and heat waves. It is expected for the tourists also have concerns regarding safety in outdoor activities during rainfall season. Such extreme conditions directly affect how tourist will recreate, limiting options or making it unhealthful to involve in outdoor activities. Therefore, major decrease in output of amusement and recreational services sector can be said will be affected the most resulting from climate change in Malaysia.

In year 2010 and 2015, the second highest sector affected by climate change is restaurants and food and beverages. The restaurant sector's output has decreased 13.32 percent from RM37.32 million to RM 32.78 million compared with the year 2015 the food and beverage sector have decreased 12.75 percent (RM66.68 million to RM 58.18 million) from the initial output. Even though from year 2010 to 2015 the output has risen from RM37.32 million to RM66.68 million, the climate change still shows a large impact of the output. Malaysia is known for the wide choices of dining and majority of the restaurants offer Asian cuisine where it is mainly dependent supplies from local farms. The rising global temperature causing dry spells or drought have threaten the rice yield which will also cause shortage of supplies for the local restaurants. The rice self-sufficiency level (SSL) in Malaysia marks at 71 percent and the climate change is accelerated by the increase of carbon dioxide

concentration in the atmosphere worries the farmers to sustain at the same level to supply the demands from the food and beverage sector in Malaysia.

The accommodation sector for both year initial output shows a fall of 10.01 percent and 12.27 percent respectively. In year 2015, the output in accommodation sector have decline more compared to year 2010 even though the initial output shows a positive change from RM9.85 million to RM13.46 million. The accommodation sector is the heart of tourism industry in Malaysia. This sector provides tourists wide range of hotels and accommodation ranging from one star to five stars. Despite its potential, Malaysia's accommodation sector is vulnerable to climate change. The climate change has affected the coastal communities and hoteliers as increased sea level, heavy rain falls could damage their property. The hotels around beaches and island are among the highest demanded accommodation by tourists. The uncertainty in the climate can also affect the development of hotel industry mainly near the coastal areas. Therefore, the decline in output multiplier in accommodation sector can be clearly caused by the impact of climate change.

Wholesale and retail trade, repair of motor vehicles and motorcycles accountable for the highest number of initial outputs in year 2010 and 2015 which is RM199.97 million and RM302.03 million. From year 2010 to 2015, the initial output has surged about 51 percent (RM102.05 million). Despite the favourable figure shown, the climate change has negatively impacted the sector. In year 2010, the output in wholesale and retail industry have reduced 9.63 percent and in year 2015 it also declined 8.03 percent. Although changes in this sector is not as high as the other three sectors but direct impact of climate change can be clearly seen. There are numerous impacts of climate change on companies and business as it creates a new series of business risks. The most apparent physical risk that businesses might face operational disruption when there are extreme weather events also transition risk which appears from consumer's response due to climate change such as changes in regulations in markets and technologies. Another climate-related challenge for companies will be emission of greenhouse gasses (GHG).

In year 2010 output in transportation sector has decreased by 9.38 percent whereas in year 2015 it has decline from RM92.78 million to RM85.58 million which is about 7.76 percent slightly lesser compared to year 2010. Transportation sector can be divided into 3 types which are land, air and water. Climate change in Malaysia have caused flash floods, landslide also extreme weathers which might increase the risk of delays, damages and failures in the transportation system. Heavy rainfall and storms may have caused the flood in many places which reduces the mobility of tourists across the states via land also via air. Exposure to extreme weathers might also cause more road accidents and shortens the life expectancy of highways and roads. Besides, the unfavourable weather conditions may cause flights to delay or even cancelled in worse-case scenario.

Apart from the sectors discussed above, there are six more sectors shown a negative impact due to climate change in both years. In 2010, the construction sector has decreased 0.1 percent followed by mining and quarrying 0.52 percent, manufacturing 0.88 percent, services sector 0.95 percent, agriculture 1.11 percent and utilities 1.99 percent comparing with year 2015, the construction sector have dropped 0.54 percent then mining and quarrying 0.57 percent followed by services sector 0.9 percent, manufacturing sector 1.06 percent, agriculture 1.33 percent and utilities 1.98 percent. Even though the fall off in these sectors did not exceed 2 percent, the impact of climate change affecting industries in Malaysia as a whole.

