ISSN: 2634 - 8845

Journal of Earth and Environmental Science Research

SCIENTIFIC Research and Community

Research Article

Open Access

Hoteliers' Perceptions of and Responses to Climate Variability and Change in Antigua and Efate

Adelle AC Blair

Lightfoot West, St. George's Parish, Antigua, West Indies

ABSTRACT

Many economies in small tropical islands are built on tourism, using their sun, sea and sand to entice visitors. However, climate variability and climate change are affecting these small islands, threatening many livelihoods and their fragile economies. There is limited information on the adaptation strategies and perception of climate change within key sectors of these economies, including the accommodation sector. Hence a study which examines the experiences of Antigua Island in the Caribbean and Efate Island in the South Pacific. The uniqueness of this study is that there are few published articles on this topic especially those comparing two islands. This study found that whilst all hoteliers perceived changes in precipitation, temperature and sea level only a limited number implemented few adaptation measures. We conclude that there is need for government regulation of the accommodation sector as it relates to managing the impacts of climate change, to help build resilience within the sector and wider economy.

***Corresponding author**

Adelle AC Blair, Lightfoot West, St. George's Parish, Antigua, West Indies. E-mail: aacblair@gmail.com

Received: July 06, 2022; **Accepted:** July 11, 2022; **Published:** August 05, 2022

Keywords: Climate Change, Perception, Adaptation, Antigua, Efate, Hoteliers

Introduction

Over the last 35 years, climate change has presented major concerns for the tourism sector on which many Small Island Developing States (SIDS) rely for their economic development. Intergovernmental Panel on Climate Change (IPCC) Reports have discussed the substantive risks to which coastal tourism in particular is vulnerable, including sea level rise (SLR), weather and climate extremes, increase in ocean temperature and acidity as well as surface temperature [1,2]. As a result of these impacts, these small islands now face aggravated beach erosion, coral reef degradation and bleaching and coastal squeeze [1,3]. At the same time climate change is also impacting human health, terrestrial and marine ecosystems including species reduction and or loss, precipitation leading to more droughts and floods [2,4].

The sustainability of the tourism industry is therefore critical to the survival of these small economies which rely on sun, sea and sand. As it stands, the contribution of tourism to the gross domestic product (GDP) in the Caribbean and Oceania for example, was 13.9% and 11.7%, respectively [5.6]. The negative impacts of climate change have occurred in the face of continued growth in travel and tourism which grew by 3.5% in 2019, outstripping the global economy for nine straight years [5]. However, many of these economies have seen drastic declines because of the COVID-19 Pandemic in 2020. Globally, in 2020, travel and tourism suffered a GPD loss of 3,815 Billion USD or 43%. The Asia-Pacific region experienced a GDP loss of 1,475 Billion USD, a 50% reduction while in the Caribbean, the loss amounted to 36 Billion USD, a reduction by 62% [6].

Whilst this reliance continues, the natural resources of these countries are still being heavily impacted by changing climatic conditions. The Caribbean and the Pacific have been described as some of the most vulnerable regions to these effects of climate change [7]. The physical impacts observed in these two regions include increase in heat extremes and aridity, coral bleaching, changes in precipitation patterns, higher drought risk, more frequent and intense tropical cyclones [8,9].

What is Happening Now

Temperature

Globally, temperatures have increased over the last 150 years but markedly so during the last 60 years [10,11]. The following table shows the 10 warmest years since records have been kept in the United States of America.

Table 1: NOAA GlobalTemp dataset 10 Warmest Years on Record (1880-2018)

Ranking	Year	Anomaly (°C) (relative to 1971-2000 base period)
1	2016	0.675
2	2015	0.615
3	2017	0.590
4	2018	0.507
5	2014	0.423
6	2010	0.409
7	2013	0.359
8	2005	0.355
9	1998	0.340
10	2009	0.330

During the period 1910-2020, the Caribbean experienced a +0.09 (°C)/decade increase in the land and ocean temperature. During the same period, Antigua Island (Caribbean) experienced an increase of +0.12 (°C)/decade in land temperature. Over the same period, Oceania recorded an increase in land temperature of +0.12 (°C)/decade. Efate Island (Vanuatu) recorded an increase of +0.07 (°C)/decade in land and ocean temperature [12].

Oceans and Coral Reefs

Warm-water coral reef ecosystems are predominant in the Atlantic, Indian and Pacific oceans and have declined by approximately 50% over the last 30-50 years [13]. This decline was mainly due to human activities including over-exploitation of fish stocks, pollution from land-based sources as well as disease and physical damage from storms and cyclones [8,14]. In addition to the anthropogenic stressors, coral reefs are impacted by warming ocean temperatures and acidification increasingly since the early 1980s, mainly due to the burning of fossil fuels [13,15].

Ocean acidification has declined by 0.1 pH units over the last 150 years which represents a 26% increase in hydrogen ions [13,17]. This increase in ions affect the corals' ability to build calcareous structures (Kroeker et al., 2013). When the symbiotic algae that lives in corals is impacted by temperatures reaching 1-2°C above maximum summer temperatures, the expulsion of zooxanthellae from its tissue causes what is referred to as coral bleaching (causing the corals to appear white) [18-20].

Coral bleaching events have been reported since the last 100 years but reports have increased since the early 1980s [13,21]. Globally, between 1976-2016, there have been 6 distinct bleaching events [22]. In the Caribbean, coral reefs have been affected by bleaching episodes in the 1998, 2005, 2010 and 2015/16 [8,23]. The Pacific Ocean experienced major bleaching events in 1998, 2000 and 2015/16 [22].

Drought and Flooding

There are various definitions of drought, however, Van Loon et al describes it as the lack of water during a period of time when compared to normal conditions and may be driven by human action or the climate. Worldwide, aridity has increased significantly between 1950-2012 mainly because of drying in many land areas [24-26]. The Caribbean experienced significant drought periods between the mid-1930s –1940s, mid 1960s - 1970s, 1974-1977, 1997/98, 2000-2001, 2009-2010, 2013-2016 [27,28]. Antigua experienced 15 severe drought episodes between 1929 -2003 and 16 serious episodes between 1941-2014 [29,30].

Like the rest of the world, since the 1950s, there has been a warming trend in the South Pacific [32,33]. Specifically, between 1985 and 2016, Asia and the Pacific experienced over 110 drought events [33,34]. Vanuatu experienced severe drought events in 1994/95, 2005/6, 2008 and 2015 [35]. Droughts have had significant impacts on water security, tourism, human health, agriculture and forestry and ecology (terrestrial and aquatic) [36,37].

With rising sea levels, flooding has become a major issue for small islands. Further, the location of settlements and agriculture in low-lying flood-prone areas increases the vulnerability to coastal inundation and flooding [38]. There are many examples of marine inundation from places including Vanuatu, Fiji, the Solomon Islands, Haiti, Cuba, Barbuda [39,40]. The increase in other extreme weather events such as tropical cyclones also increase the risk of flooding in these islands. During the passage of cyclones such as Luis, Georges, Lenny, Irma in the Caribbean and Heta, Pam, Winston, Harold and Yasa in the South Pacific, Antigua and Efate were affected by serious flooding resulting in the loss of life and damage to the key sectors of agriculture and tourism [41-44].

Sea Level Rise

Globally, since the 20th Century, sea levels have risen by 17 cm due to a combination of effects including increase in global temperatures, melting of glaciers and icecaps, thermal expansion of sea waters and vertical land motion [45-48]. The impacts of sea level rise include inundation and flooding, coastal erosion, saline intrusion into ground water sources, degradation of coastal habitats [48].

In the Caribbean, sea levels have risen 1.8mm/yr between 1950-2009 [49,50]. During the same period, sea levels in the South Pacific have risen by 1.5±0.5 mm/yr [45,51].

Cyclones

Globally, there has been a positive trend in the intensity of tropical cyclones and trends in frequency occurrence since 1980 [52,53]. Tropical cyclone impacts include storm surges, landslides, coastal flooding, damage to coral reefs, sea grass beds and critical infrastructure, damage to the economy especially agriculture and tourism [54,55].

The South Pacific Ocean was affected by 63 cyclones/hurricanes that were either Category 4 or 5 between 1980 and 2016 [56]. Between 1939 to 2016, Vanuatu experienced 124 tropical cyclones [57]. Cyclones Pam, Winston and Harold made landfall in Vanuatu at Category 5 [58].

The Caribbean has been affected by 264 cyclones between 1960 to 2017 [55]. Between 2000 and 2016, this region had experienced 31 cyclones that were either Category 4 or 5 and prior to 2000 there were 22 [59]. Between the period 1700–1960, Antigua was affected 65 hurricanes and tropical storms [60]. Between 1961-2019, Antigua was affected by 46 tropical systems, five of which made landfall as hurricanes [61].

