The impact of climate change in tourism sector in Java Island: a literature review

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Abstract. As a common global concern, climate change impacts society in a multitude of effects, including tourism. Given that climate change is closely linked to tourism, this paper will examine the growing body of knowledge linked to climate change and tourism in Java Island. The purpose of this literature review is twofold. First, it shows the state of the art of the subject matters and the second one is to identify the main topics of the current research. This review was conducted by finding the keywords related to climate change and tourism in the literatures. This literature review was conducted semi-systematically by searching well-known digital libraries using keywords related to tourism sectors and climate change. A total of 24 literatures were identified as relevant to our inclusion criteria. Required information was extracted from these 24 literatures and grouped into each topic. The result is, current research on impacts of climate change in the tourism sector in Java Island is mainly focused on the threat of extreme weather to the tourism sector. Extreme weather directly linked with the tourism sector by significantly decreasing the number of visitors. Another important point to highlight is the change of adaptation pattern in societal, governmental, or private sector institutional level is also an important topic to be examined thoroughly in further research.

1. Introduction

According to BPS (Central Statistic Bureau of Indonesia), the Island of Java contributes to almost 59% of Indonesia’s Gross Domestic Product (GDP)[1]. And within that contribution, 4.8% of total GDP came from the tourism sector[1]. The tourism sector itself is deeply interlinked with other aspects of livelihoods, such as people’s employment and income, infrastructure development, earning through sales, rent, and services, foreign currencies, and especially the multiplier effect of tourism in society [2]. The tourism sector in Indonesia grew steadily during the 2015-2018 period. This growth certainly has a positive impact on society, especially on the directly dependent on the tourism sector. This growth is mainly supported by the growth of the domestic economy, as seen in the proportion of domestic (250 Million) tourists compared to foreign tourists (9 Million) [1]. In economic terms, Java held an important factor that significantly contributes to the Indonesian GDP. Demographically, more than 120 million people living in the Island of Java, this condition puts Java as one of the world’s most populous islands.

The rise of global mean temperature characterizes global climate change. While the climate itself is dynamic and varied, the global mean temperature has been steadily rising to more than 1.5 °C in the past two decades [3]. This condition leads to some phenomenon that directly correlates to climate change, such as rising sea level and temperature, global warming, extreme weather, water scarcity, and
unpredictable rainfall. In general, the impacts of climate change in Indonesia can be felt significantly. First, there is an increase in the average annual temperature of 0.3 °C since 1990 [4]. Second, the decrease in rainfall is 2-3% since 1990 [5]. And lastly, changes in seasonal patterns between the wet and dry seasons [5][6]. Specifically, on the island of Java, the threat from climate change also appears in the form of the rising sea level [7]. The vast coastline causes this threat to Java, which puts Java in a vulnerable position. Threats such as abrasion and coastal erosion in major cities such as Jakarta and Semarang threaten the livelihood of millions of residents who depend on coastal areas [8].

Disruption to the tourism sector will undoubtedly disturb the livelihood of the people in general. Several studies have shown disturbances such as conflict, war, regulation, negative perceptions, disease outbreaks, and terrorism [2]. The same is true of climate change. The tourism industry, especially those that depend on natural tourism, will be negatively affected by climate change globally and locally [9]. Some of the correlations that emerge include extreme weather and climate change making some areas empty of visitors. Climate change is also destroying tourist attractions due to the abrasion or loss of biodiversity. In conclusion, climate change can severely affect the tourism sector if not appropriately managed [10].

In the last 10 years, there has been many research linking tourism and climate change. In the global scope, several studies have seen that climate change can threaten the tourism sector, both economically and in other aspects such as social, culture, geography, and biology. In the regional scope, several literature reviews have shown that climate change has become a threat to the tourism industry in areas such as China and Africa [9][10][11]. In Indonesia's context, this concern leads to several studies that correlate between the climate change phenomenon and the tourism sector. However, these studies generally only focus on one specific location. This research aims to map the impact of climate change on tourism specifically on the island of java to fill this gap. By examining the research conducted in the last 10 years, this paper tries to bridge this gap by compiling a body of knowledge.

2. Methodology
By referring to Snyder's definition, this research was conducted in a semi-systematic way [12]. Its purpose is to provide an overview of the topic being researched. The second objective is to describe the development of the research being carried out on the topic.

