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Article *in* Tourism Review International · March 2008

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Tourism Review International, Vol. 12, pp. 5–12
Printed in the USA.

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THE PLACE OF TOURISM IN THE IPCC FOURTH ASSESSMENT REPORT: A REVIEW

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The Intergovernmental Panel on Climate Change (IPCC) recently published its fourth assessment report (AR4), representing the current state of knowledge about the causes and impacts of climate change as well as possible options for adaptation and mitigation. This article reviews the place of tourism in the AR4. Clearly, tourism has been given more space in comparison to the previous report. Nevertheless, substantial regional imbalances in available knowledge are revealed, as well as a virtual absence of information about the contribution of tourism to climate change. The article ends with a discussion of several issues that demand a priority position for tourism on the research agenda for the coming years.

Key words: IPCC; Climate change; Tourism impacts

Introduction

Climate change has the potential to alter the environment and our societies in a fundamental way, and on a global scale. This was already acknowledged by the United Nations Framework Convention on Climate Change (UNFCCC), produced in 1992 during the Earth Summit in Rio de Janeiro: "The ultimate objective of this Convention . . . is to achieve . . . stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the United Nations Environmental Programme and the World Meteorological Organization to inform society and policy makers about the current state of knowledge about the causes and impacts of climate change as well as possible options for adaptation and mitigation. As part of its mandate, the IPCC periodically produces assessment reports that are based in the latest peer-reviewed scientific literature, undergo extensive expert and government reviewing, and involve thousands of scientists worldwide, making them very authoritative and a key reference for decision makers in the international community. The first of these reports appeared in 1990 and the fourth one has recently been published.

Almost a decade ago, Wall (1998) reported on the discussion of tourism in the IPCC Second Assess-

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ment Report (SAR) that was published in 1995. He noted that tourism was not even mentioned in the IPCC First Assessment Report (FAR) in 1990 and proceeded to concisely document the extent to which tourism was incorporated into the SAR. At that time, Wall concluded that, "While it is encouraging that tourism is receiving greater attention in IPCC reports, it is also apparent that the likely consequences of climate change for tourism and recreation are not well understood" (p. 68).

Much has changed in the interceding 12 years with regard to the scientific understanding of anthropogenic climate change and its potential implications for natural and human systems around the world. Even the vocabulary used to assess the potential implications of climate change has changed over this time frame, with adaptation and vulnerability now much more prominent terms than in the SAR. The purpose of this article is to identify the extent of progress in our understanding of the interactions of climate change and tourism by examining the place of tourism in the Fourth Assessment Report (AR4) published in 2007. The article briefly describes the AR4 process and the methodological approach used in this review. The subsequent section identifies the chapters of the AR4 documents where tourism is found and briefly summarizes the tourism-relevant discussion. Well-known uncertainties that are acknowledged in the IPCC reports or the original scientific literature that the IPCC assessment is founded on and key knowledge gaps are also discussed throughout the article. (Authorship teams in the IPCC assessments struggle with severe space limitations in their reports and often the limitations of individual studies are not adequately reflected in the IPCC reports as a result.)

Review Approach

The Fourth Assessment Report in 2007 is the result of 6 years of work by more than 2,500 scientific expert contributors and reviewers. The AR4 is composed of four volumes: three working group reports and a synthesis report. The first volume "The Physical Science Basis" (IPCC, 2007a) by Working Group I discusses the science of climate change from its origins to the most recent knowledge on the global climate system and its interactions with other Earth systems. The second volume "Impacts, Adaptation and Vulnerability" (IPCC, 2007b) by Working Group II focuses on different ecosystems and regions, examining observed and potential ecological, economic, and social vulnerabilities. Volume three "Mitigation of Climate Change" (IPCC, 2007c) by Working Group III describes short-, medium-, and long-term mitigation options (both carbon sequestration and decarbonization of the global economy) in various economic sectors and geographic regions. It also presents cross-sectoral synergies and trade-offs, macroeconomic effects, interactions between mitigation policies and sustainable development goals, and policy instruments to reduce greenhouse gas (GHG) emissions. The fourth report draws on the previous three to succinctly answer key policy-relevant scientific questions posed to the IPCC by the international community.