The evidence thus far shows that SIDS in the Caribbean and Pacific have already been impacted by the effects of climate change. However, there must be cognizance of the fact that many of these countries have done irreparable damage to their natural resources in the name of development e.g. coral mining in Indian and Pacific Ocean SIDS, sand mining in Kiribati, coastal (tourism) development with inadequate setbacks in Barbados, land reclamation in flood-prone swamps in Pacific SIDS, salt pond, sea grass bed and mangrove swamp destruction, reef dredging, sand mining and deforestation in Antigua and in Vanuatu reef damage, deforestation, over-exploitation of reef fishing, unsustainable agriculture and uncontrolled burning [62-73]. Therefore, it may not be conclusive that climate change is solely responsible for the vulnerability which these SIDS now face [66,74].

Considering the projected and observed impacts of climate variability and change, it is important to understand how they are being perceived and addressed by tourism stakeholders. This assessment is crucial in the accommodation sector, one of the main components of the tourism industry, so vital to these economies.

Worldwide, tourism contributes 10.4% of GDP and in 2018 , travel and tourism as a sector, experienced 3.9% growth and accounted for 1 in 5 jobs, globally [75]. In the Caribbean travel and tourism contributed $62BN and 15.5% of GDP an increase of 2.1% while

in Oceania, the contributions were $206BN and 12.2% of GDP, representing a growth of 3.5% [75]. Specifically, Antigua and Vanuatu are in the top 25 countries for which tourism is significant to their economies as borne out in Table 1:

Table 2: Key Statistics 2018

Details	Antigua & Barbuda	Vanuatu
Contribution of travel & tourism to GDP	44.1%	48.0%
2018 travel & tourism GDP growth	+4.9%	+7.7%
Contribution of travel & tourism to employment	16.3 jobs (000's) 44.1% of total employment	32.3 jobs (000's) 44.1% of total employment
Expected employment in 2019	20.6 jobs (000's)	45.4 jobs (000's)
International visitor impact	USD819.1MN in visitor spend (36.8% of total exports)	USD291.3MN in visitor spend (63.3% of total exports)
Expected international arrivals for 2019	328.2 (000's)	122.7 (000's)

Source [75].

Globally, prior to the COVID-19 pandemic, coastal tourism had been growing at a fast pace despite the impacts of climate variability and climate change [76,74]. Whilst research has increased on tourism and climate change in many regions, there is still a knowledge gap in case studies from different regions. Comparative climate change and tourism studies provide insights into the perceptions of supply-side providers, making it easier to plan assistance which so many of them require.

Perception of Climate Change within the Hotel Sector

As it relates to climate change, adaptation is a process which involves perceiving and learning by the observation of climatic impacts and the adoption of response strategies to lessen these impacts or to benefit from opportunities that may arise [78]. A study of how hoteliers (which include owners or managers of hotels, resorts, inns, guesthouses, holiday villas and cottages) have been adapting to climate variability and climate change commences with an understanding of how they perceive climate change. However, it has been established that the general public do not perceive climate change and its consequences in the same way as climate scientists [79]. Perception, which is a subjective evaluation, may be direct, formed through experiences within the environment, or indirect, via internal processes such as memories [80,81]. Perception may also be influenced or reinforced by the media and may help determine behaviour [82]. It has been found that within the tourism industry, many actors have knowingly or unknowingly adapted to climate change because of the very nature of their businesses, especially in the areas of future investments and infrastructural development [83]. In this study, they found that most actors (including accommodation providers) denied making any change because of climate change impacts only.

Similar supply-side of tourism studies such as Helgenberger and Trevo-Kankare came to the same conclusion that climate change did not play a major role in the product development or rearrangement plans [84,85]. Studies in the hotel industries in South Africa, Taiwan and Macedonia discovered that although most of their participants were aware of climate change and its impacts, the implementation of environmental management/adaptation measures did not match their perception. Low implementation was attributed to the hotel owners' belief that the measures were not relevant at the present time [86-88]. In other instances, the hoteliers were not aware of some adaptation strategies in addition to the lack of professional advice, knowledge and skills and high initial cost [86,88-90]. These factors contributed to the low implementation of adaption strategies.

With specific regard to the Caribbean, Altchuler and Brownlee (2016) found that the assessment of climate change perception at the individual level had received little attention. In their research, the accommodation providers in Provdencia perceived that climate change impacts were caused by internal factors such as the burning of garbage. Among Dominica's accommodation owners/operators, whilst they believed in environmental sustainability, they were most concerned about making a profit. This study also found that low cost alternatives to energy consumption were underutilised because of a lack of awareness [91]. Although local tourism stakeholders in Grenada perceived that climate change would affect the industry with rainfall changes, sea level rise and intense hurricanes, they believed that these impacts would be felt in the future [92]. In St. Kitts, whilst the people perceived that coastal erosion was the most serious climate change impact, they were most concerned about the socio-economic issues within the country [93].

Research on understanding the relationship between climate change impacts on the peoples of the Pacific and their livelihoods is limited [94]. As it relates to other small islands in the South Pacific, in the Maldives, it was found that locals were most concerned about the prevailing social and economic issues rather than climate change impacts, main of which they perceived to be sea level rise [93]. A study by Barnett and Waters argued that whilst the peoples of the Pacific Islands were experiencing significant risks from climate change, they responded based on their socio-cultural traditions, which enhanced their adaptive capacities [95]. In Vanuatu, Warrick argued that local perception of climate change was influenced by socio-cultural factors and processes which impacted their adaptive capacity [96]. In a study conducted in both Vanuatu and Fiji, it was found that the locals had "robust knowledge-practice-belief systems" which have allowed them to adapt to climate change risks [35]. In Tuvalu, McCubbin et al. discovered that although the people were affected by climate change impacts, the non-climatic forces (socio-economic and cultural stressors) were perceived to be most impactful on their livelihoods [97].

Whilst it may be clear that climate change is affecting many livelihoods in SIDS around the world, it is a common finding that among hoteliers, there has been a low level of uptake of adaptation measures to respond to climate change [98]. Saarinen & Tervo and Njoroge found a high level of scepticism within the tourism industry which may contribute to the cause of low level of implementation of adaptation measures in some places and reactive rather than planned strategies in others [90,99]. These findings suggest that tourism accommodation providers may need some

encouragement to implement adaptation measures in a timelier manner. Considering that most SIDS are engaged coastal tourism which is under pressure from coastal squeeze exacerbated by sea level rise, their economies may well be at risk if they continue to depend on tourism without seriously addressing adaptation.

Climate Change Adaptation Conceptual Framework

Adaptation leads to changes which are based on an individual's perception of the seriousness of the matter. Therefore, personal factors including knowledge, culture and social networks and responsibility help to shape response that will have long-term consequences [100,101]. Further, climate change adaptation within the tourism industry is based on each of its 8 segments but here only accommodation is highlighted. The climatic zones within which accommodation occurs is also an important determinant of the possible types of adaptation strategies that may be implemented. The types of adaptation are shown in Figure 1.

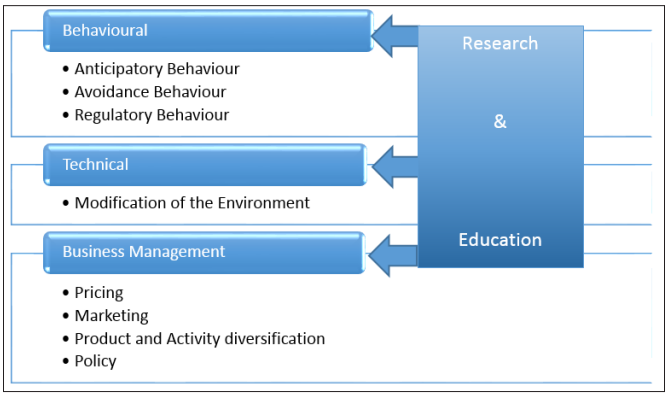

Figure 1: Types of Adaptation
Source [102].

Knowledge and other personal factors do not mean that action will be automatic. However, in some instances, hoteliers have been incorporating adaptation measures in their daily activities without viewing them as such [103]. Inactivity within the sector has also been attributed to unbelief and uncertainties about climate change, the public nature of some resources such as beaches, initial substantial capital expenditure, immediate challenges, and priorities [104-107].

Study Sites

The information used in this paper was part of a PhD thesis research into climate change threats and responses in Antigua & Barbuda and Vanuatu. This is the last paper to be published of the three livelihoods studied in the thesis. Antigua is the birthplace of the researcher and corresponding author. As a Small Island Developing State, Vanuatu was chosen because of its proximity to Australia, where the PhD was conducted.

Antigua

The twin-island nation of Antigua & Barbuda is in the Eastern Caribbean and washed by the Caribbean Sea and the Atlantic Ocean (Figure 1). Antigua is 280 km^2 in size with the highest peak reaching 402 m. Its deeply indented coastline means that it has many beaches and bays which are protected by fringing, large bank reefs and patch reefs.

