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The Ecological Footprint of Tourism in Jalapão/TO/Brazil

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***Abstract*—**The development of tourism causes negative impacts on the environment. It is in this context, through the Ecological Footprint (EF) method that this study aimed to characterize the impacts of ecotourism on the community of Mateiros, Jalapão, Brazil. The EF, which consisted in its original a method to construct a land use matrix, considering some major categories of human consumption such as food, housing, transportation, consumer goods and services, and six other categories from the main land use which are divided into the topics: land use, degraded environment, gardens, fertile land, pasture and forests protected by the government. The main objective of this index is to calculate the land area required for the production and maintenance of goods and services consumed by a community. The field research was conducted throughout the year of 2014 until July 2015. After the calculations of each category, these components were added according to the presented method in order to determine the annual EF of the tourism sector in Mateiros. The results show that the EF resulting from tourism in Mateiros is 2,194.22 hectares of land required for tourism activities in the region. The EF of tourism was considered high, nevertheless, if it is added the total of hectares needed annually for tourism activities, the result found would be 2,194.22 hectares needed to absorb the CO_2 emissions generated in the region directly from the tourism sector.

***Keywords*—**Sustainable tourism, tourism ecological footprint, Jalapão/TO/Brazil.

I. Introduction

AIMING to analyze the environmental impacts of tourism, the indicator proposed by Rees and Wackernagel referred to as the EF, is applied [1]. In its original approach, it consists of building a land use matrix envisaging numerous categories of human consumption such as housing, food, transportation, consumer goods and services, as well as six main categories of land use including energy land, degraded environment where the degradation took place for construction activities, gardens, fertile lands, pastures and forests protected by the government. The main objective of this index is to determine the area of land necessary to produce and maintain the goods and services consumed by a community. An adjustment was made in 2002 [2], since it was created as a measure to figure the quantity of bioproductive lands, land used for construction activities and land use impacts of fossil fuels required to endure the tourism activities. This analysis implemented by [2], established four categories of consumption including transport, accommodation, leisure activities, and finally, food and fibre intake, and may have one or more types of land associated with each category, as it will be shown later in the detailed method. Thus, the EF of tourism was applied to assess the environmental impacts of tourism activities in the tourist region of Jalapão.

The EF has been defended by some scholars as an important ally in the analysis of sustainable tourism development [1], [3]-[5].

Generally, the EF performs calculations combining the use of energy, food, raw materials and water, as well as to measure the impacts related to transportation and the production of waste, in the same way, and the loss of productive land associated with the construction of buildings, roads and other aspects of the construction activities [3]. Conversion factors for the global hectare (GHA) unit are used to express the magnitude of the impact of all components [6].

Reference [5] states that the politics face difficult decisions with regard to tourist destinations where there is little information about the economic, social relations and environmental costs and impacts of these activities. Thus, the EF has been used by the scientific community for its easy understanding concerning the way to express the final results: hectares of land [7].

Four categories of consumption were established, namely: transport, accommodation, leisure activities and food and fibre consumption [2]. It is possible to exist one or more types of land associated with each category, as it will be seen further in the detailed method. To calculate the EF of tourism, the lands considered include bio-productive lands, built land and land use impact of fossil fuels.

The transportation category is related to land use impact of fossil fuels (fossil fuels burnt on transportation), as well as the land used for construction activities to serve transportation needs, for example, airports. The accommodation category is related to construction activities lands predetermined for building hotels, inns, restaurants, as well as the land use impact of fossil fuels of the daily energy consumption of the hosting arrangements.