Table 1Output Multiplier for year 2010 (RM, 000)

Sector	Tourists Expenditure	Initial Output	Output Multiplier	Decrease in Output	Output Change (%)
Agriculture, Forestry and Fishing	0	126,650,738	1.50	125,250,987	-1.11
Mining and Quarrying	0	107,549,280	1.19	106,991,840	-0.52
Manufacturing	0	900,727,903	1.78	892,833,087	-0.88
Utilities	0	51,724,062	1.59	50,697,206	-1.99
Construction	0	73,448,549	1.92	73,374,416	-0.10
Wholesale & Retail Trade and Motor Vehicle	98,351,190	199,971,866	1.54	180,722,124	-9.63
Accommodation	5,363,749	9,859,533	1.85	8,873,071	-10.01
Restaurants	24,791,165	37,821,006	1.84	32,782,780	-13.32
Transportation	26,662,227	64,991,047	1.94	58,892,289	-9.38
Amusement and Recreational Services	11,404,258	15,886,817	1.85	13,555,913	-14.67
Services	0	485,539,781	1.67	480,916,644	-0.95
TOTAL	166,572,588	2,074,170,582	19	2,024,890,359	

Table 4.2 Output Multiplier for year 2015 (RM, 000)

Sectors	Tourists Expenditure	Initial Output	Output Multiplier	New Output	Output Changes
Agriculture	0	131,600,384	1.35	129,856,062	-1.33
Mining and Quarrying	0	130,225,585	1.30	129,488,427	-0.57
Manufacturing	0	1,156,705,658	1.95	1,144,433,108	-1.06
Utilities	0	72,907,995	1.73	71,464,031	-1.98

Construction	0	181,342,215	2.03	180,365,456	-0.54
Wholesale & Retail Trade, Repair of Motor Vehicles and Motorcycles	117,222,657	302,030,616	1.59	277,780,787	-8.03
Accommodation	8,694,354	13,462,027	1.68	11,810,187	-12.27
Food and Beverage	44,388,017	66,685,677	1.89	58,182,680	-12.75
Transportation	33,810,004	92,786,662	1.95	85,585,535	-7.76
Arts, Entertainment and Recreation	15,737,089	20,375,591	1.80	17,541,796	-13.91
Services	0	594,308,520	1.64	588,971,990	-0.90
TOTAL	219,852,121	2,762,430,929	19	2,695,480,058	

3.2 Income Multiplier

The income multiplier shows every ringgit decrease in total output in tourism sector will also decrease the total income for households in tourism sector as well as other sectors. While also assuming the climate change gives 15 percent impact on the tourism industry in Malaysia, the income multiplier in this study is used to describe the changes in total income for households in the 13 aggregated sectors due to the climate change. The income multiplier shows every ringgit decrease in total output in tourism sector will also decrease the total income for households in tourism sector as well as other sectors directly or indirectly. Overall, it can be seen all the sectors are negatively affected due to climate change and the urgency to mitigate climate change is in need. As the year passes by, the percentage of decline in initial output and initial income are escalating. Hence, the economy have to boost up the actions taken to reduce the impact of climate change as well as increase the revenue created. The policymakers should acknowledge the alarming issue of climate change.

Thus, Table 3 and 4 discuss the changes occurred in income of households for the year 2010 and 2015 respectively.Table 3 shows the income multiplier for the year 2010 and table 4 shows the income multiplier for the year 2015. It can be interpreted there are five main sectors with major changes in the total income. While other six sectors show only changes less than two percent from the initial income. Five sectors with major impact are also as same as output multiplier are arts, entertainment and recreation, food and beverage, accommodation, transportation and wholesale and retail trade.