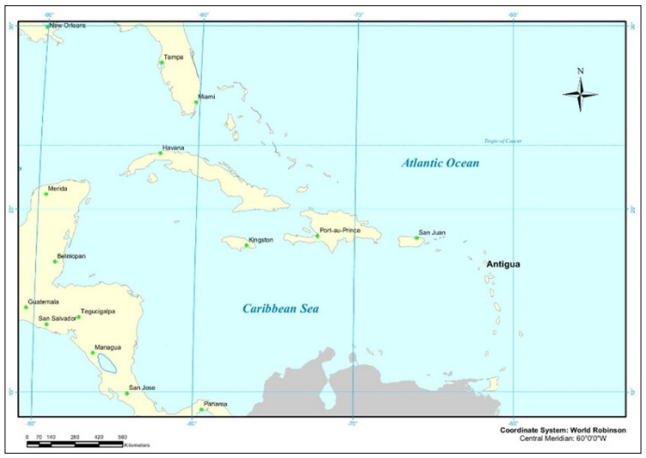

Figure 1: Location Map of Antigua

Efate

Vanuatu lies in the South Pacific Ocean, east of north Australia and is made up of approximately 80 islands with 65 inhabited (Figure 2). Efate covers an area of 889.5 km^2 with the highest elevation reaching 647 m. It is the main urban centre of Vanuatu and holds the seat of government and has the highest population, approximately 66,000 (GovV, 2009). In addition to the many smaller islands in proximity to Efate, there are mainly fringing reef systems and many beaches.

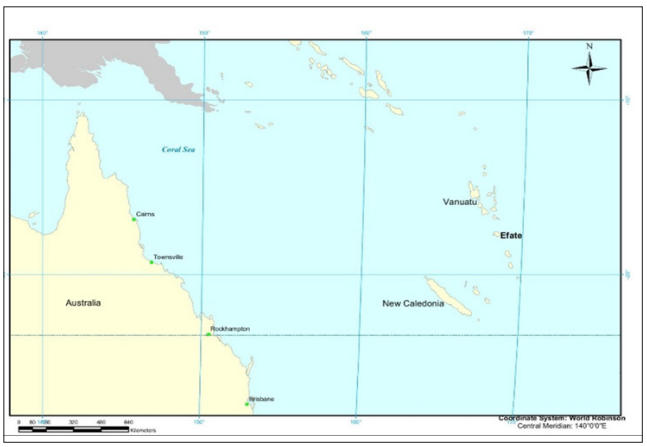

Figure 2: Location Map of Efate

Materials and Methods

A structured questionnaire was the method used to collect data. This method was chosen because of its high response rate, responses may be compared and the process is standard for all participants [107,108]. In Antigua, field work was conducted throughout the month of July 2014 and in Efate, during the months of October and November 2014. The questionnaire was pre-tested in Antigua on a group of 30 which included tourism officials, to enhance the design where possible. The sample frame was derived from the list of hoteliers registered with the national tourism associations who had a minimum of 10 years' experience because of the high turnover rate among hotel employees [109]. A stratified random sampling technique was used to select the samples. Participants were randomly selected from across the island where possible. In instances where participants could not be found with the 10 years' experience, a convenience sampling technique was used to obtain the remainder.

A sample size of 30 was used as this is established in the literature [110]. To account for possible non-response, the sample size was

increased by 20% and rounded off to 40 participants per island [111,112]. The 40 hoteliers from each island represented 46% and 67% of those registered in Antigua and Efate, respectively in 2013 [113,114]. The questionnaire elicited information on the hoteliers' perception of climate change and its causes, perceived changes in the climate and livelihood and implemented adaptation measures. The questionnaire was completed anonymously, taking approximately 30 minutes.

Content analysis was used to make the data meaningful, identifying various categories, trends, and differences across islands. The quantitative survey data were collated in themes using Microsoft Excel. Further analysis was done using SPSS (version 23). To determine statistical significance of the information a non-parametric test, Fisher's Exact Test was used. This test was used to ascertain non-random associations between the information from Antigua and Efate. Climate data were collected from the meteorological departments in both Antigua & Barbuda and Vanuatu for the 43 years from 1971-2014. The data were analysed using the Mann-Kendall (MK) trend test by means of the Addinsoft XLSTAT 2016.06.36773 for Microsoft Excel. The MK method is used to detect linear trends mainly in rainfall and temperature time series and has been endorsed by the World Meteorological Organisation and was used in many recent studies [115,116]. The MK statistic (S) indicates the existence of a trend in the data and where it does, whether it is positive or negative [117]. In XLSTAT 2016, the MK statistic (S) used for the test and its variance are given by the following:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} Sgn\left(x_j - x_i\right) \quad (1)$$

$$Var(S) = \frac{n(n-1)(2n+5)}{18} \quad (2)$$

Where n represents the number of observations and xi(i=1…n) are the independent observations.

Whilst the MK test is used to determine statistical significance, the Sen's slope estimator tells the magnitude of the slope in the trend and whether it is positive (upward) or negative (downward) [118]. Based on Jain & Kumar, the slopes (Ti) of all data pairs are first obtained using the following [119].

$$T_i = \frac{x_j - x_k}{j - k} \quad \text{for } i = 1, 2, \ldots, N, \quad (3)$$

Where x_j and x_k are data values at time j and k (j > k) respectively. The median of these N values of T_i is Sen's estimator of slope which is calculated as

$$\beta = \begin{cases} T_{\frac{N+1}{2}} & N \text{ is odd,} \\ \frac{1}{2}\left(T_{\frac{N}{2}} + T_{\frac{N+2}{2}}\right) & N \text{ is even.} \end{cases} \quad (4)$$

A positive β indicates an upward or increasing trend while a negative result indicates a downward or decreasing trend in the data [118,119].

The qualitative responses were coded into themes based on the issued highlighted in the responses.

Results and Discussion

Hoteliers' Characteristics

Table 1 presents a summary of the demographic characteristics of the hoteliers. Of the properties what were not group-owned, most of the hoteliers were males, 57.5% and 65% for Antigua and Efate, respectively. In terms of education, 57.5% and 62.5% of respondents from Antigua and Efate respectively, had attended either college or university. This means that this male-dominated sector is managed by the highly educated in both islands [120-123]. Further, the fact that over 7% of all hotels were a part of chain or group-owned means that the premises were leased and may have limited the types of measures implemented [105].

Table 1: Hoteliers' Demographic Characteristics

Factors		Antigua & Barbuda	Efate
Gender (%)	Male	57.5	65
	Female	35	25
	Refused	7.5	10
Age Range (%)	18-24	0	0
	25-34	5	7.5
	35-44	7.5	12.5
	45-54	30	27.5
	55-64	20	32.5
	65-74	12.5	10
	75+	15	0
	Refused	10	10
Level of Education (%)	Primary	2.5	0
	Secondary	10	15
	Technical/ Vocational	7.5	12.5
	College	30	17.5
	University	27.5	45
	Refused	25	10
Weekly Income Range (in US$) (%)	1-199	10	7.5
	200-299	15	5
	300-399	5	10
	400-599	10	5
	600-799	25	2.5
	800-999	0	7.5
	1000-1249	0	2.5
	1250-1499	0	0
	1500-1999	0	45
	2000+	0	0
	Refused	35	15

Hoteliers' Awareness and Perception of Climate Change

The findings revealed that all hoteliers perceived that the climate was changing (Figure 3). Most perceived that there were strange changes in the weather pattern, rainfall had become unpredictable, and temperatures were higher. In addition to this, most of the Antiguans also perceived that they were affected by more frequent droughts, freshwater shortages and to a lesser extent, increases in hurricanes/cyclones/storms. Specific to Efate, the hoteliers perceived they were seriously affected by increased flooding and rainfall and wetter winter months. These perceived impacts may be

categorised under changes in rainfall, higher temperatures and increases in tropical systems, all of which significantly affect tourism.

There is a high awareness of climate change among hotel owners in many parts of the world [86,124]. In this study, perception varied mainly by type of accommodation and geographical location with coastal operators more concerned about sea level rise and beach erosion [88,102,125]. Within the industry, perceived effects centred around water and ranged from unpredictable rainfall and increased flooding to freshwater shortage and drought.