The category of activities is linked both with land use impact of fossil fuels (energy demand in leisure activities) and also with the land used for construction activities (construction of parks, recreation areas, etc.). Likewise, the category food and fibre consumption is associated with bioproductive land (forests, croplands, pastures, fishing), according to [8], which points out that the proposed adaptation of EF for tourism [2] considers the category, accommodation, as all areas required for the construction of rooms/apartments, gardens, restaurants and others. The land use impact of fossil fuels from this

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category is equivalent to the energy use (heating, air conditioning, kitchen, lighting, cleaning, etc.). In the category of activities, the authors consider the visitations to recreational sites to assess the amount of land and energy that these activities require to be carried out. Therefore, the measurement unit used is occupied area by hectares. Finally, the category of food and fibre measures the total agricultural land, productive aquatic spaces, forests and pastures necessary for the production of food and fibre consumed by tourists.

Reference [9] proposed an adjustment to the studies conducted by [2], because they considered that there was a gap in the analysis conducted by the original authors of the Ecological Footprint Tourism (EFT) due to the fact that they disregarded the categories of water consumption and solid waste generation.

II. Methodology

For this analysis, the EF were chosen for its calculation purposes relating to tourism in the city of Mateiros, the following categories, based on the work of [8], with the exception of the category Shipping, which does not apply in the region, and the land transport category addition which is adequately adapted in the surveyed area, as can be seen in Table I.

TABLE I
CALCULATION OF THE EF [10]

Category	Main Land Use	Calculation of the EF
Transport	**Built Environment**	1) Estimate the total number of leisure tourists visiting the tourist destination in the year under investigation; 2) Identify the area in hectares of transport infrastructure used by tourists (airports, ports, airfields, parks, parking lots, highways, existing railways); 3) Add all areas belonging to the airport get its infrastructure surface area; 4) Divide the surface area by the number of tourists.
	Land Use Impact of Fossil Fuels	Air Transport: 1) Estimate the total number of passengers per flight bound to Jalapão; 2) Estimate the average distance traveled for each flight; 3) Evaluate the whole distance flown per passenger -kilometer (pkm) by multiplying the distance flown (km) by total passengers; 4) Multiplying total distance flown (pkm) the energy intensity factor (2 MJ/pkm or 2 megajoule/pkm) [2] for the energy consumption for each flight; 5) Convert the results from item-4 to gigajoules (GJ or a thousand MJ); 6) Divide the energy consumption of the flight (GJ) by the total of passengers to identify the energy consumption per capita; 7) Divide the energy consumption per capita (GJ/cap) by 73 GJ/ha/yr, (yr = year) to determine the amount of fossil fuels demanded per capita (ha/cap); 8) Estimate the fossil fuels required per passenger by multiplying the results of item-7 by the correction of the factor of high altitudes is 2.7. Land Transport: 1) Estimate the total number of tourists who visited Jalapão according to the data from the State Tourism Development Agency; 2) To estimate the amount of consumed per vehicle in liters per displacement (round trip); 3) Multiply the total liters consumed in a month by 2.63 (every liter of gasoline burned releases 2.63 kg of CO_2), and then divide the total by 1,000 to get the total tons of CO_2 emitted;4) For every ton of CO_2 emitted, a hectare of land for absorption of Intergovernmental Panel on Climate Change (IPCC) is required; 5) Divide the total CO_2 obtained in item 4 per 1 (1 hectare of land can absorb one ton of CO_2 produced by tourism sector); 6) Divide the value found in item 5 by the total number of tourists visiting Jalapão;
Water	**Land Use Impact of Fossil Fuels**	1)Estimate the consumption of water in cubic meters of 1 hotel room (consider that the average consumption is 120 L/guest/day); 2) Convert the result of the previous item to megaliter (ML); 3) Calculate the total CO_2 emitted, by converiting ML into tons. Estimate that during the treatment process and distribution of water that 0.37 tons of CO_2 are released for every ML of water; 4) Estimate the total occupied hotel beds in a year; 5) Multiply the consumption of water per hotel room by the number of available beds.
Waste Solid	**Built Environment** [a]	1) Estimate the total number of beds in the hotel infrastructure. 2) Multiply the land area required for each bed considering the total amount of beds in hotel infrastructure.
Activities Leisure	**Land Use Impact of Fossil Fuels** [b]	1) Estimate the total number of tourists visiting the tourism destination in the year under investigation; 2) Estimate the suface area (sa) of all built areas in the tourist attractions of each destination; 3) Divide the attraction suface area by the amount of tourists who have visited Jalapão.
Food and Consumption Fibre	**Bioproductive Land**[c]	1) Identify the nationality of the tourists visiting the destination under investigation; 2) Identify the food and fibre consumption of tourists in their city throughout one year; 3) Calculate all food consumption values and fibres found within one year; 4) Calculate the average spending by tourists per year; 5) Divide the value found in item 4 by 365 (or 366 for a leap year); 6) Multiply the value found in item 5 by the average length of stay at the destination.

