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Relationship between tourism and climate change

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1. Summary

Tourism is one of the greatest generators of CO₂. Furthermore, the growth forecast is very high, expecting travels to be 1.8 billion in 2030. As a result, climate change will become more severe and many areas will be badly affected such as coastal areas and islands. It is necessary to carry out a study and analysis of the links that connect these two topics in order to be able to face them more effectively. Having the necessary information to do so, it will be possible to develop strategies and tools to minimize their effects and achieve greater adaptation. This adaptation and mitigation are of special interest here in Spain, as our country is very dependent in tourism and is one of the most sensitive areas.

2. Introduction.

Tourism and climate change have a reciprocal relationship. In recent decades, there has been growing interest in the study of the two subjects, both because of the growing importance of tourism in the world economy and because of the evidences of the current and future effects of climate change. Given the mutual impacts between tourism and climate change, the study in this relationship have become important.

According to the World Tourism Organization (UNWTO) tourism is defined as a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business purposes. Applied in practice, tourism is one of the most powerful industries worldwide with very important data. Around 1.4 billion people travelled in 2018, representing about 10% of total world GDP and every 1 of 10 employees are engaged in tourism, among many other data. This gives us an idea of the economic impact that tourism has on our global economy. Furthermore, tourism is expected to grow rapidly during next years, expecting 1.8 billion travels in 2030 (UNWTO, 2020).

The spectacular growth of tourism in the last decades have generated increasing impacts, many of which are contributing to global warming of the planet [...]. The important contribution of tourism to climate change makes it necessary to carry out efforts to reduce greenhouse emissions attributable to tourism. (Pulido-Fernández & López-Sánchez, 2014, p. 13)

Climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as:

A change in the state of the climate that can be identified by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings. (IPCC, 2020)

During last decades, and specially this last years, climate change has risen as one of the most relevant issues on the global agenda due to the precocity of its effects, which are being greater than expected. It is now a priority issue both for private companies and for the public institutions.

The effects of climate change in the coming decades in terms of rising temperatures, rising sea levels and erosion of the territory, among other impacts, could have an impact on tourism infrastructure and on the attractiveness of tourism in different areas, among which Spain could be specifically affected. The importance of these impacts may be important in Spain because of the special dependence of its economy on tourism.

The first step is to study and analyse present and future impacts of climate change on tourism in order to be able to design strategies in reducing impacts and develop a sustainable tourism. Many institutions at local, national and European level, are already reacting and have developed useful tools to provide potential solutions.

A possible solution is to apply the concept of sustainable tourism. Sustainable tourism is tourism that takes full account of its current and futures economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities (UNWTO, 2020).

Sustainable tourism can be developed by considering the social, economic and environmental context of each territory. This work has the objective to study the impact of tourism over climate change and also which are the effects that climate change is going to have and is having on tourism. In addition, I will revise the research on tools that could be appropriate to solve and mitigate those impacts.

3. Methodology.

First of all, I have researched data and literature about both subjects. Hereafter, I have formed the structure, which will be described below with its respective sources of information.

In order to study the relationship between tourism and climate change, I first present the time trends of both topics. Then, I present the links between tourism and climate change. Thirdly, I will identify the available tools and strategies to mitigate and fight those impacts. Finally, conclusions and key ideas will be given.

Trends in tourism in recent decades are analysed at a national level (Spain) using the following variable: the trends of international arrivals, the evolution of expenditure by tourist (Absolute figures and per person) and finally the weight of tourism in total GDP. The sources of information on these variables are respectively the following: Encuesta de movimientos turísticos en fronteras (Frontur: <http://estadisticas.tourspain.es/es-ES/estadisticas/frontur/Paginas/default.aspx>), Instituto Nacional de Estadística (INE: <https://www.ine.es/>) and World Travel and Tourism Council (WTTC: <https://www.wttc.org/>).

I performed an analysis of climate change by gathering information on climatic related variables. The variables analysed are: the evolution of global average temperature, the sea level rise and the evolution of heat waves in Spain. The sources of information used are: National Aeronautics and Space Administration (NASA: <https://www.nasa.gov/>) and Epdata (<https://www.epdata.es/>).

Once tourism magnitudes and climate change variables are described, the links between tourism and climate change will be analysed in both ways.