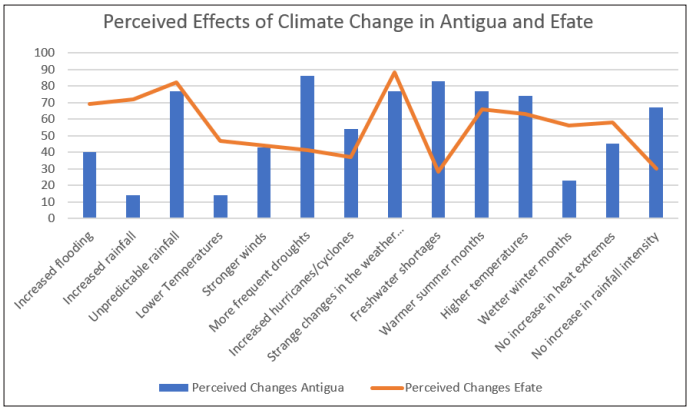

Figure 3: Perceived Effects of Climate Change

Perception of Precipitation Changes

Overall, the Antiguans perceived that the rainfall had decreased as 86% believed that droughts were more frequent and 67% felt that there was no increase in its intensity. Analysis of Antigua's rainfall figures from 1972-2014, showed that there had been significant inter-annual variability which may account for the perception of unpredictability. The results of the Mann-Kendall test showed no statistically significant trend in the rainfall data at the 95% confidence interval. However, the nature of the trend in the series is negative (Kendall S =-39) (Table 2), which means that rainfall is decreasing in Antigua. Further, perusal of meteorological data for the 50 years from 1964-2014 support the perception of more frequent droughts. These records showed an increase in moderate drought episodes (14) which range from 4 to 17 months and last for 7.8 months on average when compared to the 30-year period between 1933-1963, when 8 were recorded. For a moderate drought, the rainfall range is from less than the 20th percentile to the 10th percentile [29]. This information is supported by the findings of Dai who reported that during the period 1950-2010, a statistically significant increase in drought conditions was found in the Caribbean [127].

Table 2: Results of trend analyses for selected climatic variables, Antigua and Efate

Variables	Mann-Kendall Test						Sen's slope Estimator					
	Kendall (S)		Trend Nature		p-value		Trend Significance		Magnitude		Trend Nature	
	Antigua	Efate	Antigua	Efate	Antigua	Efate	Antigua	Efate	Antigua	Efate	Antigua	Efate
Annual Rainfall	-39	83	Negative	Positive	0.68*	0.38*	No	No	-1.403	5.491	Negative	Positive
Maximum Temperature	142	180	Positive	Positive	0.14*	0.00*	No	Yes	0.007	0.053	Positive	Positive
Minimum Temperature	0.274	76	Positive	Positive	0.01*	0.14*	Yes	No	0.011	0.025	Positive	Positive
* Two-tailed test at significance level: α 0.05.												

With respect to an increase in hurricanes/cyclones/storms near Antigua, meteorological data showed that 56 per cent of the 161 Tropical cyclones (TCs) that affected the Lesser Antilles between 1851-2015, either the centre directly passed over Antigua or it passed within 15-61 nautical miles from the island [126]. The IPCC predicted an increase in wind intensities in TCs, causing higher storm surges, damage to beaches and coastal infrastructure including hotels and road networks [78]. Not only are destinations affected by the physical impacts of these systems but their occurrence can negatively impact visitor perception of the location.

Efate's hoteliers perceived that rainfall and flooding had increased. However, the meteorological data did not substantiate this increase in precipitation (Figure 3). The results from Table 3 showed no statistically significant trend in the meteorological data (p=0.38). However, positive Kendall (S) and Sen's slope estimator suggested that the nature of the trend was toward an increase in rainfall. The high inter-annual fluctuations in rainfall totals could be responsible for the perception of increased rainfall. With regard to flooding, Efate had experienced extremes in rainfall on a number of occasions including a record 157.7 mm which fell within a 24-hour period, in October 2014 [128]. Although just under a quarter of hoteliers perceived that hurricanes/cyclones/storms had increased, meteorological data from Vanuatu showed that between 1968–2010, 94 TCs passed within 400 km of Efate, an area where these systems occur the most [129]. Increased rainfall is usually associated with passage of TCs which may cause flash flooding so this could be responsible for the hoteliers' perception [109].

The impact of changes in precipitation had been reported in previous research mainly as a negative, as it reduces the attractiveness of the destination [130]. de Freitas found that rain, cloudiness, wind and severe weather are perceived by tourists as annoying and dangerous as they reduce enjoyment [131]. These findings were corroborated by Hubner & Gössling and Forster et al. in which cases, persistent rainfall and the passage of TCs made the destinations less desirable as vacation spots [132,133]. The flip side of this is the prevalence of drought conditions which is significant for tourism, as precipitation affects the water supply. This is a major issue for Antigua as water demand in the accommodation sector can range from 84 to 2,000 litres per tourist per day which works out to be several times higher than the resident population's usage [134]. In Benidorm, Spain, Martinez-Ibarra reported that a water supply crisis in 1978 caused not only significant economic losses but damaged its reputation as a vacation destination [135]. In Grenada, the drought of 2009/2010 caused some hotels to close, others had to ration water for guests (which they complained about) and some tourism water-related activities were interrupted [136]. Although a limited number of Efate's hoteliers perceived that droughts had increased (41%) and that there was a scarcity of freshwater (28%), limited water supply could affect hygiene and sanitation, increasing the risk of water and food contamination [137]. This is a major concern for many islands in the Caribbean, the Pacific and Indian Oceans as compromised health standards could increase the risk of exposure of guests and staff alike to infectious diseases [138].

Changes in precipitation therefore have major implications for the reputations of hotels, their marketing strategies and the ability to implement adaptation measures to address the risks presented by climate variability and change. The perception of frequent occurrences of extreme weather events such as storms, droughts and water scarcity will lead to declines in tourist arrivals which in turn affect the fragile economies of small islands. Tourism demand models predict that the impact of climatic features will cause a reduction in arrivals by about 1% to 5% per year for some small islands [130]. Tourists found beach erosion control structures unsightly and many said they would not return to destinations where beaches had significantly eroded [139].

Perception of Temperature Increase

Seventy-four per cent of the Antiguans perceived that temperatures had increased. The MK test corroborated this perception only in relation to the minimum temperature, which had a statistically significant increasing trend (p=0.00) (Figure 4). The nature of the trend in the maximum temperature, however, was found to be increasing (Kendall S=142) (Table 2). Sixty-three per cent of Efate's hoteliers perceived that temperatures had increased. A statistically significant increasing trend was found in the maximum temperature at the 95% confidence level. Although the nature of the trend in the minimum was toward an increase (Kendall S=76), this was not statistically significant.

Previous studies have also reported hoteliers' perception of increased temperatures, raising concerns over decline in tourist arrivals and increasing operational costs [140]. de Freitas (2003) reported that high air temperature may have impacts which include environmental stress, physiological strain and hyperthermia reducing visitor satisfaction and the attractiveness of the holiday destination. In Granada, Spain, hoteliers expressed fear over the spread of malaria and how it may impact visitor perception of the destination [140]. In both the Caribbean and the Pacific, studies have shown the linkages between higher temperatures and the negative impacts on human health including malaria, dengue and ciguatera fish-poisoning [141,142]. For example, in the tourism-dependant South Pacific island of Moorea, ciguatera fish poisoning was found to be a serious public health problem with significant impact on the economy due to loss of tourism and reduced work days for affected locals [143]. This points to the need for planned adaptation measures including awareness raising of the potential risks associated with climatic changes.

Hoteliers' Perception of Climate Change Impacts on Properties

The hoteliers perceived that a number of changes had occurred on their properties (Figure 4). Most of the hoteliers from both islands perceived that within the last decade, beach erosion had increased and the amount of fish available for purchase locally had decreased. Whilst 91% of the Antiguans noted the implementation of water conservation initiatives, 58% of Efate's hoteliers had implemented no such initiatives (30% had). Increased beach erosion had been reported in previous studies although some hoteliers did not consider relocating their businesses [144]. In a study conducted in eight Caribbean islands (including Antigua) during the period 1985-2000, overall, an erosion trend was observed with a retreat rate of 0.5 m yr -1 [145]. The rate of sea level rise for the Caribbean between 1950 to 2009, was found to be similar to that that of the global mean rate of approximately 1.8 mm yr -1 [50]. In the tropical Pacific, between 1993 to 2009, spatial trend patterns showed that around Vanuatu, the rate of sea level rise had been twice the global average (approximately 6 mm yr1) [146]. One of the main impacts of sea level rise is shoreline erosion [47]. Beach loss has serious implications for the economies of small tropical islands as most of their tourism marketing strategies are based on sun, sea and sand [145]. Shoreline erosion not only affects beaches but the size of coastal properties (including hotels) and coastal habitats (including mangroves) [139]. These impacts have serious implications for tourism marketing and revenues, property values and insurance costs and the local economy in general as tourism is linked to many other sectors of the economy.

Regarding the perceptions of whether the amount of local produce available for purchase had decreased or whether more indoor activities were planned for guests, hoteliers from both islands expressed a high degree of uncertainty. In the case of Antigua, a similar percentage (35) both agreed with and expressed uncertainty over the statement of whether the amount of local produce available for purchase had decreased or not. For Efate, 43% perceived that the amount of produce had not decreased while 30% expressed uncertainty over this occurrence. When it came to planning more indoor activities, 43% of the Antiguans did not perceive they were doing this while 40% were uncertain. In the case of Efate, 46% of the hoteliers were uncertain and 40% perceived no increase in planning more indoor activities for guests. In South Africa, hoteliers not only increased indoor activities for guests they promoted tourism during the winter months when conditions were less humid [86]. Nevertheless, the high level of uncertainty over changes on the property, when these owners and managers had on average, over 10 years' experience on the job suggests that something may be happening. Less local produce means that the import bill rises as well as the operational costs for these hotels, the spin-offs from linkages with local farms are reduced and the local economy suffers due to leakages within the system [147,148].