a. Estimate the area required per bed, considering that, in general, the built environment amount needed per bed is 60 m^2, for a luxury hotel is 200 m^2, 100 m^2 for one to two-star hotels, 300 m^2 for three to four-star hotels, 2,000 m^2 in five star hotels, from 300 m^2 apartments to 50 m^2 for private houses, and 15 m^2 for boats (already including the harbor area). b. For the purpose of calculating the footprint for the category activities, considered only the areas related to the golf courses. Thus, adapted here to built environment concerning the most visited tourist attractions: c. To calculate the food consumption category and fibres, it was considered that visitors in a tourist destination consume the same types of food and fibre in their home country.

III. Results and Discussions

A. Transport Category–Subcategory Environment Built

For calculating the subcategory of Environment Built, it was necessary to estimate the number of leisure travellers who visited the region in the year chosen for the investigation. Through interviews with park managers, the number obtained was 8,726 [10], and the existing transport infrastructure in place, in this case, Mateiros most common access via Palmas, the capital of the Brazilian state Tocantins.

In regard to the existing transport infrastructure, it was noticed that the main mean of transportation used to travel to the location is by car. The local airport is small and does not have the necessary infrastructure to receive tourists. Hence, it will not be considered in Mateiros as transport infrastructure for tourism: airports, ports, airfields, parking lots and railways parks, due to the inexistence in the region or are unrepresentative.

As it was considered that the access roads connecting the city to the surrounding cities were not created specifically to meet the needs of tourism in the region, but for the local residents, only the highways connecting the city of Mateiros to the main attractions of were recognized for the EF calculation. Considering also that some attractions are on the same route,

the roads were measured considering only the differences among attractions. In Table II, the attractions that are on the same route were divided by shades of the same colour, and the first that appeared was added to other routes built.

TABLE II
MEASUREMENTS OF DISTANCES AND ROAD WIDTHS FOR ROUTES TO THE ATTRACTIONS IN THE REGION

ATTRACTION	Distance from the city to the entrance of the attraction (meters)	Average road width (meters)	Area (m^2)
Mirante da Serra do Espírito Santo	24,840.00	11.06	274,730.40
Dunas	+ 8,100.00*	7.45	60,345.00
Fervedouro dos Buritis	1,990.00	6.50	12,935.00
Fervedouro do Ceiça	+ 12,170.00*	7.26	88,354.20
Cachoeira do Formiga	+ 8,010.00*	940	75,294.00
TOTAL	73,020.00	8.33	511,658.60

* + = distance added to previous path.

The total value of transport infrastructure calculated was 51.16 hectares; if this amount is divided by the number of tourists who have visited Jalapão in 2014, the amount found will be 8,726, which is the value of the EF of Tourism in the subcategory Environment Built in the category Transportation which is 0.0058629 per tourist.

B. Subcategories of Land Use Impacts of Fossil Fuels in Air Transportation

Analyzing this subcategory of air transportation, it was necessary to estimate the number of passengers in each flight to Jalapão and the main places of origin of these passengers to estimate the distance flown of each passenger to find out the total distance of passenger kilometres flown (pkm). For this, it was necessary to establish a parameter in order to calculate this subcategory. Tour operators working in the region were contacted to obtain this data. The results show that 2,805 leisure travellers in the year of the survey used aeroplanes as a means of transportation to arrive in Palmas, the capital of the Brazilian state Tocantins and the closest big city.