Effects of tourism on climate change will be examined by studying variables such as CO₂ tourism emissions, water consumption and waste production. The sources of information used were: Ministerio para la transición ecológica (MITECO: <https://www.miteco.gob.es/es/>), Ecounion (<http://www.ecounion.eu/>) and Institut de Ciència i Tecnologia Ambientals de la Universitat Autònoma de Barcelona (ICTA-UAB: <https://ictaweb.uab.cat/>).

Secondly, by looking at different information sources, like World Tourism Organization reports and scholarly papers, I study how climate change affects tourism.

After analysing the relationship between tourism and climate change, I have revised the tools, measures and strategies that private and public institutions have carried out and are planning to implement in the mitigation of those impacts. For this purpose, I reviewed data from official sources such as governments and national and international institutions. In addition, I performed a literature search on climate change and tourism both from scientific and academic resources. The keywords used were: tourism, sustainable tourism, climate change, relationship, impacts, mitigation policies.

4. Results.

In the following section, I'm going to present all the data in order to have a clear view of the size of these two subjects. In the tourism part, we will carry out a data analysis at a national level. Following that part, we will analyse climate change variables on different geographical levels.

4.1 Tourism.

Firstly, we are going to analyse tourism impact over the Spanish economy. Spanish data have been chosen as Spain is the second most visited country worldwide, as well as being the place where this project is being elaborated.

By using the data of FRONTUR, we see in the next chart the evolution of the international arrivals to Spain in the last 12 years. Arrivals have been always higher than 50 million people, however, during the crisis Spain had a small fall in the number of arrivals.

On the other side, from 2010 we observe an exponential growth in the number of arrivals reaching up to 82,8 million during 2018, being the second highest in the world just behind France (89,4M).

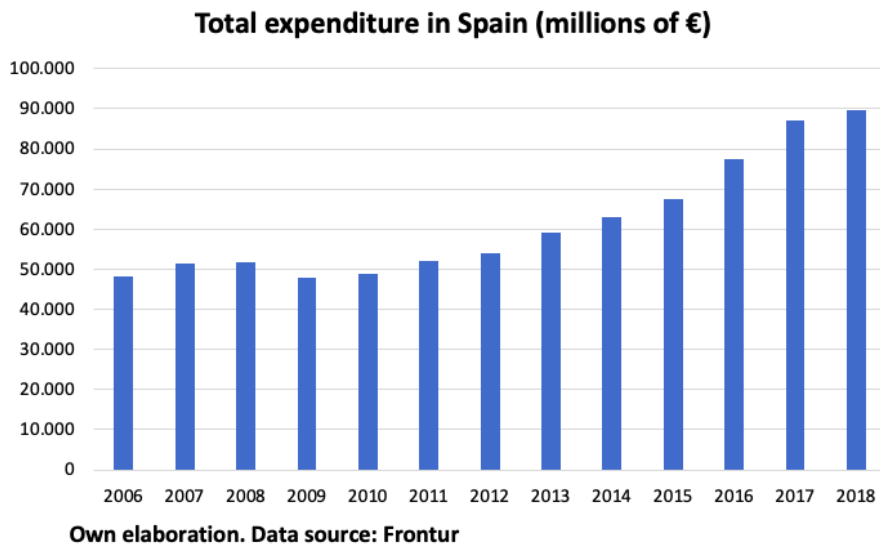
Figure 1. Trends of international arrivals to Spain 2006-2018.



This large number of arrivals is also connected to a high touristic expense. In the following charts it is described two indexes about the expenditure of international tourist in Spain.

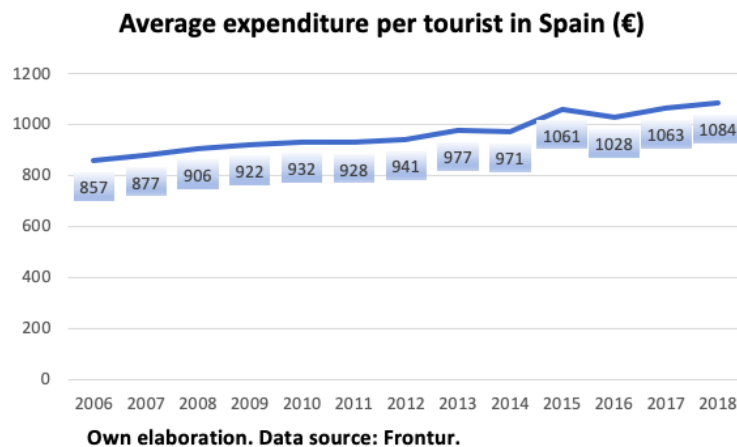
As we may observe, the trend is quite similar to the number of arrivals in Spain. We see how in 2007 and 2008 spending is over 50.000 million, however, during the crisis, total expenditure falls down to 47.961 million, recovering until nowadays and having a great increase between 2016 and 2017 of nearly 10 million euros. Last year total expenditure was of 89.750 million.