It was not surprising that most of the hoteliers in this study perceived that the amount of fish available for purchase had decreased. Increasing ocean temperatures have been found to negatively affect fish composition, distribution and abundance [149-151]. Further, fish habitats have also been affected by

higher water temperatures, leading to a number of coral bleaching episodes in the both the Caribbean and the Pacific [13,152,153]. These findings have socio-economic implications as hoteliers and restaurateurs would increase importation which would increase their operational costs. However, according to the FAO, fish catch has been stable in Antigua & Barbuda between 2005 and 2014, at approximately 3,000 tonnes [154]. In 2015, importation of fish and fishery products amounted to USD6.8 million while exports stood at USD0.02 million. With respect to Vanuatu, fish capture figures varied between 2003 and 2007, ranging from 8,351 tonnes to 18,292 tonnes [155]. In 2007, the value of fisheries exports amounted to USD62.7 million and the imports were valued at USD2.8 million.

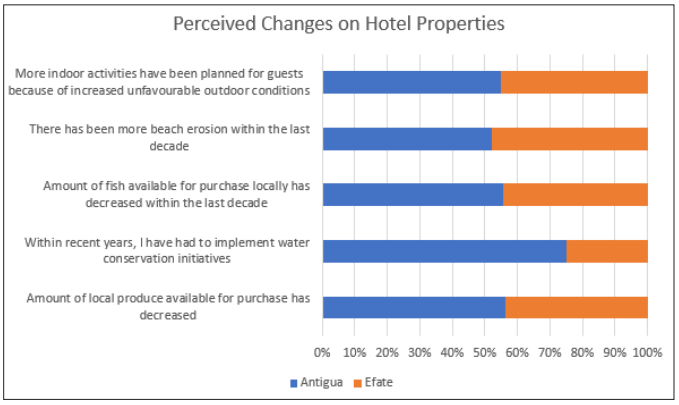

Figure 4: Perceived Changes on Hotel Properties

Adaptation Strategies

In response to the perceived changes in the climate and on their properties, the hoteliers implemented several strategies (Figure 5) (n= 40 for both islands).

Respondents were specifically asked which measures were implemented because of climate change. The main measures implemented in both islands were retrofitting, coastal protection, the provision of shade or shelter from the sun and the use of better technologies. A further 10% of the Antiguans improved their water management capability. With regard to Efate, a further 10% installed drainage and pumping systems. The other measures that were implemented in both islands were by less than 10% of the hoteliers. With the highest implementation for Antigua and Efate being only 15% and 20%, respectively, these results mirror previous research which found very low implementation of adaptation strategies within the hotel industry [89,90,140]. In those instances, despite the positive perceptions and awareness of environmental protection, hoteliers were in no hurry to adapt because of uncertainty of future climate change. However, most of the hoteliers in this study did not perceive adaptation as a priority issue and the associated cost was also a deterrent. Cost was also a major barrier in a number of previous studies including Wolfsegger et al., Becken and Jarvis & Ortega [89,140,156]. No studies were found in which the reason given for the low uptake of adaptation measures was "not on the list of my priorities" as found in this research. Nevertheless, Wyss et al. found that the tourism community did not perceive climate change impacts as important and where changes have been made, they were not attributed to climate change [83].

The adaptation measures implemented could broadly be categorised under energy and water-saving, coastal defence and sun protection. These measures, though few, reflect the hoteliers' perception of changes in precipitation and temperature and beach erosion. A number of previous studies have highlighted the cost savings and environmental benefits of implementing energy and water saving measures within the accommodation sector so this finding was not surprising. As found in this study, countries that have been affected by sea level rise and beach erosion have responded by installing sea defences (either through hard or soft engineering methods). However, some of these defences, especially the hard ones such as groins have been found to damage adjacent areas and instead, greater setbacks and the relocation of properties have been recommended. Protection from the sun not only entails measures to install more coverage from the direct rays of the sun but the organisation of more indoor activities as also found by Scott et al. [156].

The tourism industry is critical to the economies of small tropical islands. This sector is complex and is critical to survival of many other livelihoods including agriculture, fisheries and construction. Whether the hoteliers in Antigua and Efate believe it or not, the climate is changing. Their inactivity may cost them the competitive advantage as already accommodation consumers are willing to pay more for rooms in hotels which engage in sustainable practices or green initiatives [157]. As governments rely on tourism for its contribution to revenue earnings, employment and poverty alleviation, they must become the catalyst for change by regulating the tourism industry regarding their response to climate change as agreed to by operators within the Taiwanese hospitality industry.

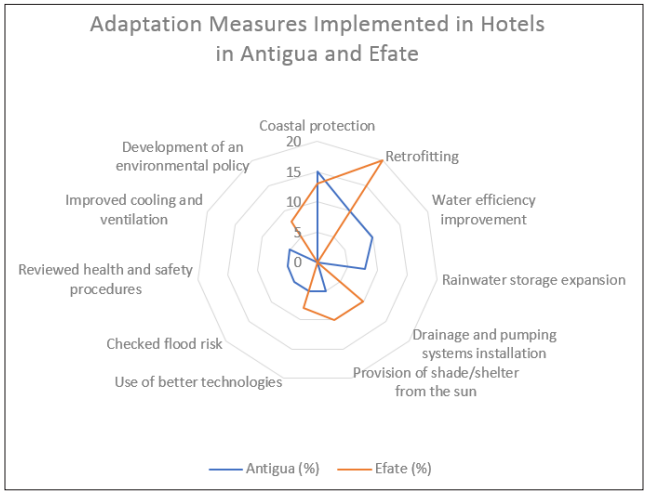

Figure 5: Implemented Adaptation Strategies

Conclusion

All the hoteliers in this study were aware of climate change and its effects. Although they perceived that they were affected by changes in precipitation, temperature and sea level rise, only a small number implemented few adaptation measures. Retrofitting, installation of coastal defences, use of better technologies and the provision of shelter from the sun were main measures common to both islands. Nevertheless, no more than 20% of hoteliers implemented any adaptation measure so they largely remain vulnerable to the impacts of climate change. Therefore, it is recommended that governments regulate the accommodation sector regarding adaptation to climate change to ensure that tourism continue to play the vital role as the mainstay of these small, fragile economies.