In addition to the estimation of distances flown by tourists visiting Jalapão, it was taken as a parameter the total number of flights arriving in Palmas in that year. In 2014, there were nine daily flights to Palmas (Palmas is the capital of Tocantins, Brazilian state, which is the closest big city from Jalapão with better infrastructure. Mateiros is a small village in Jalapão State Park). Multiplying the total amount of daily flights to Palmas times 365 days of the year the value obtained is 3,285 flights to Palmas.

The total amount of tourists who visited Jalapão via air transportation was divided by the number of flights to Palmas; the number obtained was 0.853881 passengers per flight, due to the fact that an aeroplane heading to Palmas transports many passengers at once, nevertheless, the final destination of all of them is not Jalapão.

Furthermore, it was necessary to know the main provenance of passengers visiting to Jalapão. The data was collected with representatives of hotels, camps and tour operators. After obtaining the passengers main provenance, the Air Distance Calculator was used to find the distance in kilometres from the provenance place to Palmas. The results are highlighted in Table III.

TABLE III
TOTAL DISTANCE ESTIMATION FLOWN FROM THE PROVENANCE PLACE TO PALMAS/TO/BR (KM)

Origin	Distance	Proportion	Distance flown for weighted average
South-west	1,492	18	26,856
North-east	2,334	3	7,002
Central	623	2	1,246
South	1,932	3	5,796
Total	6,381	26	40,900
Weighted average		1,573.077	

Following the same reasoning, it was calculated the total distance passenger kilometres flown (pkm), the total distance by flight obtained multiplying by two the final weighted average from Table III, considering that in a normal fly travel, there is one flight to go and one to go back to the provenance place. Moreover, it is considered that to get the total distance passenger kilometres flown (in pkm); it should be multiplied times the total distance flight (in km) by the number of tourists visiting Jalapão via air transportation. The results can be seen in Table IV.

TABLE IV
TOTAL DISTANCE PASSENGER KILOMETRES FLOWN TO PALMAS

Total distance per flight in Km	Number of tourists/flight	Total distance flown (in pkm)
3,146.15	0.853881	2,686.44

TABLE V
SUMMARY OF AIR TRANSPORT CATEGORY CALCULATIONS: LAND USE IMPACTS OF FOSSIL FUELS

	Item	Calculation
1	Total amount of tourists who go by plane to Jalapão/year	-
2	Total amount of flights to Palmas/day = 9	9 x 365 days
3	Passengers per flight	Item 1/Item 2
4	Distance per flight (km)	Weighted average from main destinations 1,573.077 x 2 (round trip)
5	Distance flown * total amount of passengers (pkm)	Item 3 x Item 4
6	Flight energy consumption	Item 5 x 2
7	Consumption in GJ	Item 6/1.000
8	Consumption *per capita*	Item 7/100 * Item 3
9	Quantity of land from fossil fuels requested *per capita* (ha/cap)	Item 8/73
10	Land use impacts of fossil fuels requested per passenger	Item 9 x 2,7
11	Land use impacts of fossil fuels requested per passenger/year	Item 10 x Item 1

According to the methodology proposed by reference [2] aiming to calculate land use impact of fossil fuels on air transport, the value obtained of the total distance passenger kilometres flown (pkm) must be multiplied times the energy intensity factor (2 MJ/pkm) in order to obtain the energy consumption of the flight. Thus, the value obtained was 5,372.88 MJ/pkm. This result must be converted to GJ, which

value was 5.37 GJ, considering that 1GJ = 1,000 MJ. Next, it should be divide the energy of flight consumption (GJ) by the total amount of passengers to identify the energy consumption per capita, as well as dividing the per capita energy consumption (GJ/CAP) by 73 GJ/HA/YR, which YR means year to determine the amount of fossil energy land demanded per capita (HA/CAP) and finally again to estimate the fossil energy land required per passenger, multiplying the result of the previous item by the corrected factor to high altitudes, it means, 2.7 [2]. The results are shown in Table V. Thus, it was necessary 4,7685 hectares for the tourists visiting Jalapão via air transportation.