Although we have endeavored to make this analysis comparable with Wall's (1998) review, we have adopted a different methodological approach out of necessity. Wall's discussion relied heavily on direct quotations and paraphrases of sections of the SAR. Because the volume of material specific to tourism or recreation has increased substantially in the AR4, we could not follow this same approach. Instead an electronic word search was performed on the three AR4 volumes for the following terms: tourism, tourist, recreation, leisure, holiday, vacation, sports. The initial results were checked for unrelated or less relevant items (e.g., the casual mentioning of "tourism" in a long list of examples). In this review, the statements in AR4 are not substantiated or critically examined; for references to the original sources, the reader is referred to the full IPCC assessment reports. Chapter and section numbers from the AR4 reports are provided for easy navigation—except where specifically mentioned, all chapter or section references are to the report of Working Group II.

Analysis of Tourism in the AR4

The word search revealed that tourism was discussed in two volumes of the AR4, that of Working Group II, which focuses on the impacts, adaptation and vulnerability of natural and human systems to climatic change (328 references), and, more briefly (8 references), in the volume of Working Group III, which focuses on the contribution of various economic sectors and geographic regions to an-

thropogenic climate change and possible mitigation strategies. Table 1 summarizes the specific chapters that tourism appeared in and the number of word search occurrences that were documented.

Considerable diversity turns out to exist in how prominently tourism is treated in the various regional chapters, and important geographic gaps in the research literature are revealed. Chapter 16 on Small Islands pays much attention to tourism, both in terms of possible impacts and adaptation options, which is perhaps not a surprise given the importance of tourism for many of these islands. The sector is also treated in some detail in the Europe, North America, and Australia chapters, with references to multiple studies. Remarkably, the number of word occurrences in these chapters is not much higher than in the chapter on Africa. The critical message found there, however, is that while the impacts of climate change on tourism are anticipated to be very important, there are almost no tourism specific studies available on this continent. Tourism-specific studies are also absent from the Asia, Latin America, and the Polar Region chapters, and the gap in knowledge related to this economically important sector is not explicitly identified in these chapters. Tourism receives extensive treatment in Chapter 7 on Industry, Settlement and Society, is amply discussed in Chapter 6 on Coastal Systems, and is casually mentioned as a user of ecosystem amenities in Chapter 4 on Ecosystems. Mountain tourism features in Chapter 1 on observed biophysical and socioeconomic changes observed in the late 20th century. Tourism is all but absent in some of the other chapters by Working Group II, where some discussion could be expected. This is particularly striking for the chapters on human health (e.g., effect of heat waves on tourism) and freshwater resources (e.g., competition for water between tourism and other sectors). The treatment of tourism is also very limited in the chapters on sustainability and on the interrelationships between adaptation and mitigation.

Tourism receives minimal attention in the report by Working Group III, where the word search yielded just 8 occurrences in 5 separate chapters. The prominence of tourism in overall transport emissions and the implications of mitigation for tourist mobility might have been expected to be acknowledged more explicitly.

The remainder of this review is structured around the five main areas of tourism discussion found within the AR4:

Table 1

Word Search Results by IPCC AR4 Chapters

Chapter	Word Search
Working Group II: Impacts, Adaptation and Vulnerability	
1 Assessment of observed changes and responses in natural and managed systems	17
2 New assessment methods and the characterization of future conditions	0
3 Freshwater resources and their management	2
4 Ecosystems, their properties, goods and services	9
5 Food, fibre, and forest products	3
6 Coastal systems and low-lying areas	30
7 Industry, settlement and society	60
8 Human health	1
9 Africa	25
10 Asia	7
11 Australia & New Zealand	29
12 Europe	37
13 Latin America	11
14 North America	22
15 Polar regions	7
16 Small islands	48
17 Assessment of adaptation practices, options, constraints and capacity	9
18 Inter-relationships between adaptation and mitigation	5
19 Assessing key vulnerabilities and the risk from climate change	6
20 Perspectives on climate change and sustainability	0
Working Group III: Mitigation of Climate Change	
All chapters together (occurrences in 5 separate chapters)	8

1. Impact of a changed climate and future climate-induced environmental change on vulnerable regions.
2. Adaptation by destinations.
3. Behavioral adaptation by tourists.
4 Climate change mitigation.
5 Evaluation of regional vulnerability of the tourism sector.