The research was conducted by collecting literature related to the impact of climate change on the tourism sector on Java's island. The literature collection is carried out online by conducting a thorough search based on specific keywords. The determination of keywords was based on climate change, tourism sector and the island of Java. This keyword was also expanded by adding terminology derived from the two topics, for example, unpredictable season, coral bleaching, extreme weather, rising air temperatures, rising sea levels and other related keywords both in English and Bahasa Indonesia.

The search results were further refined by adding this condition (1) A study that contains “climate change” and/or “tourism” keywords, or any other keywords that represent both climate change and tourism such as “global warming”, “Extreme weather”, “Rising sea level” (2) The study must be conducted between 2010 and 2020 (3) The study must be conducted in the Java Island Area. In total, 24 literatures that follow this criterion were collected.

An analysis was then conducted on these literatures. The analysis was carried out by “identifying, analyzing and reporting patterns in the form of themes within a text” [12]. A qualitative data analysis software (QDAS), NVIVO12, was used in this literature review to identify and categorize data into meaningful ‘codes’. These ‘codes’ were used by the researcher in finding the main themes of each literature.

3. Findings

3.1. Literature characteristics
From the search that was conducted, we found 24 literatures that matched the criterion. The distribution of the literature can be found in this table:
Table 1. Printed literature on climate change and tourism in the Island of Java

|                | N | % |
|----------------|---|---|
| journals       | 16| 67|
| conferences    | 4 | 17|
| thesis         | 4 | 17|
| total          | 24| 100|

3.2. Topics

The topics of each research can be summarized in Table 2.

3.2.1. Extreme weather. In this category, extreme weather affected various tourism objects on the coastline. Storms and floods are two of the disasters that directly correlated with climate change [13]. In one of the articles, extreme weather affected the sea turtle nesting ground in the East Java coastline [14]. One of the findings in this article states that sea turtles will be declined because of extreme weather. This becomes a potential threat for the tourism industry because sea turtle nesting ground is a popular tourist attraction. While in another article, it decreases the number of visitors due to the high tides in Karimunjawa, Central Java, since access to the island relies only on two routes, the sea and the air [15]. High tides will reduce the number of tourists because it is mostly closed in high tide season due to safety reasons. Mostly through the former. Another article discussed Dahlia Cyclone [16]. It created high tides on Southern Java Coast. While the southern Java coastline is known for its beaches and surfing spots, the coastline itself is vulnerable to an oncoming cyclone from the Indian Ocean. These articles are proving the effect of extreme weather on tourism on Java Island. However, the authors of these articles were discussing extreme weather that impacted Java Island’s coastline the most. This opened up a new research possibility to examine how extreme weather affecting tourism in the land, such as mountains or lowlands.

3.2.2. Loss of biodiversity. In all publications in this category, biodiversity loss is discussed as coral bleaching due to global warming in various water in Java. In these articles, the relationship between global warming and coral bleaching is explained by rising sea temperature. Rising sea surface temperatures cause coral bleaching. In several tourism objects, the main attraction is the pristine marine life, the loss of marine life can reduce the interest of tourist to travel. Several studies, such as Karimunjawa and Indramayu, show that some coral locations have shown extensive bleaching [17]. Biodiversity in these articles is considered as marine biodiversity. The topic is even narrowed to coral bleach on Java’s coast. While coral is an important aspect of marine biodiversity, it is also possible to focus on the migration of fishes due to rising sea temperature. On the other hand, loss of biodiversity on the mainland of Java Island is also worth the attention.

3.2.3. Infrastructure damage. This category discussed broad topics on how climate change damages infrastructures. In one article, infrastructure damage by climate change is considered as a catalyst for the National Action Plan on Climate Change (RAN-API). The plan is supposed to build resilience in various sectors in the conservation area [18]. While in the rest of the article, infrastructure damage is explained as the effect of climate change. First, high wind speeds and excessive rainfall are the main causes of infrastructure damage [16]. Second, damage to infrastructure is caused by abrasion and erosion that arise from a combination of rising sea levels and land surface subduction. This can cause extensive damage to human settlement and other infrastructures such as ports, roads, and other infrastructures that support tourism. Lastly, if the infrastructure itself is a tourist attraction, then climate change can be considered as direct threat to tourism [19]. Water crisis is a crucial finding regarding Indonesia’s only two seasons. However, the small number of articles discussing this topic means that there is not enough
attention to the topic. This topic’s importance should open a new possibility to deepen the topic and provide more data that matters to tourism.