Figure 2. Total expenditure in Spain 2006-2018 (millions of €).



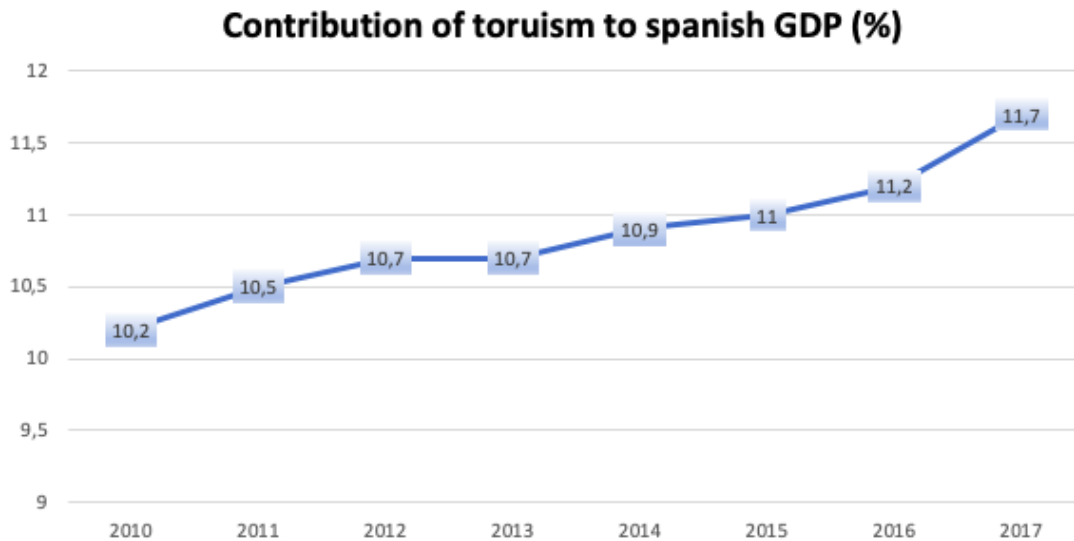
In the next chart we observe a very interesting index, the average expenditure per tourist in Spain. Values have been always increasing and higher than 850€. Last year, average expenditure has been more than 1000€, which is a good data as it means that tourism in our country is more valuable.

Figure 3. Average expenditure per tourist in Spain (€).



Finally, an important index to analyse is the contribution of tourism to total GDP. By using the data of INE and WTTC, we see in the next chart the evolution of tourism contribution to total GDP. As it is showed on the chart, the weight of tourism on the total GDP has been increasing in the last decade. Tourism is becoming increasingly important on our economy. On the one hand it is certainly beneficial for our society, but on the other hand this high dependence could damage the economy as a result of climate change, as we will explain later.

Figure 4. Contribution of tourism to Spanish GDP (%).



Own elaboration. Data source: INE

With the data, we see how huge the impact of tourism in Spain is. It is important to maintain this growth, but it is necessary to keep this growth on a sustainable way so that future generations won't be affected.

Although we have demonstrated that tourism is important for our economy, problem arises when climate change begins to affect our nature and resources and consequently affects tourism. Therefore, it is necessary to study and analyse climate change effects over tourism so that we can find strategies to mitigate them. Climate change seemed a long way off, but in recent decades national and European governments are beginning to legislate on this issue as we have exceeded expectations.

In order to introduce in the subject of climate change in the next section we are going to analyse some variable to know the real impact of climate change.

4.2 Climate change:

To reflect the climate change, we could analyse hundreds of data, but I decided to choose three variables that above all represent this phenomenon: the evolution of global average temperature, the evolution of the sea height and the evolution of the heat waves in Spain.

During the last years, the global average temperature has increased. This increase in temperature is going to affect agricultural production, water availability, health and natural areas. Some places are not going to be much affected, but there are a lot of other places like coastal areas or islands that are going to be more vulnerable.