C. Subcategories of Land Use Impacts of Fossil Fuels in Land Transportation

In order to calculate the land use impacts of fossil fuels on the subcategory of transportation, it was necessary to know the total amount of tourists who visited Jalapão in 2014. As the tourists who arrive via air transportation in Palmas willing to go to Jalapão by automobile, also need to go from Palmas to Mateiros via roads; it was considered the total of 8,726 tourists who visited Jalapão in this year. Moreover, it was necessary to know the total amount of fuel litres necessary to accomplish one-way trip from Palmas to Mateiros. Considering a four-wheel drive car, which are the vehicles most commonly used in the region due to the road conditions, the average of fuel consumption is 1 litre/6 Km (Brazilian unit of measure) with a total of 800 km when it is a round trip, the result obtained is an average of 133.3 litres of fuel used in a round trip from Palmas to Jalapão.

TABLE VI
SUMMARY OF LAND TRANSPORTATION CATEGORY CALCULATIONS: LAND USE IMPACTS OF FOSSIL FUELS

Values		Item	Calculation	Values
2,805	1	Total of tourists	-	8.726
3,285	2	Total of litres of fuel by round trip from Palmas to Mateiros	880 km divided by 6 km/1 litre	133.3
0.853881279	3	Total of tons emitted of CO^2 by trip	Item 2 x 2,63/1,000	0.350579
3,146.15	4	Total of tons of CO^2 emitted per trip and per tourist (Average of 3 people by car)	Item 3 divided by 3	0.116859667
2,686.44	5	Necessary area to absorb the CO^2 emitted (ha) per tourist	Item 4	0.11686
5,372.88	6	Necessary area to absorb the CO^2 emitted (ha) per all the tourists throughout the year	Item 4 x item 1	1,019.71745
5.37	7	Fossil energy land requested for all passengers/year (ha/year)	1,019.7174	

Still following the method used, 1 litre of gasoline burned releases 2.63 kg of CO_2 and 1000 kg corresponds to 1 ton, obtained the total amount of CO_2 tons emitted in the trip to Jalapão, considering that the total of litres consumed are multiplied times 2.63 and the result divided by 1000, the result obtained was 0.350579, but knowing that each car takes about 3 tourists, it was necessary to divide it by the average tourist by car. Therefore, the value is 0.116860.

According to [8] since the data from the Intergovernmental Panel on Climate Change (IPCC) for every 1 ton of CO_2 emitted is necessary 1 hectare of area for absorbing it, the area required to absorb the CO_2 emitted per tourist is 0.116860 ha. The surface area requested for the category of land use impacts of fossil fuels on the subcategory of transportation was 1019.71745 ha, this result obtained per tourist must be multiplied times the total number of tourists visiting Jalapão in 2014 (8726). Below, the calculations are shown on Table VI.

D. Water Category

In order to calculate the land use impacts of fossil fuels from this category, it is considered that in the process of treatment and distribution of a megalitre (ML) of water it is released 0.37 ton of carbon dioxide.

The emission of CO_2 is generated from the water treatment process. As in the year of this research there was still no water treatment, it was decided to neglect it in the annual EF of tourism in the city of Mateiros. Thus, this category was calculated for information purposes aiming to understand possible environmental impacts that may arise after the water treatment, which began in mid-2015.

E. Solid Waste Category

The Jalapão region does not have a solid waste treatment plant and its storage occurs in dumps. This already implies environmental impacts in the locality.

To perform the calculation of this item, it was necessary to estimate the daily volume of waste produced in kilograms per tourist, the average number of days that they were in the place and the total number of tourists who visited the town in the year chosen for the research.

