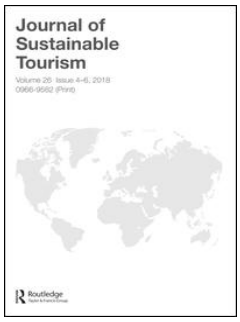

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The Vanuatu Tourism Adaptation System: a holistic approach to reducing climate risk

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ABSTRACT

Tourist destinations in small island developing states are facing increasing risk from climate change, threatening not only tourism businesses but all destination elements including the community and ecosystems. In order to reduce climate risk destination wide, this paper first enhances the Intergovernmental Panel on Climate Change risk framework by extending it with destination specific features. This extended framework was drawn upon to develop a system model for Vanuatu, called the Vanuatu Tourism Adaptation System, using a qualitative multi-phase research design. The system highlights economic, socio-cultural, political, and environmental variables, how they are interlinked and thereby influence climate risk to destinations in Vanuatu. It provides a novel tool for understanding climate risk reduction within destinations as a holistic system and based on this understanding, destination trade-offs and policy recommendations are discussed. It can thus aid tourism and climate change decision makers in identifying and testing adaptation measures that benefit not only tourism but the destination more broadly, including the local community and ecosystem health. This study fills a gap in the academic literature by enhancing the systemic understanding of climate risk in small island developing states destinations and contributes to our understanding of tourism as a climate-resilient development pathway.

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Climate risk; destination; systems thinking; climate adaptation; Vanuatu

Introduction

The recent Intergovernmental Panel on Climate Change (IPCC) report on the impacts of global warming of 1.5 °C states clearly that the impacts of climate change will become increasingly notable and damaging (Intergovernmental Panel on Climate Change, 2018). As knowledge of projected climate change impacts rise, and lack of political action on mitigation becomes more apparent, the need for effective risk reduction measures becomes more pressing. This is particularly the case for small island developing states (SIDS). According to the IPCC's Small Island chapter in the Fifth Assessment Report (AR5), SIDS are highly exposed to climate risk due to their unique characteristics, exposed locations, and high coastline to land ratios (Nurse et al., 2014).

Tourism is one of the most important sectors for the economies of Pacific SIDS (Jiang, Wong, Klint, DeLacy, & Howes, 2012; World Travel & Tourism Council, 2017), contributing significantly to export earnings and development (Nurse et al., 2014). Tourism activity is highly integrated with

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its socio-cultural and environmental surroundings. This is especially so for smaller, rural destinations around the South Pacific (Movono, Dahles, & Becken, 2017; Parsons, Brown, Nalau, & Fisher, 2017), which are characterised by a high reliance on tourism as an income generating activity and a range of socio-cultural and environmental impacts. Climate change adds additional pressure, threatening not only tourism infrastructure, but also the natural assets such as the coral reef ecosystems that the tourism sector and local communities rely on (Becken & Hay, 2012; Nunn et al., 2014; Scott, Simpson, & Sim, 2012). The combination of those characteristics create tourism vulnerability hotspots, destinations most at risk from climate change (Simpson, Gössling, Scott, Hall, & Gladin, 2008; United Nations World Tourism Organisation, United Nations Development Programme & World Meteorological Organization, 2008). At the same time, tourism as a global industry significantly contributes to climate change and is itself exposed to an increasing carbon risk (Becken & Shuker, 2019; Lenzen et al., 2018). This highlights the need for the tourism sector to engage in climate risk reduction activities to ensure the sustainability of SIDS destinations as well as the social stability and economic vitality of SIDS more broadly (Nurse et al., 2014).

Despite the complex relationship between the local community, ecosystems, and tourist infrastructure, most tourism climate change studies focus either on specific interventions (Mycoo, 2014; Schliephack & Dickinson, 2017) or on specific parts of the overall tourism system (Bhandari, Cooper, & Ruhanen, 2016; Klint, Jiang et al., 2012). Few have assessed climate risk to destinations holistically, whereby the approach looks at the problem 'as a whole', including the problem's environment (White, 1995), rather than focusing on separate elements. This paper addresses this gap by applying systems thinking to identify to what degree SIDS can capitalise on the tourism sector in order to reduce climate risk to the wider destination, including the community and natural environment.

Adaptation projects in the South Pacific tourism sector have previously been aimed at strengthening the tourism industry in order to provide income, which in turn should then help reduce the vulnerability of the rural population (United Nations Development Programme, 2017). It has been argued that "there is a very strong link between resilience of tourism establishments and the resilience of communities in which they are located and their ability to recover from events" (Caribbean Disaster Emergency Management Agency, 2009, p. 16). To date, this synergistic relationship is implicit and has not been conceptualised or tested. The AR5 highlights in regard to small islands that "not all adaptations are equally appropriate in all contexts" and that "understanding the baseline conditions and stresses (both climate and other) are important in understanding which climate change adaptation option will generate the greatest benefits" (Nurse et al., 2014, p. 1636). Given that tourism strategies typically aim to grow the sector, it is quite conceivable that the wider effects on the community are not considered when implementing climate change action in tourism, potentially exacerbating vulnerability. There is hence a risk that only the tourism industry benefits, including foreign investors and corporations, whilst non-tourism actors might be disadvantaged.