By using data from the page NASA, we observe in the following chart how global average temperature has been increasing. Before 1980-1990, temperature was 0°C or below 0°C, however, from those years temperature began to increase dramatically. Nowadays, temperature is quite higher than 0, the last data obtained place the global average temperature at 0,98°C. If this temperature is not controlled, it will continue growing.

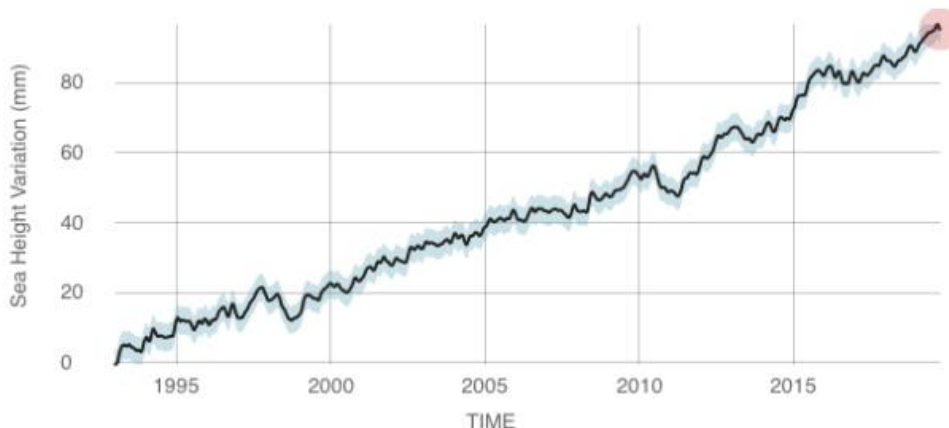
Figure 5. Evolution of the global average temperature (°C).



Source: NASA

The next chart that we are going to analyse is taken from the NASA (National Aeronautics and Space Administration), where it is shown the evolution of the sea height. As it is said by the NASA, sea level has been increasing constantly and nowadays has a rate of change of 3.3 mm per year which is caused primarily by: “the added water from melting ice sheets and glaciers and the expansion of seawater as it warms.” (NASA, 2019).

Figure 6. Evolution of the sea level height (mm).



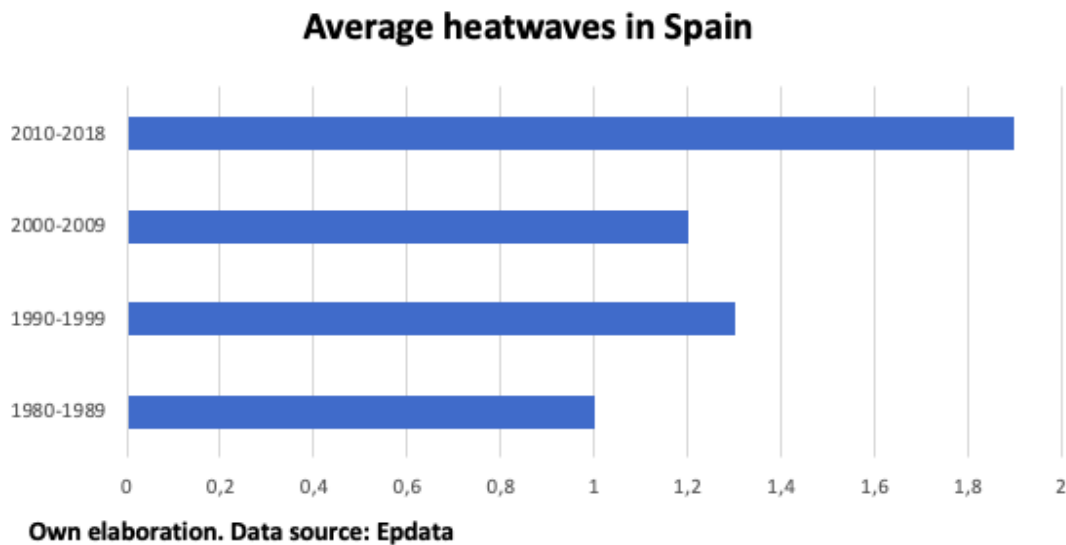
Source: NASA.