Table 2. Summary of the topics

| Author                | Year | Region      | Climate Change Topics                                                                 |
|-----------------------|------|-------------|---------------------------------------------------------------------------------------|
| Rosyidie *et al*      | 2010 | West Java   | Number of visitor change, climate change                                              |
| Fahriyah *et al*      | 2011 | East Java   | Domestic income change                                                                |
| Ndela                 | 2011 | West Java   | Seasonality                                                                           |
| Desmawan              | 2012 | Central Java| Domestic income change, adaptation pattern change                                      |
| Rif’an                | 2012 | Yogyakarta  | Climate change                                                                        |
| Wibowo                | 2013 | West Java   | Infrastructure damage, seasonality                                                     |
| Rahardjo              | 2013 | Jakarta     | Water crises, global warming, adaptation pattern change, sea-level rise, biodiversity loss |
| Prasita and Kinsarti, | 2013 | East Java   | Climate change, sea-level rise                                                        |
| Andri Engki           |      |             |                                                                                       |
| Dhaniswara            | 2014 | Central Java| Extreme weather, number of visitor change                                              |
| Nuary *et al*         | 2014 | West Java   | Biodiversity loss, global warming, sea-level rise                                     |
| Marfai                | 2014 | Northern Java Coast | Infrastructure damage, adaptation pattern change, sea-level rise                   |
| Widiyanti and Dittman, Andreas | 2014 | East Java   | Water crises, social change                                                           |
| Adil                  | 2015 | East Java   | Water crises                                                                          |
| Syukri                | 2016 | Central Java| Sea-level rise, climate change                                                        |
| Akbar and Huda, Mi’rojul |   |             |                                                                                       |
| Wijaya and Furqan, Alhilal | 2017 | Java Island | Climate change, sea-level rise                                                        |
| Pangestu *et al*      | 2018 | Java Coast  | Global warming, biodiversity loss                                                     |
| Ruhimat               | 2018 | West Java   | Global warming                                                                        |
| Wulan                 | 2018 | West Java   | Number of visitor change, climate change, seasonality                                 |
| Rif’an *et al*        | 2018 | Central Java| Adaptation pattern change                                                              |
| Mahsunah *et al*      | 2019 | Southern Java Coast | Extreme weather, infrastructure damage                                          |
| Sagala                | 2019 | Central Java| Infrastructure damage                                                                 |
| Uzdah                 | 2019 | Java Island | Number of visitor change, seasonality                                                  |
| Saputra *et al*       | 2019 | East Java   | Climate change, extreme weather                                                       |

Source: secondary data processing

3.2.4. Water crises. Water crises are the scarcity of water in some tourist destinations. It is considered a threat to tourism. Some of tourist attraction relies on water availability. One article explains how unsustainable hydro-ecology has an impact on tourism. In that article, the relation between water scarcity and climate change is that climate change will pressure the scarcity and thus impact tourism [20][21][22]. Concerning climate change, water scarcity can arise from a combination of low rainfall, limited bearing capacity and is sometimes exacerbated by contamination of seawater in groundwater. The relation between global warming and tourism is an interesting one. It will
mostly be affected by international tourism rather than domestic. International tourists are used to low temperatures however, high temperatures and humidity in Indonesia will make tourists reluctant to visit Indonesia.

3.2.5. Global warming. Rising air temperatures directly affect people’s comfort, and the same condition can also be applied to the tourist. One literature states that tourists are more likely to choose a destination with a cooler temperature because it makes them more comfortable [23]. While the comfortable temperature is often considered a relative concept, there is a tendency that some tourist destinations are steadily rising. This can become a threat to the tourism destination with comfortable cooler temperatures such as Bogor and Bandung. However, climate change is only considered as one of the aspects that affected these changes. The logical relation between changes in the number of tourists’ visits and climate change opens up possibilities to directly examine climate change and changes in the number of tourists’ change.