In the year 2010 and year 2015, arts, entertainment and recreation sector shows the highest fall in income due to the impact of climate change which is 13.93 percent and 16.15 percent. From the figure, the decline in overall income for the labours has also increased 2.22 percent from year 2010 to year 2015 which indicates the unsatisfactory impact of climate change. Mostly the outdoor activities and recreational is avoided by the tourist for safety purposes which might give pressure on the income for the labours involved in this sector. Furthermore,

the extreme weather conditions also might damage the outdoor facilities built for tourist and the income generated by owners will be affected as well.

The restaurant sector is also the second most affected sector in both year 2010 and 2015. It has decreased 12.49 percent in year 2010 and 14.61 percent in year 2015. The rising temperature and extreme weathers have affected the local agriculture by destroying the crops in flash floods and limiting the source of water during droughts. The shortage of local supplies to the restaurants has affected the both parties' income negatively – the farmers and the restaurant owner.

The accommodation sector in both years 2010 and year 2015 have also decreased in total income 9.1 percent and 13.99 percent. The initial income for the accommodation sector shows a positive change in year 2015 compared to the year 2010. It has increased RM 2.98 billion. This can be due the initiatives taken by the Malaysian Government to boost tourism sector. However, the decline labour's income by 13.99 percent in year 2015 in this sector shows vulnerability of hotel industry labours. The coastal communities are affected the most by the climate change such as heavy rainfall and cyclones can destroy infrastructures and the accommodation facilities which will limit the choices for the tourists. This effect also gives clear cut loss for the owners as they need to spend more on repairing the damages rather than making revenue out of it.

The wholesale and retail trade sector is main sector that generates income for the labours. The table 3 and table 4 shows a highest number of tourist expenditure and initial income compared with all the other aggregated sectors both years. Regardless of the high numbers shown, it is also another sector with a high impact of climate change. Besides, the initial income has grown about 37% (RM67.19 billion) from year 2010 to year 2015 projecting the importance of this sector in tourism industry. In year 2010, the initial income has decreased 8.72 percent which is from RM112.4 billion to RM9.01 billion almost similarly in year 2015 the initial income has decreased 8.73 percent (RM 179.6 billion to RM 14.42 billion). As the climate change introduces new risk in this industry, it also pressures the income of the business. The business owners bare losses due to the new risk and also during the process of adaptation to new rules and regulations. Furthermore, the climate change stresses the industry to also accommodate new technologies for the business to reduce the impact of climate change. This scenario also may be the reason for the decline in initial income.

Transportation sector also negatively affected due to climate change. In year 2010 the initial income fell 8.48 percent which is correspondingly in year 2015 the initial income also declined 8.41 percent. The extreme weather due to climate change the transportation sector have certainly caused damages in the system. These damages may lead to losses and more money to be pumped out for repairing cost such as in highways and roads. The air transportation may face a major income downfall since there will be lesser tourists able to travel via flight.

The other six aggregated sectors also stipulate a decrease in the initial income for year 2010 and year 2015 which is less than 2 percent. However, the pressure faced in the income is not as severe as the five other sectors discussed above. The utilities sector in year 2010 shows decline of 1.68 percent and 2.02 percent in year 2015. This shows the utilities sector also faces much pressure due to climate change in year 2015 compared to year 2010. This may be because more business relying on climate and the extreme weather can disrupt the income of labours in this sector. Likewise all the other sectors decline in income have also increased from year 2010 to year 2015 such as the agriculture sector have decrease 1.34 percent, mining and quarrying sector have decreased 0.57 percent, manufacturing sector shows a drop of 1.07 percent, construction sector 0.54 percent and lastly services sector 0.91 percent.