The following variable it's really impacting: average heatwaves in Spain. “With regard to climatic comfort in tourism areas of the Mediterranean seaboard, the forecast increase in the number of warm days, warm nights and the duration of

heatwaves in all the Spanish Mediterranean regions are significant.” (Cantos & Rebollo, 2016, p. 11)

Having a look at real data, it is very impressive as the heatwaves in Spain have increased in recent years. One of the effects of climate change is that it causes greater extreme temperatures in both winter and summer. In the following graph it is reflected how in the last decade heatwaves have increased from an average of 1,2 to 1,9.

Figure 7. Evolution of heatwaves in Spain (1980-2018).



Having analysed those charts, some questions arise: Which are the causes? How huge is the impact of tourism? Are there any solutions and mitigations? This is what are we going to answer in the following sections.

5. Tourism impacts on climate change.

As we will see in the following section, tourism has a great impact on climate change. Using different sources from books and articles we will study three impacts of tourism: the CO₂ tourism emissions in relation to global emissions, the water consumption and waste production. As you will see impacts are analysed on different geographic levels as it is complicated to find information of all impacts on the same level.

Having a look at the Guide to the climate change convention and the Kyoto protocol (2003), the following statement is exposed:

The world's climate has always varied naturally. Scientists believe, however, that a new kind of climate change is now under way. Its impacts on people and ecosystems are to be drastic. Levels of carbon dioxide and other 'greenhouse gases' in the atmosphere have risen steeply since the industrial revolution. Concentrations have increased mainly because of the use of fossil fuels, deforestation and other human activities, spurred on by economic and population growth. (*Caring for climate*, 2003, p. 1)

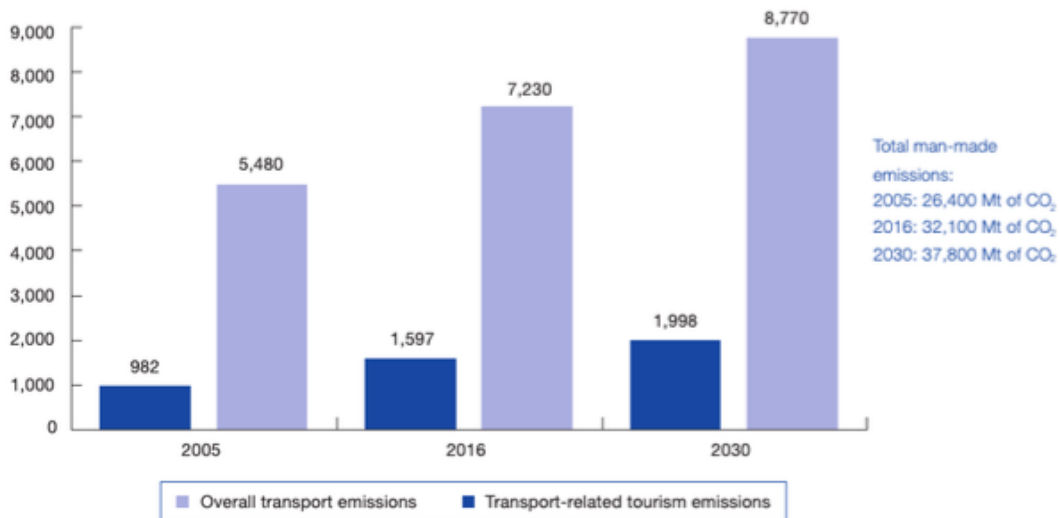
It follows from the last statement that tourism is directly in relation with climate change as tourism is part of the human activity. Then, it is necessary to measure this relation.

One of the major causes of climate change is the emission of greenhouse gases. Following the NASA statement (2020): Carbon dioxide (CO₂) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels. Among the activities that burn fossil fuels we find the transportation. The transport industry is a key activity in tourism and leads us to say that the current tourism development responds to the model of intensive energy consumption in large amounts of carbon emissions. (Pulido-Fernández & López-Sánchez, 2014, p. 5)

A recent study by the Instituto de Ciencia y Tecnología Ambientales de la Universidad Autónoma de Barcelona (ICTA-UAB, 2019), shows for example that air transport is the main source of pollution in Barcelona. This study shows that each visitor in Barcelona produces each day an emission equivalent to driving a car for 410km (96,9kg CO₂ eq), being the 95,9% associated with transport.