Implications of a Changed Climate and Climate-Induced Environmental Change

Climate itself is an important resource for tourism, as it co-determines the suitability of locations for a wide range of tourist activities and the seasonality of demand (Amelung, Nicholls, & Viner, 2007). Regional differences in natural resources for tourism may be magnified, and existing assets (e.g., biodiversity, water, snow, climatic comfort) are likely to be reduced at some destinations (Chapters 9, 11, 12, 14). Mountains and coastal regions are prominent in the AR4 as far as tourism-related physical impacts of climate change are concerned, as much of the available research has focused on these areas. They host much of the world's tourism activity and are considered highly sensitive to climatic change. Nevertheless, the focus on these regions in past research does not imply that there may not be other vulnerable areas.

Mountains, Snow, and Ice. Mountain regions are, in general, associated with two different types of tourist activities: those that are based on cryospheric elements (snow and ice) and those that are not. Negative impacts of climate change on mountain tourism are mainly related to the observed (1.3.1) and projected reduction of the cryosphere. Skiing is the main international tourist activity that is affected. Global warming causes glaciers to retreat (Chapter 17) and changes the temporal and spatial distribution of requisite natural snow cover. As glaciers retreat and the snow line moves up and/or retreats to higher latitudes, many ski areas are projected to face a decrease of the skiing season. Reductions in snow and ice-related sports are projected for mountain ranges in several regions: Alps of Switzerland and Austria, eastern and western US and Canada, Australia, and South America (Chapters 7, 10, 11, 14).

It is likely that some of the projected impacts of climate change on winter sports tourism in mountain regions is overestimated because widespread climate adaptations that are in use currently, such as snowmaking, are not incorporated in the large majority of these impact studies (Scott & McBoyle, 2007). Different adaptation measures are being put into place or suggested to offset the negative impacts of climate change on snow-dependent mountain activities. Snowmaking technologies are widely used in North America, Australia, Japan, and parts of Europe (Austria, France, Germany) and are capable of considerably reducing the climate change vulnerability of ski resorts in most locations (Chapters 12, 14), although there are technological and economic limitations as machine-made snow can only be produced with sufficiently cold temperatures and the increased costs may be prohibitive to some operators. Snowmaking technologies may also be environmentally problematic in some locations because of its intensive use of water or chemical additives. Where feasible, ski resorts may also propose to extend their terrain higher up in search of more reliable natural snow conditions and entirely new ski areas may be developed at higher elevation (Chapters 12, 14). However, government policies or public opposition may pose a significant barrier to such an adaptation strategy in many locations (Scott & McBoyle, 2007). Snowmobililing, a US$10 billion industry in North America (Chapter 14), is identified to be even more vulnerable to a reduction on the snow cover than skiing due to its complete reliance on natural snowfall.

Diversification into activities not based on snow and ice is put forward as an adaptation strategy for tourism operators (Table 17.1, Chapters 10, 12). Opportunities for these types of mountain tourism activities, ranging from spa and health tourism to outdoor nature-based tourism and ecotourism, are projected to increase even with only moderate climate change (Chapter 14). In Canada and the northern areas of the US, where visitation to parks is limited by winter conditions, longer and climatically more suitable warm-weather tourism seasons are projected to result in higher visitation levels as early as the 2020s (14.4.7). Thus, a climate-induced increase in visitation would have positive economic implications, but could exacerbate visitor use pressures such as crowding and ecological impacts in some park areas. Interviews with visitors of mountain areas in North America suggest that the large majority of these visitors will not alter their intention

to visit these mountain parks or the frequency of their visits because of climate-induced environmental change through to at least the latter decades of this century (Chapter 17). There are expected to be destination-specific exceptions, where changes in high-profile tourist attractions are likely to impact visitation levels sooner. For example, glacial retreat is thought to cause striking changes in mountain landscapes, with possible, but as yet speculative, implications for local tourism in many areas around the world (Chapters 1, 9).