Table 3 Income Multiplier year 2010 (RM, 000)

Sector	Tourists Expenditure		Initial Income	Income Multiplier	Decrease in Income	Income Changes (%)
Agriculture, Forestry and Fishing	0		77,038,312	1.35	709,526	-0.93
Mining and Quarrying	0		89,211,066	1.09	385,326	-0.43
Manufacturing	0		183,655,422	2.66	1,341,439	-0.74
Utilities	0		22,942,228	1.57	379,552	-1.68
Construction	0		23,129,860	2.05	19,454	-0.08
Wholesale & Retail Trade and Motor Vehicle	98,351,190		112,408,782	1.36	9,017,269	-8.72
Accommodation	5,363,749		4,434,700	1.80	369,749	-9.10
Restaurants	24,791,165		15,201,732	1.81	1,687,549	-12.49
Transportation	26,662,227		18,884,346	2.20	1,476,755	-8.48
Amusement and Recreational Services	11,404,258		5,228,658	2.08	639,288	-13.93
Services	0		253,027,637	1.58	2,007,699	-0.80
TOTAL	166,572,588.29		805,162,744.56	19.54	18,033,606.44	-0.57

Table 4 Income Multiplier year 2015 (RM, 000)

Sector	Tourists Expenditure	Initial Income	Income Multiplier	Decrease in Income	Income Changes (%)
Agriculture	0	97,462,480	1.19	1,291,835	-1.34
Mining and Quarrying	0	102,217,932	1.19	578,618	-0.57
Manufacturing	0	245,441,117	2.84	2,604,110	-1.07
Utilities	0	33,441,787	1.60	662,324	-2.02
Construction	0	52,836,039	2.31	284,590	-0.54

Wholesale & Retail Trade, Repair of Motor Vehicles and Motorcycles	117,222,657	179,602,322	1.40	14,420,146	-8.73
Accommodation	8,694,354	7,421,331	1.52	910,624	-13.99
Food and Beverage	44,388,017	26,754,565	1.89	3,411,437	-14.61
Transportation	33,810,004	33,820,131	2.01	2,624,764	-8.41
Arts, Entertainment and Recreation	15,737,089	8,716,358	1.84	1,212,253	-16.15
Services	0	340,419,027	1.50	3,056,756	-0.91
Total	219,852,121.06	1,128,133,088.83	19.30	31,057,456.06	- 0.68

4. CONCLUSION

The important service sector, tourism industry will also be affected by this climate change directly and the economy may have to face the consequences. This study's main objective is to analyse the overall impact of climate change on Malaysia's tourism sector and its effect on the economy and to examine the effects of industrial's output change on households' income level. To achieve the objectives of this study, output multiplier and income multiplier analysis have been carried out comparing 13 aggregated sectors for the year 2010 and year 2015. Both multipliers show that there are five main sectors with the highest negative impact which are arts, entertainment and recreation sector, food and beverage sector, accommodation sector, wholesale and retail trade, repair of motor vehicles and motorcycles sector and transportation sector for the year 2010 and 2015. The other six sectors also show an unfavourable percentage for both output and income multiplier but much lesser percentage. From the analysis, it can be said that the tourist expenditure in this sector have also increased along with the impact of climate change.

In attempt to cope with climate change, both adaptation and mitigation should be enforced in an integrated and balanced manner. Raising awareness the government has also conducted formal and informal education for the general public which also eventually received attention from the private sector. Malaysia also have successfully moved from the use of the Revised 1996 IPCC Guidelines for National Greenhouse Gas (GHG) Inventories to the 2006 IPCC Guidelines. As a result, the private sectors also have started with adopting low GHG emission practices in their business operations. This are evident in the oil and gas, public utilities, transport, cement production and construction industries.

In the area of adaptation to the issues of climate change and increasing extreme weather challenging Malaysia to sustain its pace of national development. Consequently, it is urgent to evaluate the vulnerabilities of the nations in key sectors and improve its resilience to

safeguard the development gains. This also calls for a holistic and integrated national adaptation plan that integrated the elements of disaster risk reduction from the Sendai Framework and the Sustainable Development Goals. Malaysia have begun this endeavour through the National Adaptation Plan through years but more resources and funding are required to develop a full national adaptation plan to enhance systematic observation and research in key areas.

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