References

1. Lithgow D, Martínez ML, Gallego-Fernández JB, Silva R, et al. (2019) Exploring the co-occurrence between coastal squeeze and coastal tourism in a changing climate and its consequences. Tourism Management: 74: 43-54.
2. Nurse LA, McLean RF, Agard J, Briguglio LP, Duvat-Magnan V, et al. (2014) Small islands Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change 1613-1654.
3. Scott D, Hall CM, Gössling S (2016) A review of the IPCC Fifth Assessment and implications for tourism sector climate resilience and decarbonization. Journal of Sustainable Tourism 24: 8-30.
4. IPCC (2014a) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge University Press.
5. WTTC (2021a) Economic Impact Reports. In. London, UK: World Travel and Tourism Council.
6. WTTC (2021b) Recovery Scenarios 2020 & Economic Impact from COVID-19. World Travel and Tourism Council. Retrieved 15/01/2021.
7. Betzold C (2015) Adapting to climate change in small island developing states [journal article]. Climatic Change 133: 481-489.
8. McField M (2017) Impacts of Climate Change on Coral in the Coastal and Marine Environments of Caribbean Small Island Developing States (SIDS). Caribbean Marine Climate Change Report Card: Science Review 52-59.
9. Reyer CPO, Adams S, Albrecht T, Baarsch F, Boit A, et al. (2017) Climate change impacts in Latin America and the Caribbean and their implications for development. Regional Environmental Change,17: 1601-1621.
10. Layne, D. (2017). Impacts of Climate Change on Tourism in the Coastal and Marine Environments of Caribbean Small Island Developing States (SIDS) (Caribbean Marine Climate Change Report Card: Science Review.
11. Wuebbles DJ, Easterling DR, Hayhoe K, Knutson T, Kopp RE, et al. (2017) Our Globally Changing Climate. Chapter 1.
12. NOAA (2021) Climate at a Glance: Global Time Series. NOAA National Centers for Environmental Information. Retrieved 18/01/2021 from https://www.ncdc.noaa.gov/cag/
13. Hoegh-Guldberg O, Ridgway T (2016) Coral bleaching comes to the Great Barrier Reef as record-breaking global temperatures continue. The Conversation. Retrieved 03/05/2017 from www.theconversation.com.
14. Field CB (2014) Climate change 2014–Impacts, adaptation and vulnerability: Regional aspects. Cambridge University Press.
15. Gattuso JP, Hoegh-Guldberg O, Pörtner HO (2014) Cross-chapter box on coral reefs. In Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel of Climate Change 97-100.
16. Harvey BJ, Nash KL, Blanchard JL, Edwards DP (2018) Ecosystem-based management of coral reefs under climate change Ecology and Evolution 8: 6354-6368.
17. Carilli J, Donner SD, Hartmann AC (2012). Historical temperature variability affects coral response to heat stress. PLoS One 7: e34418.
18. Jackson JBC (2010) The future of the oceans past. Philosophical Transactions of the Royal Society B: Biological Sciences 365: 3765-3778.
19. Arguez A, Hurley S, Inamdar A, Mahoney L, Sanchez-Lugo A, et al. (2019) Should We Expect Each Year in the Next Decade to Be Ranked among the Top 10 Warmest Years Globally? Bulletin of the American Meteorological Society 101: E655-E663.
20. Yonge CM, Nicholls AG (1928) Studies on the physiology of corals. V. The effect of starvation in light and in darkness on the relationship between corals and zooxanthellae. Scientific Reports of the Great Barrier Reef Expedition 177-211.
21. Dutra L, Haywood MDE, Singh SS, Piovano S, Ferreira M, et al. (2018) Effects of climate change on corals relevant to the Pacific Islands. Pacific Marine Climate Change Report Card 132-158.
22. Lough JM, Anderson KD, Hughes TP (2018) Increasing thermal stress for tropical coral reefs: 1871–2017. Scientific reports 8: 1-8.
23. Dai A (2013b) Increasing drought under global warming in observations and models. Nature Climate Change 3: 52-58.
24. Dai A, Zhao T (2017) Uncertainties in historical changes and future projections of drought. Part I: estimates of historical drought changes. Climatic Change 144: 519-533.
25. Sheffield J, Wood EF, Roderick ML (2012) Little change in global drought over the past 60 years. Nature 491: 435-438.
26. Cashman A, Yawson D (2019) Water, Livelihoods, and Migration in SIDS: Climate Change and Future Prospects for Carriacou, West Indies. Resources 8: 174.
27. Herrera D, Ault T (2017) Insights from a New High-Resolution Drought Atlas for the Caribbean Spanning 1950–2016. Journal of Climate 30: 7801-7825.
28. ABMS (2017) Droughts. Antigua and Barbuda Meteorological Services. Retrieved 27/02/2017 from www.antiguamet.com
29. Destin D (2016) Drought watch in effect for the short term. Antigua and Barbuda Drought Outlook 2.
30. Annamalai H, Keener V, Widlansky MJ, Hafner J (2015) El Niño strengthens in the Pacific: Preparing for the impacts of drought.
31. Kuleshov Y, McGree S, Jones D, Charles A, Cottrill A, et al. (2014) Extreme weather and climate events and their impacts on island countries in the Western Pacific: cyclones, floods and droughts. Atmospheric and Climate Sciences 4: 803.
32. Unescap (2021) Monitoring Drought From Space. United Nations Economic and Social Commission for Asia and the Pacific. Retrieved 5th March 2021 from https://staging-legacy.unescap.org/our-work/ict-disaster-risk-reduction/regional-space-cooperation-mechanisms-drought-monitoring-and-sustainable-development/about
33. Warrick O (2015) El Nino brings drought and heightened cyclone risk to Vanuatu. The International Federation of Red Cross and Red Crescent Societies. Retrieved 5th March, 2021.
34. Mc Namara KE, Prasad SS (2014) Coping with extreme weather: communities in Fiji and Vanuatu share their experiences and knowledge. Climatic Change 123: 121-132.
35. Ebi KL, Bowen K (2016) Extreme events as sources of health vulnerability: Drought as an example. Weather and Climate Extremes 11: 95-102.
36. Van Loon AF, Stahl K, Di Baldassarre G, Clark J, Rangecroft S, et al. (2016) Drought in a human-modified world: reframing drought definitions, understanding, and analysis approaches.
37. Reguero BG, Losada IJ, Diaz-Simal P, Mendez FJ, Beck MW (2015) Effects of climate change on exposure to coastal flooding in Latin America and the Caribbean. PLoS One 10: e0133409.

38. Chew C, Reager JT, Small E (2018) CYGNSS data map flood inundation during the 2017 Atlantic hurricane season. Scientific reports 8:1-8.
39. Kundzewicz ZW, Kanae S, Seneviratne SI, Handmer J, Nicholls N, et al. (2014) Flood risk and climate change: global and regional perspectives. Hydrological Sciences Journal 59: 1-28.
40. Diakakis M, Deligiannakis G, Katsetsiadou K, Lekkas E (2015) Hurricane Sandy mortality in the Caribbean and continental North America. Disaster Prevention and Management.
41. Handmer J, Iveson H (2017) Cyclone Pam in Vanuatu: Learning from the low death toll. Australian Journal of Emergency Management 32: 60-65.
42. Mohan P (2017) Impact of hurricanes on agriculture: Evidence from the Caribbean. Natural Hazards Review 18: 04016012.
43. Terry JP, Lau AYA (2018) Magnitudes of nearshore waves generated by tropical cyclone Winston, the strongest landfalling cyclone in South Pacific records. Unprecedented or unremarkable? Sedimentary Geology 364: 276-285.
44. Ballu V, Bouin MN, Siméoni P, Crawford WC, Calmant S, et al. (2011) Comparing the role of absolute sea-level rise and vertical tectonic motions in coastal flooding, Torres Islands (Vanuatu). Proceedings of the National Academy of Sciences, 108: 13019.
45. Bruun P (1986) worldwide impacts of sea level rise on shorelines. Effects of Changes in Stratospheric Ozone and Global Climate 4: 99-128.
46. Cazenave A, Cozannet GL (2014) Sea level rise and its coastal impacts. Earth's Future 2: 15-34.
47. Nicholls RJ (2011) Planning for the impacts of sea level rise. Oceanography 24: 144-157.
48. Lewsey C, Cid G, Kruse E (2004) Assessing climate change impacts on coastal infrastructure in the Eastern Caribbean. Marine Policy 28: 393-409.
49. Palanisamy H, Becker M, Meyssignac B, Henry O, Cazenave A (2012) Regional sea level change and variability in the Caribbean sea since 1950. In Journal of Geodetic Science 2: 125.
50. Becker M, Meyssignac B, Letetrel C, Llovel W, Cazenave A, et al. (2012) Sea level variations at tropical Pacific islands since 1950. Global and Planetary Change 80-81: 85-98.
51. Kossin JP, Knapp KR, Olander TL, Velden CS (2020) Global increase in major tropical cyclone exceedance probability over the past four decades. Proceedings of the National Academy of Sciences 117: 11975.
52. Murakami H, Delworth TL, Cooke WF, Zhao M, Xiang B, et al. (2020) Detected climatic change in global distribution of tropical cyclones. Proceedings of the National Academy of Sciences 117:10706.
53. Mohan P, Strobl E (2013) The Economic Impact of Hurricanes in History: Evidence from Sugar Exports in the Caribbean from 1700 to 1960. Weather, Climate, and Society 5: 5-13.
54. Vosper EL, Mitchell DM, Emanuel K (2020) Extreme hurricane rainfall affecting the Caribbean mitigated by the Paris Agreement goals. Environmental Research Letters 15: 104053.
55. Hoarau K, Chalonge L, Pirard F, Peyrusaubes D (2018) Extreme tropical cyclone activities in the southern Pacific Ocean International Journal of Climatology 38: 1409-1420.
56. Johnson JWD, Fraser A (2016) Climate Change Impacts In North Efate, Vanuatu (Pacific Community, Issue. https://www.spc.int/sites/default/files/wordpresscontent/wp-content/uploads/2016/12/Climate-change-impacts-North-Efate.pdf
57. Holland E (2020) Tropical Cyclone Harold meets the Novel Coronavirus. Pacific Journalism Review: Te Koakoa, 26: 243-251.
58. Cashman A, Nagdee MR (2017) Impacts of climate change on settlements and infrastructure in the coastal and marine environments of Caribbean small island developing states (SIDS). Science Review 155-173.
59. Chenoweth M (2006) A Reassessment of Historical Atlantic Basin Tropical Cyclone Activity, 1700-1855. Climatic Change 76:169-240.
60. Destin D (2020) Antigua Tropical Cyclones 1851-2019. Antigua and Barbuda Meteorological Services. Retrieved 15 Mar 2021 from http://www.antiguamet.com/Climate/HURRICANE_SEASONS/AntiguanStorms.txt
61. Brown BE, Dunne RP (1988) The Environmental Impact of Coral Mining on Coral Reefs in the Maldives. Environmental Conservation, 15:159-165. https://doi.org/10.1017/S0376892900028976
62. Crosby MP, Brighouse G, Pichon M (2002) Priorities and strategies for addressing natural and anthropogenic threats to coral reefs in Pacific Island Nations. Ocean & Coastal Management 45:121-137.
63. Duvat V (2013) Coastal protection structures in Tarawa Atoll, Republic of Kiribati. Sustainability Science 8: 363-379.
64. Mycoo M (2014) Sustainable tourism, climate change and sea level rise adaptation policies in Barbados Natural Resources Forum 38: 47-57.
65. Yamano H, Kayanne H, Yamaguchi T, Kuwahara Y, Yokoki H, et al. (2007) Atoll island vulnerability to flooding and inundation revealed by historical reconstruction: Fongafale Islet, Funafuti Atoll, Tuvalu. Global and Planetary Change 57: 407-416.
66. Baldwin J (2000) Tourism development, wetland degradation and beach erosion in Antigua, West Indies. Tourism Geographies 2: 193-218.
67. De Albuquerque K, McElroy JL (1995) Antigua and Barbuda: a legacy of environmental degradation, policy failure, and coastal decline.
68. Phillips W (2012) Regional environmental policy and sustainable tourism development in the Caribbean.
69. Bani E (2016) Vanuatu-National Report for Third International Conference.
70. Caminade P, Charlie D, Kanoglu U, Koshimura SI, Matsutomi H, et al. (2000) Vanuatu earthquake and tsunami cause much damage, few casualties Eos, Transactions American Geophysical Union 81: 641-647.
71. Komugabe-Dixson AF, de Ville NSE, Trundle A, McEvoy D (2019) Environmental change, urbanisation, and socio-ecological resilience in the Pacific: Community narratives from Port Vila, Vanuatu. Ecosystem Services 39: 100973.
72. Vuki VC, Appana S, Naqasima MR, Vuki M (2000) Vanuatu.
73. Kelman I (2018) Islandness within climate change narratives of small island developing states (SIDS). Island Studies Journal 13:149-166.
74. WTTC (2019) World Travel & Tourism Council. WTTC. Retrieved 12/04/2019 from wttc.org//
75. Gössling S, Hall CM, Scott D (2018) Coastal and ocean tourism. In Handbook on Marine Environment Protection 773-790.
76. Klein YL, Osleeb JP, Viola MR (2004) Tourism-generated earnings in the coastal zone: a regional analysis. Journal of Coastal Research 1080-1088.
77. IPCC (2007) Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Cambridge, UK: Cambridge