In order to have a clear view of global data, we can have a look at the next chart that shows the comparison between overall transport emissions against transport-related tourism emissions. Globally, we see a progressive increase in emissions. In relation to the transport-related emissions, they increased from 3.7% in 2005 to 5% in 2016, whereas from 2016 to 2030 this proportion is expected to increase to 5.3%.

Figure 8. Overall transport emissions VS. Transport-related tourism emissions (2005, 2016 and 2030).



Source: UNWTO (2019), Transport-related CO₂ emissions of the tourism sector.

Therefore, this chart demonstrates that tourism is not just a victim it also takes part in the impacts. Although tourism has a strong impact on the environment through the emissions of CO₂, it is also involved in another type of impacts. (Hamilton et al., 2005, p. 1)

Now we look how tourism affects to water consumption. As the foundation We are Water exposes, in 2017 while the average Spanish citizen consumes 127 litres per day, water consumption per tourist ranges from 450 to 800 litres, depending on the season and the area. These figures are calculated taking into account the hotel and restaurant consumption (cooking, laundry, toilets, swimming pools, refrigeration and irrigation), as well as activities such as golf, saunas, theme parks and municipal consumption.

A study, carried out in Calvia (Mallorca) by Gonzalez et al. (2019), shows the enormous impact of tourism on water consumption. Their findings were shocking.

In the study carried out in the field of PIAT, the average water consumption per resident and day is estimated to be 16 litres, contrary a tourist is estimated to consume 466 litres per person per day, demonstrating an excess of water resources by the tourism sector, especially during the summer season. Nowadays, the resources and infrastructure are overloaded, which increases the risk of water scarcity in the coming decades. The 35,9% of water bodies are overexploited [...]. Considering the forecast of decrease in rainfall due to the climate change and, at the same time, a possible growth of the incoming tourist and population in the coming years, there is a risk in the growth water requirements. (González et al., 2019, p. 15)

It is really surprising the huge difference between a resident in Calvia and a tourist. The difference is so drastic because of the decrease in population during

the low season which causes water consumption to be only 16 litres per day, however, during the high season the water consumption is overexploited being more than 460 litres per day.

In addition to consumption of water above limits, the rise in sea level also affects the water resources. If sea level rises, water resource will be “polluted” which will make them useless. Moreover, average precipitations are decreasing. Therefore, it is necessary to have control both on water consumption and on water resources, carrying out sustainable development.

Now we focus on how tourism is related to waste production. To know more about this impact, we are going to have a look at a recent project called Blueislands.

The project carried out a study between 2017 and 2018 in order to assess the impact of tourism on the waste generated on eight islands of the Mediterranean Sea. They have investigated different aspects such as the marine litter generated and its accumulation on sandy beaches, the enrichment of coastal waters by nutrients of anthropogenic origin and the waste generated by Tourist Accommodation Establishments (TAEs). And they present a clear conclusion: the seasonal increase of the population during the high touristic season, on the Mediterranean islands, is associated to an increase of the waste generated, representing a challenge for the local authorities.

The study found that the accumulation of marine litter during the high season is on average multiplied by 2.62 on the touristic beaches, 2.35 on the beaches mainly used by locals and 1.54 on the remote beaches compared to the low season. The most common items found were cigarette butts and pieces of plastic.

In relation with the enrichment of coastal waters by nutrients of anthropogenic origin results carried out in three different islands expose that the rise in population during the high season is directly in relation with the increase of organic and nutrients load as a result of an increase of sewage discharge.

Finally, the amount of waste generated by the TAEs situated behind the selected beaches where the marine litter surveys were conducted, show a clear seasonal pattern with on average higher amount of waste collected during July and August.

This study has the aim to analyse the impact of tourism during high season in the Mediterranean so that, having obtained the results, local authorities and institutions are able to carry out strategies to reduce these impacts. (*BLUEISLANDS -Key results from BLUEISLANDS' studying phase, 2020*).

We have seen three major impacts of tourism in the environment: greenhouse emissions, water consumption and waste production. These are just some direct impacts that tourism has over climate change, however, we find thousands of more impacts, direct and indirect, which also damage the environment. Those impacts have been studied and analysed and therefore some solutions and mitigations have been created, we are going to have a look at them later. Before that, we are going to analyse how climate change affects and could affect tourism.

6. Climate change over tourism.

Having seen how tourism affects climate change, we will now have a look at how climate change may influence present and future tourism activity.