Coastal Areas and Islands. With very high confidence, which in the IPCC AR4 reports translates into a more than 80% chance of being correct, the AR4 concludes that climate change vulnerabilities are greater in "certain high-risk locations, particularly coastal and riverine areas, and areas whose economies are closely linked with climate-sensitive resources, such as agricultural and forest product industries, water demands and tourism" (Chapter 7). Coastal tourism, a climate-sensitive activity in a high-risk area, can therefore be considered highly vulnerable to climate change. The attractiveness of the coast has resulted in disproportionately rapid expansion of economic activity, including tourism (Chapter 6). Tourism based on the attractions of sun, sea, and sand makes up a large share of tourism in the world. The Mediterranean alone accounts for an estimated 16% of international tourist arrivals (6.4.2.6) and in many small island states tourism is a major contributor to GDP and employment (16.4.6).

According to AR4, the "more significant impacts" of climate change on tourism in coastal areas will result from temperature change, extreme events, floods, erosion, and biological effects (Chapter 6), while the impacts from rising water tables and salt water intrusion are considered negligible or have not been established. Overall, temperature increase is deemed more important to coastal tourism than sea-level rise, except where factors such as sea-level rise promote beach degradation, and viable adaptation options to sustain the beach (via nourishment or erosion control structures) are not available (6.4.2.6). The temperature ranges required for coastal tourism are uncertain, however, and our understanding of how tourists respond to increases in mean and extreme temperatures remains limited (Amelung & Scott, 2007). In high-risk coasts, such as hurricane-prone coastlines, insurance costs for tourism could increase substantially or may no longer be available, exacerbating the impacts of extreme events or restricting new tourism development (Chapter 14).

Small islands face all the impacts of climate change related to coastal zones and several others, often in an intensified form. For small islands, climate change is considered a major threat to sustainable development (Executive Summary). In many cases, small islands are very sensitive to climate change (e.g., low lying), have high exposure (e.g., hurricane prone), and they have a low adaptive capacity (e.g., relatively poor, with less diversified economies). As a result, sea-level rise, beach erosion, and the effects of extreme events are likely to cause very significant problems for many of these islands. These phenomena can affect tourist infrastructures, such as hotels and transportation networks (16.4.7). Hurricane Ivan, which struck Grenada in September 2004, for example, damaged the island so severely that the socioeconomic development was set back by at least a decade (16.4.6). Ninety percent of guest rooms were damaged or destroyed, with damages estimated at 29% of GDP. In some locations, the availability of fresh water sources may be affected by changes in precipitation patterns and salinization through sea-level rise (16.4.1), increasing competition for water between tourism and other sectors, such as agriculture (16.4.3), and potentially limiting further tourism development or jeopardizing existing tourism operations.

In some coastal areas, coral reefs are an important resource for tourism (e.g., the Great Barrier Reef). Coral reefs ecosystems are broadly covered by the IPCC report due to their high sensitivity to slight changes in parameters affected by climate change, such as water temperature and ocean acidity. As a result of climate change, thermal thresholds could be exceeded, resulting in bleaching and high mortality in many of these ecosystems around the world (Box 4.4; Executive Summary, Chapter 6; 9.2.1; 9.4.5; 11.4.9; 16.4.4; 16.4.6). The deterioration of these environmental assets may cause a decrease in the number of visitors to nearby coastal or island regions (Chapter 16, Executive Summary).