University Press 976.
78. Weber EU, Stern PC (2011) Public understanding of climate change in the United States. American Psychologist 66:315-328.
79. Bickerstaff K (2004) Risk perception research: socio-cultural perspectives on the public experience of air pollution. Environment International 30: 827-840.
80. Rock I (1985) The Logic of perception. Massachusetts Institute of Technology.
81. Niemeyer S, Petts J, Hobson K (2005) Rapid Climate Change and Society: Assessing Responses and Thresholds [Article]. Risk Analysis: An International Journal 25:1443-1456.
82. Wyss R, Abegg B, Luthe T (2014) Perceptions of climate change in a tourism governance context. Tourism Management Perspectives 11: 69-76.
83. Helgenberger S (2011) The Capacity of Locally Bound Tourism Firms to Respond to Climate Variability and Long-Term Change: Qualitative Case Studies on Organizational Learning in the Austrian Winter Tourism Sector. Tourism and Hospitality Planning & Development 8: 69-86.
84. Tervo-Kankare K (2011) The Consideration of Climate Change at the Tourism Destination Level in Finland: Coordinated Collaboration or Talk about Weather? Tourism Planning & Development 8: 399-414.
85. Fitchett JM, Grant B, Hoogendoorn G (2016) Climate change threats to two low-lying South African coastal towns: Risks and perceptions [Article]. South African Journal of Science 112: 86-94.
86. Petrevska B, Cingoski V (2018) Environmental Management: Assessment of Macedonian Hotel Industry. Quality-Access to Success 19: 122-125.
87. Su YP, Hall CM, Ozanne L (2013) Hospitality industry responses to climate change: A benchmark study of Taiwanese tourist hotels. Asia Pacific Journal of Tourism Research 18: 92-107.
88. Becken S (2013) Operators' perceptions of energy use and actual saving opportunities for tourism accommodation. Asia Pacific Journal of Tourism Research 18: 72-91.
89. Saarinen J, Tervo K (2006) Perceptions and adaptation strategies of the tourism industry to climate change: the case of finnish nature-based tourism entrepreneurs International Journal of Innovation and Sustainable Development 1: 214-228.
90. Nelson V (2010) Investigating energy issues in Dominica's accommodations [Research Paper]. Tourism and Hospitality Research 10: 345-358.
91. Filimonau V, De Coteau D. (2019) Tourism resilience in the context of integrated destination and disaster management (DM2). International Journal of Tourism Research.
92. Stancioff C, Stojanov R, Kelman I, Nemec D, Landa J, et al. (2018) Local Perceptions of Climate Change Impacts in St. Kitts (Caribbean Sea) and Malé, Maldives (Indian Ocean). Atmosphere 9: 459.
93. Pearce T, Currenti R, Mateiwai A, Doran B (2018) Adaptation to climate change and freshwater resources in Vusama village, Viti Levu, Fiji. Regional environmental change 18: 501-510.
94. Barnett J, Waters E (2016) Rethinking the vulnerability of small island states: climate change and development in the Pacific Islands. In The palgrave handbook of international development 31-748.
95. Warrick OC (2011) Local voices, local choices? Vulnerability to climate change and community-based adaptation in rural Vanuatu.
96. McCubbin S, Smit B, Pearce T (2015) Where does climate fit? Vulnerability to climate change in the context of multiple stressors in Funafuti, Tuvalu. Global Environmental Change 30: 43-55.
97. Nhep T, Schott C, Sahli M (2018) Climate change adaptation in the coastal tourism hotel sector: The case of Sihanoukville, Cambodia. CAUTHE 2018: Get Smart: Paradoxes and Possibilities in Tourism, Hospitality and Events Education and Research 465.
98. Njoroge JM (2015) Climate Change and Tourism Adaptation: Literature Review. Tourism and Hospitality Management 21: 95-108.
99. Njoroge JM (2015) Climate Change and Tourism Adaptation: Literature Review. Tourism and Hospitality Management 21: 95-108.
100. Shakeela A, Becken S (2015) Understanding tourism leaders' perceptions of risks from climate change: an assessment of policy-making processes in the Maldives using the social amplification of risk framework (SARF). Journal of Sustainable Tourism 23: 65-84.
101. Hess J, Kelman I (2017) Tourism industry financing of climate change adaptation: exploring the potential in small island developing states. Climate, Disaster and Development Journal 2: 33-45.
102. Becken S, Hay J (2012) Climate change and tourism: From policy to practice. Routledge.
103. Walmsley, A. (2011). Climate change mitigation and adaptation in the hospitality industry. In Trends and Issues in Global Tourism Springer 2011: 77-91.
104. Wright N (2013) Small Island Developing States, disaster risk management, disaster risk reduction, climate change adaptation and tourism. Background paper for the Global Assessment report on DRR.
105. Aksu HH (2009) Questionnaries and interviews in educational researches. Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi.
106. Queirós A, Faria D, Almeida F (2017) Strengths and limitations of qualitative and quantitative research methods. European Journal of Education Studies.
107. Xu W, Jiang H, Kang X (2014). Rainfall asymmetries of tropical cyclones prior to, during, and after making landfall in South China and Southeast United States. Atmospheric Research 139: 18-26.
108. Bouma GD, Ling R (2004) The research process (5th ed.). Oxford University Press.
109. Bryman A (2012) Social Research Methods (Fourth ed.). Oxford University Press.
110. Kelley K, Clark B, Brown V, Sitzia J (2003) Good practice in the conduct and reporting of survey research. International Journal for Quality in health care 15: 261-266.
111. ABHTA (2013) Antigua Barbuda Hotels and Tourism Association. ABHTA. Retrieved 01/01/2014 from antiguahotels.org
112. VTO (2013) Vanuatu Travel. Retrieved 01/01/2014 from vanuatu.travel.en/
113. Karmeshu N (2012) Trend detection in annual temperature & precipitation using the Mann Kendall test–a case study to assess climate change on select states in the northeastern United States University of Pennsylvania]. Pennsylvania, PA, USA. http://repository.upenn.edu/mes_capstones
114. WMO (1988) Analyzing Long Time Series of Hydrological Data with Respect to Climate Variability and Change (The World Climate Programme Applications, Issue. W. M. Organization.
115. ITRC (2013) Groundwater Statistics and Monitoring Compliance, Statistical Tools for the Project Life Cycle. (GSMC-1). I. T. R. Council. http://www.itrcweb.org/gsmc-1/.