Cantos (2012), quoted by Cherninkova (2018, p. 15), exposes:

Climate change influences tourism by changing climatic parameters, increasing the risk of extreme event, health risk and causing a loss of comfort. "Territorial tourism resources, in a scenario of climate change go from being a 'stable' base of the tourism product, where tourist see the demands of enjoyment and security, to be territories that undergo fast environmental changes, where control over safety and comfort is lost.

It is obvious that these climatic parameters affect tourist activity since most of them are themselves a tourist resource that has power to attract people.

Climate is a fundamental resource of tourism as it constitutes one of the factors that determine whether a particular place is suitable for different tourist activities. It determines the duration and quality of tourist seasons and influences the elections of destinations and tourist expense [...]. Tourism is a victim of climate change when these climate changes in temperature, rainfall, sea level rise or land degradation will affect the capacity of tourism activity and therefore communities whose trade depend on it. (OMT, 2007)

In the case of Spain, as Greenpeace (2009) exposes, quoted by Pulido-Fernández & López-Sánchez (2014, p. 8) the climate is configured as a claim and the progressive increase in temperature threatens to transfer (and already surpasses at certain times of the year) the limits of "comfort temperature", therefore changes in weather patterns can be an important factor in the cause of major change in tourist flows.

We have a clear example of the consequences of climate change on the tourism, we can observe the increase of jellyfish in the Mediterranean, due to global warming as the first cause (Greenpeace, 2013), causing a decrease in beach tourism. Contrary, in mountain areas of the world, there is a setback in the snow line and the extent of glaciers as a result of global warming. (Pulido-Fernández & López-Sánchez, 2014, p. 8)

Following the case of Spain three major processes can be carried out due to global warming: a) an increase in atmospheric extremes (greater climatic danger); b) a reduction in rainfall and volume of available water; and c) the loss of climate comfort in the coastal areas of the peninsula due to thermal increase in the central months of summer. (Olcina Cantos & Vera-Rebollo, 2016, p. 9)

The consequence of these three processes will have an impact on the tourism activity. Cantos and Vera-Rebollo (2016, p. 8) also described the effects at medium and long term on Spanish tourism activity:

- Loss of worldwide market share, which will decrease from 6% to 4,8% in 2030.
- Long-term reduction in the number of tourist arrivals, estimated at 20% by 2080.
- Relative loss of importance of sun and beach tourism as a product due to lack of climate comfort.
- Loss of importance of the Mediterranean coast and increase of the market share on the Cantabrian coast, by the 2030.

Resuming, weather conditions like higher temperatures, increase in extreme temperatures, more hot weaves and decrease in rainfall will make high season on beach tourism areas longer but with central months with a bad climate comfort, reducing tourist arrivals. Contrary, on the winter tourism areas, the tendency is to disappear as high temperatures make snow disappear. In the long run, this change on 'climate comfort' will affect tourism demand and as a consequence our economy.

7. Solutions and mitigations.

In order to face a phenomenon diverse and complex as the relation between tourism and climate change is, it is necessary a continuous effort and a global approach aimed at identifying strategies, policies and instruments that allow the development of effective actions against climate change. In the last decades many institutions and platforms have been created to carry out this function. During this section we are going to analyse some tools that institutions either private or public have used to fight this issue.

According to a study carried out by the United Nations Environment Program (UNEP) shows that if by 2050, instead of continuing as before, an investment of only 0,2% of global GDP per year is made in actions and initiatives to reduce the environmental impact of tourism, tourism activity could continue to grow steadily in the coming decades, contributing to economic growth, job creation and economic development of countries, while significantly benefiting the environment. (Pulido-Fernández & López-Sánchez, 2014, p. 8-9)

Therefore, is important for the tourism sector to adapt and mitigate those impacts. To explain these tools, we are going to develop on four parts: Transportation industry, tourist, tourism companies and public sector.

As mentioned above the greenhouse emissions related with tourism transportation are really high. That's one of the main issues that authorities have to mitigate. To do so, the UNEP (2008) gives four steps to mitigate these emissions:

- The first step is to eliminate the emissions of the greenhouse gases by keeping away from certain activities that can be avoided without a considerable change to the tourism product or service quality.
- The second is to reduce the emissions of greenhouse gases by focusing on energy efficiency practices in specific activities.
- The third step is to substitute practices that are responsible for a large amount of greenhouse gas emissions with practices that have a lower carbon footprint.
- Finally, the institutions or business unit can offset remaining emissions to achieve full carbon neutrality.