Adaptation by Destinations

According to Chapter 7, "there are three categories of adaptation processes: technological, managerial,

and behavioural." With respect to tourism operators and destinations, most attention in AR4 is on technological and managerial adaptation to climate change. AR4 mentions a range of examples of technological adaptation in the tourism sector, including snowmaking to combat the shortening of the ski season, desalination plants to overcome periods of water scarcity, air-conditioning for visitor comfort, and infrastructure protection against sea-level rise and flooding (Chapters 12, 14, 16). Options for managerial adaptation that are mentioned include: the promotion of new forms of tourism (such as cultural tourism) to offset losses of climate-sensitive tourism, putting greater emphasis on human-made rather than natural attractions, and diversification of revenues by tourism businesses (e.g., new leisure industries such as health spas, conference centers, grass-skiing, hiking, or ecotourism for ski resorts) (Chapters 10, 12). Adaptive capacities and strategies are likely to vary substantially among tourism stakeholders (Chapter 7). Large tour operators, who do not own the infrastructure and can influence demand through marketing, for example, are in a better position to adapt to changes in tourist destinations than local tourism operators (e.g., ski area or accommodations owners), who are tied to a specific location because of high capital investment in infrastructure and facilities.

Behavioral Adaptation by Tourists

The AR4 also recognizes that climate plays an important role in tourism demand, while acknowledging that there is only very limited knowledge on the complex interactions between tourism, climate, and other environmental and socioeconomic systems (Chapter 1). Without denying the important influence of nonclimatic factors, climate is identified as being a highly relevant factor in the tourist destination choice (Chapter 1, 7). A changed climate is anticipated to make some regions more attractive for tourism (e.g., the Baltic in summer) and others less attractive (e.g., the Mediterranean in summer). Consequently, it is anticipated that tourist demand will shift, through spatial and seasonal redistribution (Chapters 6, 9, 12, 14). Very broadly, climate change is projected to lead to a poleward shift of tourist activity patterns (Chapters 12, 14) and a shift from lowland to highland tourism (Chapter 12, 9.4.7). Under a scenario of gradual warming, it is anticipated at least some tourists would spend their holidays in different places than they currently do, but the available research does not suggest reduced competitiveness of the sun, sea, and sand destinations. Furthermore, the very limited knowledge about cross-cultural climate preferences of tourists, and climatic preferences for different tourist environments currently restricts our capacity to project potential redistribution of tourists with much certainty (Amelung & Scott, 2007). At a global scale, changes in total international tourist numbers induced by climate change are generally projected to be much smaller than those resulting from population and economic growth (Chapter 6).

Behavioral changes may not only result from changing physical circumstances, but can also be triggered by institutional developments. One indirect factor of considerable importance is energy prices, which affect both the cost of providing comfort in tourist areas and the cost of traveling to them (Chapter 7). The price of air transport, now the means of transport of 42% of all international tourists (Gössling & Hall, 2005), is expected to rise as the international community attempts to reduce greenhouse gas emissions (Chapter 7). The potential increase in travel costs resulting from greenhouse gas emission reduction policies could alter mobility patterns and thus require adaptation in terms of leisure lifestyles, such as the substitution of long-distance travel by vacationing locally or regionally (Chapter 7). This effect could be especially significant for national or regional economies that are highly dependent on long-haul tourism (e.g., New Zealand and several Small Island nations—Chapter 7).

Climate Change Mitigation

Leisure styles are identified as important determinants of long-term emission profiles (WGIII-3.1.5), but the third volume of AR4 pays very little attention to tourism and recreation. Tourism is thought to be responsible for a significant and rapidly growing share of radiative forcing (Gössling, 2002; Peeters, Gössling, & Becken, 2006), in particular through transport, but it is not given explicit attention in the sections dedicated to transport. Tourism is more frequently mentioned as a sector that could be potentially affected by climate change mitigation policies, rather than as an industry contributing to the altera-