3.2.6. Changes in the number of tourists visits. Changes in the number of tourists’ visits often serve as the main indicators to assess the tourism sector’s impact [15][23][24]. The fluctuation in this number is often directly correlated with the change in the tourism sector. Moreover, with climate change, this fluctuation can serve as a basis to analyze further issues. In those articles, the relation between the two variables is negatively correlated with each other. However, climate change is only considered as one of the aspects that affected these changes. The logical relation between changes in the number of tourists’ visits and climate change opens up possibilities to directly examine climate change and changes in the number of tourists’ change.

3.2.7. Tourism income change. A decrease in income can significantly affect the community’s socio-economic conditions to hinder the growth of the tourism sector. In the first research, the decline in income was caused by climate change, which damaged apple plantations in Malang [25]. Apple is an icon of Malang’s tourism, through agro-tourism, tourism growth can grow rapidly along with the emergence of tourism objects around apple plantations. The second study shows that rising surface temperatures damage shrimp ponds in the coastal area [26]. The third research also looks at the same thing, namely the fisheries sector which depends on the coastal area being damaged due to rising sea levels [27]. The tidal floods damaged the community's fish ponds so that people’s income decreased significantly. Research objects in this article vary from apple plantation to community fish ponds affected by climate change. Income change is important aspect of tourism. These articles formed a baseline for further research in various on the income change.

3.2.8. Seasonality. In this category, seasonality is considered as one of the climate change phenomena. El Nino and La Nina are the climate phenomenon that illustrates the change of seasonality. The duration between the dry and rainy season is becoming unclear. Season’s unpredictability directly affected tourism, as one article mentioned, they affected the tea plantation to an extent where tourists cannot walk around the plantation due to rain [28]. Another article also mentioned how seasonality contributes to higher temperatures in some tourist cities such as Bandung [23]. It also mentioned how seasonality would affect tourists to decide their trip to tourism destinations. These articles showed that high rainfall and high temperature caused by season changes affected how tourists enjoy tourism sites. Although these articles only pointed out the effect of seasonality in the form of season’s unpredictability, it’s possible to point out seasonality and its relation to extreme weather.

3.2.9. Change on adaptation pattern. This category focused on discussing how climate change forces the government and society to adapt to climate change. It forces the government and society to mitigate the damage done by climate change on tourist attraction sites [19]. One article identified the local community's success in mitigating climate change, such as planting mangroves alongside the shoreline, elevating ground level, building a staged house and so on [27]. Another article suggests how the
mitigation should be done based on the particular tourism object [20][29]. The topic discussed in these articles is an important one since the mitigation is crucial to ensure the longevity of the tourism objects. However, more research should be conducted to emphasize the government’s role in mitigating the problem.

3.2.10. Social change. The relationship between social change and climate change is only discussed in an article. It shows how the relationship between water scarcity due to climate change and how the local community adapts and responses to the problem [22].

3.2.11. Sea level rise. Sea-level rise is affected directly by global warming and climate change. This category is discussed on how the sea-level rise would affect the coastline tourist attraction, including some islands such as Pramuka Island in Seribu Isle [20]. Sea-level rise threatens the infrastructure, be it tourism infrastructure or infrastructure in general along the coastline [13]. Sea-level rise is indeed an important factor along with extreme weather regarding tourism. However, the small number of articles showed that researchers’ interest in this study is low. Therefore, discussing sea-level rise and tourism in the Java coastline will be an important and useful finding for the government, stakeholders, and society.

4. Conclusion
Several climate change phenomena can be felt directly by the community and mainly the tourism sector. The primary impact that is often felt is the reduction in tourist visits, which directly impacts people's income. The reduction of people’s income can also lead to other problems such as poverty, social tension, and developmentalism issues for society due to the deep interlinkage of tourism with other sectors. Thus, the change of adaptation pattern within society is a natural reaction to solve climate change. RAN API is one of these adaptation patterns in terms of government policy. The adaptation in terms of consumer, government policy, sustainability, society is few of the aspects that can be explored further. The adaptation pattern is directly related to the root cause of the problem, namely, climate change. By deeply examining the symptoms such as loss of tourist attraction, reluctance to visit due to uncertain seasons, and also reduced tourist interest due to damaged infrastructure and water crises, further research can determine the suitable adaptation pattern in solving those issues.

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