Also, the UNEP (2008), gives some advices on the tourist side:

- a) Travelling less often and staying longer.
- b) Minimise air travel.
- c) Favour airlines that are committed to environmental management.
- d) Visit destinations and accommodations environmentally friendly.

On their behalf, tourism companies also have a role to play in this matter. The most trending policy in these companies is to obtain sustainable certificates. These certificates are achieved through management actions in different areas (CO₂ emissions, waste reduction, renewable energies, reductions of water and energy). These certifications allow the businessman to carry out an

environmental policy and as a consequence a sustainable tourism. In some cases, it is helpful for some of these certificates to be issued by independent companies for their correct certification. (Olcina Cantos & Vera-Rebollo, 2016)

Finally, we will have a look at the public side.

By using the information in the document Directrices Generales de la Estrategia de Turismo Sostenible de España 2030 (2019), we will have a look at the strategies on a national level. Spain has created an AGENDA 2030 in which a series of measures are carried out to achieve sustainable development.

In this agenda, the model of sustainable tourism is defined, which works on five main axes: 1) Collaborative governance, 2) Sustainable growth, 3) Competitive transformation, 4) Tourism space, companies and people and 5) Product, Marketing and tourism intelligence.

In essence, what is intended with these five axes is to find a better collaboration and communication between administrations to seek a more efficient and balanced tourism; promote the brand of Spain as a brand of sustainability and seek the sustainability of demand by controlling the saturation of tourist areas and a harmony with its residents; be more tourism competitive taking as a line of action the digitalization of the sector; create a greater infrastructure and greater resources combining it with a higher quality tourism and finally an improvement of tourism marketing following a line of digitalization.

Finally, cited in a document called Impactos, vulnerabilidad y adaptación al cambio climático en el sector turístico (2016) it is mentioned a strategy that has been carried out at a local level in Calvia. Calvia is one of the most crowded tourist areas in Mallorca. The strategy, called Calvia por el Clima 2013-2020, contemplates a plan of adaptation to the climate change. They establish a set of preventive measures directed to mitigate the consequences of the climate change on the ecosystems, neighbours and the infrastructures.

They are based in two lines of action: on the one hand the adaptation of the tourist sector to a sustainable management of its resources and on the other hand the promotion of sustainable municipal tourist management that incorporates an adaptation to climate change.

In essence, the lines of action want to promote water saving measures in hotels, rise in awareness and conservation of natural resources, the collaboration of the tourist sector in the development of climate-friendly projects and try to diversify and de-seasonalize the tourist demand.

Therefore, we have observed that responsibility for mitigations and adapting is not a matter of one. It is necessary that all tourism stakeholders work to reduce and prevent those impacts.

8. Conclusions.

During the elaboration of this work we have been able to see how tourism is one of the most important sectors in our economy due to its great economic impact. Contrary, we have seen how climate change is affecting our world beyond our expectations.

We have found a direct relationship between tourism and climate change. From the literature reviewed and the data presented, it has demonstrated that climate change must be considered as challenge to sustainable development. Moreover, tourism is not only a victim but also takes part of this problem being one of the activities that has a greatest impact over climate change.

We have seen, then, that tourism has a great role to play in mitigating and adapting to these impacts. Therefore, it is necessary that all tourism stakeholders, both public and private, cooperate in the implementation of different strategies and tools for this purpose.

The development of these mitigation strategies is particularly important for two reasons: tourism has a great weight in the Spanish economy and this tourism is mainly attracted by our naturales resources. Therefore, if we do not take special care of our resources and do not carry out sustainable development, this will end up harming both nature and economy.

Fortunately, in the last few years many strategies have been already carried out to solve this problem. In many institutions and conventions, the issue of climate change is a topic of first order over other issues. Moreover, in Mallorca also many institutions and private companies are cooperating in the fight against climate change. A clear example is the previously mentioned in Calvia. Although it has not been exposed, many hotel companies in Mallorca are also implementing tools to fight, for example, water consumption or plastic and waste generation.

Therefore, being part of the tourism stakeholders, it is a task for each of us to carry out a sustainable tourism development, so that our resources can persevere, and future generations may not be affected.

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