As there is no estimative of the volume of waste produced per capita in the region, it was decided to use the average of Brazil which is 1.5 kg of waste/day in Mateiros survey, pointing out 8,726 tourists visiting Jalapão in the year of this study, with an average of 3 days stay, so, the of waste produced by each tourist is 4.5 kilograms, due to the time spent in the place (1.5 x 3 days) and 39,267 kg of solid waste or 39.267 tons (39.267 kg/1000). This value is converted in tons of CO_2, according to [9], 0.00135 ton of waste is equivalent to 0.00045 tons of CO_2, and so, it has the value of 13.089 tons of gas in Mateiros (39.267 x 0.00045/0.00135). Therefore, following the parameters of these authors, 1 ton of CO_2 is assimilated by 1 hectare of land, in Mateiros 13.089 hectares of land are necessary to absorb the carbon dioxide produced.

Reference [8] also highlights that waste also produces methane gas (CH_4) which are also absorbed by forests and aiming to calculate the EF it is necessary to multiply the total number of hectares required to absorb CO_2 x 2, considering that methane gas has the same characteristics as carbon dioxide. Therefore, it is demanded 26.178 hectares of land

(13.089 x 2) to absorb CO_2 and CH_4 resulted from solid waste generated by tourists in Mateiros, Jalapão, Tocantins, Brazil.

F. Accommodation Category and Built Environment

In order to calculate built environment, it was obtained the number of inns, hotels and beds in the region, as well as the number of tourists that have visited Jalapão in the year of this study. For calculating land use impacts of fossil fuels, the study used the quantitative of inns and beds existing in the city, the estimative of energy consumption per guest, the number of tourists who visited the place and the average number of days spent in the region.

As there is no hotel with more than 90 beds in Mateiros, according to research conducted with the owners of inns in Mateiros, all hotel projects were classified as inns. Hence, it is considered the amount of 60 m^2 per bed is required. There are seven inns in Mateiros, which together provide 220 beds in the city. By multiplying the total number of beds in the city required by the quantitative m^2 per bed, the value of 13,200 m^2 of built environment is obtained. If one hectare is equal to 10,000 m^2, the value obtained is 1.32 hectares of built environment.

G.Accommodation Category and Land Use Impacts of Fossil Fuels

For the category land use impacts of fossil fuels requested to absorb the CO2 emitted by power generation of tourism accommodation, considering that the energy consumption in a inn is 130 MJ/bed/night in traditional hotels, according [9], the average stay of tourists visiting Jalapão was three days, it was possible to obtain the energy consumption of tourism in Mateiros in 2014 to be 390 MJ/bed (130MJ/bed/night x 3 nights). To obtain the estimative of energy consumption throughout the year, this value is multiplied by 8,726 tourists visiting Jalapão in 2014, the amount observed was 3.403.140 MJ.

The conversion of the MJ to GJ in order to calculate fossil energy land was needed. Therefore, it took 3403.143 GJ to meet the needs required by the tourism activity. It was necessary to divide the per capita energy consumption (GJ) by 73 GJ/Ha/Yr to determine the amount land use impacts of fossil fuels. The value of 46.61839 was the land use impacts of fossil fuels and that the tourism in Mateiros consumed all the carbon dioxide released into the atmosphere.

H.Leisure Activities Category

Aiming to calculate the EF for the category leisure activities, which has as its main objective the analysis the environment built necessary to respond the needs of tourism, the estimated quantity of tourists that visited the city, in this case, it is known that it was 8726 in the year of the study. Moreover, the calculation of environment built was performed in most visited touristic attractions of Mateiros. To obtain these values, measurements of the main attractions were made and the values are shown in Table VI. Thus, it was necessary for 16.03602 hectares of environment built to visit Jalapão in 2014. It should be noted that this structure tends to increase with each passing year, since the number of tourists is growing. Environmental impacts are perceived, as discussed earlier in this study.