116. Dhanya P, Ramachandran A (2016) Farmers' perceptions of climate change and the proposed agriculture adaptation strategies in a semi-arid region of south India. Journal of Integrative Environmental Sciences 13: 1-18.
117. Jain SK, Kumar V (2012) Trend analysis of rainfall and temperature data for India. Current Science (Bangalore) 102: 37-49.
118. Pinar M, McCuddy MK, Birkan I, Kozak M (2011) Gender diversity in the hospitality industry: An empirical study in Turkey. International Journal of Hospitality Management 30: 73-81.
119. Segovia-Pérez M, Figueroa-Domecq C, Fuentes-Moraleda L, Muñoz-Mazón A (2019) Incorporating a gender approach in the hospitality industry: Female executives' perceptions. International Journal of Hospitality Management 76: 184-193.
120. Ahmad SZ (2015) Entrepreneurship in the small and medium-sized hotel sector. Current Issues in Tourism 18: 328-349.
121. Tavitiyaman P, Weerakit N, Ryan B (2014) Leadership competencies for hotel general managers: The differences in age, education, and hotel characteristics. International Journal of Hospitality & Tourism Administration 15: 191-216.
122. Hambira WL, Saarinen J (2015) Policy-makers' perceptions of the tourism–climate change nexus: Policy needs and constraints in Botswana. Development Southern Africa 32: 350-362.
123. Torres-Bagur M, Palom AR, Vila-Subirós J (2019) Perceptions of climate change and water availability in the Mediterranean tourist sector: A case study of the Muga River basin (Girona, Spain). International Journal of Climate Change Strategies and Management.
124. ABMS (2016) Hurricanes & Storms - 1851 to 2015. Antigua and Barbuda Meteorological Services. Retrieved 27/02/2017 from www.antiguamet.com
125. Dai A (2013a) Increasing drought under global warming in observations and models [10.1038/nclimate1633]. Nature Clim. Change 3: 52-58.
126. Davies R (2014) 1 Dead, Hundreds Evacuated in Vanuatu after Record Rainfall. Australia and Oceania, News. Retrieved 28/06/2016 from http://floodlist.com/australia/1-dead-hundreds-evacuated-vanuatu-record-rainfall
127. Diamond HJ, Lorrey AM, Renwick JA (2013) A Southwest Pacific Tropical Cyclone Climatology and Linkages to the El Niño–Southern Oscillation. Journal of Climate 26: 3-25.
128. Moore WR (2010) The impact of climate change on Caribbean tourism demand. Current Issues in Tourism 13: 495-505.
129. de Freitas CR (2003) Tourism climatology: evaluating environmental information for decision making and business planning in the recreation and tourism sector [journal article]. International Journal of Biometeorology 48: 45-54.
130. Hübner A, Gössling S (2012) Tourist perceptions of extreme weather events in Martinique. Journal of Destination Marketing & Management 1: 47-55.
131. Forster J, Schuhmann PW, Lake IR, Watkinson AR, Gill JA (2012) The influence of hurricane risk on tourist destination choice in the Caribbean [journal article]. Climatic Change 114: 745-768.
132. Pulwarty RS, Nurse LA, Trotz UO (2010) Caribbean Islands in a Changing Climate. Environment: Science and Policy for Sustainable Development 52: 16-27.
133. Martínez-Ibarra E (2015) Climate, water and tourism: causes and effects of droughts associated with urban development and tourism in Benidorm (Spain) [journal article]. International Journal of Biometeorology 59: 487-501.
134. Peters EJ (2015) The 2009/2010 Caribbean drought: a case study [Article]. Disasters 39: 738-761.
135. McMichael AJ, Lindgren E (2011) Climate change: present and future risks to health, and necessary responses. Journal of Internal Medicine 270: 401-413.
136. Cashman A, Nurse L, John C (2010) Climate Change in the Caribbean: The Water Management Implications. The Journal of Environment & Development 19: 42-67.
137. Scott D, Simpson MC, Sim R (2012) The vulnerability of Caribbean coastal tourism to scenarios of climate change related sea level rise [Article]. Journal of Sustainable Tourism 20: 883-898.
138. Jarvis N, Ortega AP (2010) The Impact of Climate Change on Small Hotels in Granada, Spain. Tourism and Hospitality Planning & Development 7: 283-299.
139. Kibler SR, Tester PA, Kunkel KE, Moore SK, Litaker RW (2015) Effects of ocean warming on growth and distribution of dinoflagellates associated with ciguatera fish poisoning in the Caribbean. Ecological Modelling 316: 194-210.
140. McIver L, Kim R, Woodward A, Hales S, Spickett J, et al. (2016) Health Impacts of Climate Change in Pacific Island Countries: A Regional Assessment of Vulnerabilities and Adaptation Priorities. Environmental Health Perspectives 124: 1707-1714.
141. Morin E, Gatti C, Bambridge T, Chinain M (2016) Ciguatera fish poisoning: Incidence, health costs and risk perception on Moorea Island (Society archipelago, French Polynesia). Harmful Algae 60: 1-10.
142. Altschuler B, Brownlee M (2016) Perceptions of climate change on the Island of Providencia. Local Environment 21: 615-635.
143. Cambers G (2009) Caribbean beach changes and climate change adaptation. Aquatic Ecosystem Health & Management 12: 168-176.
144. Meyssignac B, Becker M, Llovel W, Cazenave A (2012) An Assessment of Two-Dimensional Past Sea Level Reconstructions Over 1950–2009 Based on Tide-Gauge Data and Different Input Sea Level Grids [journal article]. Surveys in Geophysics 33: 945-972.
145. Antonakakis N, Dragouni M, Filis G (2015) How strong is the linkage between tourism and economic growth in Europe? Economic Modelling 44: 142-155.
146. Ridderstaat J, Croes R, Nijkamp P (2014) Tourism and Long-run Economic Growth in Aruba. International Journal of Tourism Research 16: 472-487.
147. Alam L, Mokhtar M, Ta GC, Halim SA, Ahmed MF (2017) Review on Regional Impact of Climate Change on Fisheries Sector. Novelty Journals 4: 1-5.
148. McGregor S, Timmermann A, Stuecker MF, England MH, Merrifield M, et al. (2014) Recent Walker circulation strengthening and Pacific cooling amplified by Atlantic warming [Article]. Nature Climate Change 4: 888-892.
149. Sale PF, Hixon MA (2014) Addressing the global decline in coral reefs and forthcoming impacts on fishery yields. Interrelationships Between Corals and Fisheries (ed. Bortone SA) 7-18.
150. Eakin CM, Morgan JA, Heron SF, Smith TB, Gang L, et al. (2010) Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005 [Article]. PLOS One 5: 1-9.
151. Spillman CM, Alves O, Hudson DA (2011) Seasonal Prediction of Thermal Stress Accumulation for Coral Bleaching in the Tropical Oceans [Article]. Monthly Weather Review 139: 317-331.
152. FAO (2016) Fishery and Aquaculture Country Profiles. Antigua and Barbuda (2007). Country Profile Fact Sheets
153. FAO (2010). Fishery and Aquaculture Country Profiles The Republic of Vanuatu. Food and Agriculture Organization of

the United Nations. Retrieved 15/11/2016 from http://www.fao.org/fishery/facp/VUT/en

154. Wolfsegger C, Gössling S, Scott D (2008) Climate Change Risk Appraisal in the Austrian Ski Industry. Tourism Review International 12: 13-23.
155. Hall CM, Dayal N, Majstorović D, Mills H, Paul-Andrews L, et al. (2016) Accommodation Consumers and Providers' Attitudes, Behaviours and Practices for Sustainability: A Systematic Review [article]. Sustainability 8: 625-625.
156. GovV (2009) 2009 National Population and Housing Census Basic Tables Report. Port Vila, Vanuatu: Vanuatu National Statistics Office Retrieved from www.vnso.gov.vu
157. Gössling S, Peeters P, Hall CM, Ceron JP, Dubois G, et al. (2012) Tourism and water use: Supply, demand, and security. An international review. Tourism Management 33: 1-15.
158. Hambira WL, Saarinen J (2015) Policy-makers' perceptions of the tourism–climate change nexus: Policy needs and constraints in Botswana. Development Southern Africa 32: 350-362.
159. Hwang J, Lee J J, Park S, Chang H, Kim SS (2014) The impact of occupational stress on employee's turnover intention in the luxury hotel segment. International Journal of Hospitality & Tourism Administration 15: 60-77.
160. IPCC (2014b) Climate Change 2014–Impacts, Adaptation and Vulnerability: Regional Aspects. Cambridge University Press.
161. Kroeker KJ, Kordas RL, Crim R, Hendriks IE, Ramajo L, et al. (2013) Impacts of ocean acidification on marine organisms: quantifying sensitivities and interaction with warming. Global change biology 19: 1884-1896.
162. Srinivasan S (2021) Deploying Telemedicine in Capacity Constrained Contexts: Lessons from the Vanuatu Inter-Island Telemedicine and Learning Project. Available at SSRN 3763578.