tion of the global climate system. When describing the mitigation option of reducing deforestation, for example, the benefits for tourism and recreation are repeatedly mentioned as important side effects (e.g., WGIII-Chapter 12). However, there is no empirical evidence to indicate where this may directly (through new recreation opportunities) or indirectly (though improved habitat to support biodiversity) benefit the tourism industry. In the context of destination management, mitigation options are mentioned in connection with adaptation. Adaptation options, including air-conditioning, improved building structures, replanting of trees, and mangroves, can have direct and indirect impacts on energy consumption and GHG emissions (WGIII-Chapter 2). There is a potential for exploiting synergies between adaptation and mitigation in the tourism sector. Energy efficiency policies, for example, induce cost savings that can be attractive from an economic and adaptation perspective, in addition to the mitigation perspective, making such initiative appealing even for countries that do not have mitigation as a main priority (WGIII-Chapter 2).

Discussion and Conclusion

Tourism has clearly received more attention in the IPCC Fourth Assessment Report than in the Second Assessment Report (SAR). In particular, the impacts of climate change on the climatic and natural resources of destinations have been studied in more detail. The possible consequences for mountain areas, coastal zones, and small island states are more fully understood, although the net effect of climate change for any specific destination has yet to be ascertained. The effects of climate change and climate-induced economic or environmental change on tourist demand are receiving increasing attention, but large uncertainties remain. In part, these uncertainties result from fundamental knowledge gaps regarding tourist climate preferences and the role of climate in destination choice, and tourist perceptions of and behavioral response to environmental change (now and decades into future).

In terms of geographical coverage, the research on tourism and climate is also unbalanced. Whereas there are substantial sections dedicated to tourism in the chapters on Africa, Australia, Europe, and North America, there is hardly any consideration of tourism in the chapters on Asia and Latin America. Even among the regions with dedicated sections on tourism, the available research varies substantially. Given the regional distribution of global tourism receipts and relative importance of tourism to the economies to some nations in the Caribbean and Southeast Asia, these regional gaps need to be redressed in the future.

The focus of climate change impact on the tourism sector is slowly moving away from purely physical impacts to incorporate socioeconomic impacts, but there are some large unexplored research areas that are in need of urgent attention in the coming years. It is not known, for example, how significant the discrepancies are between actual and perceived climate change, which is important for anticipating changes in tourist behavior. The same holds for the relative importance of gradual climate changes versus extreme weather events when explaining tourist behavior. The AR4 also reveals that adaptation by destinations and tourism operators is poorly accounted for. Ceron and Scott (2007) believe tourism is a decade behind some other sectors with regard to adaptation research. In economic cost–benefit analyses and climate change costing analyses, tourism has been underrepresented relative to its contribution to global GDP. In the AR4 there are fewer references to studies estimating economic impacts on tourism sectors than in the SAR, which may be related to the crudeness and low confidence of these earlier estimates [e.g., the estimated US$1.7 billion impact of climate change on the US ski industry cited in the SAR (p. 259) even though not a single impact assessment on the US ski industry had been conducted]. Climate change-induced reductions of global GDP (e.g., Stern, 2006) may have implications for tourism spending, but this subject has also hardly been explored to date.

There are many relationships between the climate system, the environment, overall society, and tourism. These relationships involve billions of tourists and other stakeholders, and take place at many different spatial and temporal scales. As the bibliography of Scott, Jones, and McBoyle (2006) revealed, the volume of research dedicated to exploring these complex relationships has increased substantially since the SAR in 1995. New methodological approaches have emerged in this increasingly multidisciplinary field and in some instances revealed important limita-

tions of earlier work. The body of research referred to in the AR4 has clearly advanced our knowledge of the many interlinkages of climate change and tourism, but it has also revealed more complexity and fundamental knowledge gaps, so that our conclusion from this review remains very similar to Wall's (1998). While we are very encouraged that tourism has received greater attention in the AR4, attention more consistent with the contribution of tourism to the global economy and society, our understanding of the potential consequences of climate change for tourism remains highly limited. However, with the number of new researchers contributing to this field, the increasing organization of the climate change and tourism research community and the better involvement of the tourism research community and tourism stakeholders, we believe that there are very positive prospects for substantially improving this situation over the next 10 years.

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