TABLE VII
ENVIRONMENT BUILT IN TOURIST ATTRACTIONS

Attraction	From de road to attraction (in m^2):	Attraction (in m^2)	Environment Built (in m^2)
Dunas	91,885.7	805.7	92,691.4
Fervedouro Ceiça	1,332.0	815.0	2,147
Serra E. Santo	2,904.0	3,177.5	6,200.50
Formiga	58,590.0	731.3	59,321.30
Total of Built Constructions			160,360.2

I. Food and Fibre Intake Category

For the sake calculating the category food and fibre consumption, [2] considered that tourists in a tourist destination consume the same types of food and fibre available in their place of provenance. But, as the city of Mateiros has no infrastructure of medium-sized restaurants at least, so it is not possible to have diversified food which refers to the method proposed for food and fibre consumption, and therefore, this category will be considered based on local references, in other words, the consumption of fibres in Brazil.

It was necessary to know the average footprint of food and fibre consumption in Brazil, which according to the Living Planet Report [11] is 2.35 hectares of land, considering agriculture, pasture, fishing areas and forests. It was necessary to calculate the EF of consumption of food and fibre for the period in which the tourists stayed in Jalapão. Thus, if the divided value obtained in the average footprint and food and fibres for 365 days (2.35/365 days) obtaining the value of 0.006438. This value is multiplied by the average time that tourists stay in Jalapão (three days) obtaining the value of 0.01931, which was multiplied times the total number of tourists who visited the region in this period which was 8726, totalling 168.542 hectares of bioproductive land.

J. EF of Mateiros Tourism

From each category after the calculations of the components were made following to the proposed method aiming to discover the EF of annual Mateiros tourism, it was necessary to calculate the sum of Land Use Impacts of Fossil Fuels of each category, namely: Land Use Impacts of Fossil Fuels of air transportation (4.7596 ha), Land Use Impacts of Fossil Fuels of land transportation (1,019.7174 ha), Land Use Impacts of Fossil Fuels of accommodation (46.6183 ha) Land Use Impacts of Fossil Fuels of solid waste (26.178 ha). The Land Use Impacts of Fossil Fuels of water is not going to be calculated. However, for this category it was requested 1,097.2733 hectares of land. After the calculations made in each category, all the results were summed following the proposed method in order to obtain the annual tourism EF of Mateiros.

Similarly, the EF of Environment Built which should be considered in the case of the object of study, only Environment Built of accommodations (1.32 ha), Environment Built of roads (50.47 ha) and Environment Built of tourist

attractions (16.03602 ha) which result of all these groups summed is 67.82602 hectares needed for this category.

For the category of Bioproductive Land, the value of 168.542 hectares was obtained; the calculation of the EF was followed by the proposed method which provided the multiplication of equivalence factors. Thus, the category of Land Use Impacts of Fossil Fuels (1097.2733 ha) should be multiplied times 1.8, the result of which was 1,975.0919 ha and the category of Built Lands (67.82602 ha) which is multiplied by 3.2 to generate a total 217.04326 ha, that after adding the values of the Environment Built, Land Use Impacts of Fossil Fuels and Bioproductive Land, the EF of Tourism in Mateiros was presented, which is 2,361.606 hectares of land requested for tourism sector in the region.

The category with greater Land Use Impacts of Fossil Fuels is the subcategory of Land Transportation. It is believed that this high number is not only the 800 km of road needed to gain access to Mateiros, but also the poor conditions of the main roads that are the main access routes to Mateiros, consequently making the land displacements longer and enhancing vehicle fuel consumption.

IV. Conclusion

Concerning the EF of Tourism, as presented in the previous chapter, it was considered high because, when added up, the total number of hectares required annually for tourism activities was 2,194.2263 hectares to absorb the CO_2. When this figure is compared to the total value of Mateiros, which is according to IBGE data 969,125.5, it is considered small; however, when it is compared to the area of Jalapão State Park, which is 158,000 hectares and holds the greatest tourist attractions of the region, it can be considered high, and if this situation continues, within 10 years, it is estimated probably 21,000 hectares would probably be needed for the tourist activity in the region, what represents more than 13% of the park total area.

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