It has been suggested there is a need for a more systemic approach to inform cost-effective and socially appropriate, government and private sector investment into adaptation (Nurse et al., 2014). However, there is still limited understanding of what constitutes holistic, destination wide, climate risk reduction (Becken, Montesalvo, & Whittlesea, 2018) and how different elements of a destination interact and thereby influence climate risk. To address these needs, the first objective of this study is to develop a comprehensive tourism specific climate risk framework. The second objective is to apply the framework to increase our understanding of what constitutes the Vanuatu Tourism Adaptation System, i.e. what are the variables that make up the system in a Vanuatu tourism context. The third objective is to more specifically examine the interactions of variables, underlying structures, and system behaviour influencing climate risk to destinations in Vanuatu.

Climate change response

Climate change response is particularly challenging for decision makers (Tompkins & Adger, 2005), as traditional decision-making tools (e.g. probability-based frameworks) are proving to be less efficient. This can be linked to the nature of climate change, including its global scale across human and environmental systems, high uncertainties, and prolonged impact time frames. While risk assessments become more advanced and realistic, they often fail to consider social parameters such as inequities, leading to adaptation outcomes with varied benefits across populations or groups within destinations (Oulahen, McBean, Shrubsole, & Chang, 2019). In addition, research has found that interventions often fail to reach the most vulnerable (Eriksen et al., 2011) which limits their effectiveness.

To gain a more holistic perspective on risk, this study builds on the IPCC's conceptualisation of climate risk, which is defined as a function of climate hazards, vulnerability, and exposure (Oppenheimer, Campos, Warren, Birkmann, Luber, O'Neill & Takahashi, 2014). Exposure is location-specific and influenced by what is considered valuable (Oppenheimer et al., 2014) and vulnerability is the tendency to be negatively affected (Gallopín, 2006). Therefore, systemic risks from climate change should not be limited to impacts occurring from changes in global mean temperature alone. They are rather the result of socioeconomic processes, including development pathways and the complex interactions of the human and environmental components of a system, highlighting the dynamic nature of risks (Oulahen et al., 2019).

To address climate risk, the potential of new risks emerging through development processes and the implementation of adaptation actions or their knock-on effects need to be considered (Oppenheimer et al., 2014). While adaptation aims to reduce harm from actual or anticipated climate risk this is not always the case in practice. Research on farming for example found that adaptation interventions that reduce risk to one group may compromise ecosystem integrity and resource access for other groups (Eriksen, Brown, & Kelly, 2005). This suggests that knock-on effects created by the interventions were overlooked. Furthermore, adaptation cannot avoid all impacts and is hence not a substitute for mitigation (Füssel, 2007). Trade-offs between the two need to be understood to avoid maladaptation (e.g. energy intense adaptation measures (Barnett & O'Neill, 2010) such as increased air conditioning in hotels to combat heat). These aspects of risk reduction, including the synergies between mitigation and adaptation, are important considerations relevant for the sustainability of tourism (Becken, 2005) and will help to address the underlying systemic risk rather than the symptoms of risk.

Existing tourism adaptation frameworks

Tourism researchers have developed several climate change adaptation frameworks, which predominantly focus on the process of adaptation. Simpson et al. (2008) present the sequence of events in the adaptation process in an iterative cycle, acknowledging that there may be feedback between the different steps of the adaptation process. The Regional Adaptation Framework developed by Jopp, DeLacy, and Mair (2010) takes a linear approach. It is made up of consecutive steps such as identifying the tourism system (after Leiper's (2004) tourism system, which focuses on identifying key stakeholders of demand and supply of a destination), assessing risks, and understanding vulnerabilities. Once established, adaptation options are identified, tested with consumers, implemented, and evaluated (Jopp et al., 2010). This approach was later advanced by Njoroge (2014), to include more details on the 'adaptation process' phase of the framework, and the feedback between actors at different decision-making levels (global, national, regional). While the idea of feedback processes became increasingly apparent as frameworks developed, these frameworks fall short of applying a holistic systems perspective. There is a lack of consideration of the range of variables across scales that influence the processes and outcomes outlined in the frameworks. In particular, variables that go beyond the core tourism

industry and reflect underlying socio-economic processes and vulnerabilities influencing the destination.

Different to these specific tourism adaptation frameworks, the Destination Sustainability Framework (DSF) takes a more holistic approach. It provides a framework to assess the vulnerability of destinations in the context of disasters and crisis, with the aim to enhance resilience to shocks and stressors (Calgaro, Lloyd, & Dominey-Howes, 2014). For example, this framework has been applied to better understand Thailand's vulnerability in context of the 2004 Tsunami (Calgaro, Dominey-Howes, & Lloyd, 2014). The DSF identified variables internal to the system as contributing to vulnerability and acknowledges feedback from adaptation actions that may influence outcomes (vulnerability). The feedback, however, is generic as adaptation interventions lead to a reduction in vulnerability of the destination, and a lack of adaptation or failed strategies lead to an increase in vulnerability (Calgaro, Lloyd, et al., 2014). The framework lacks interconnections and feedbacks between all variables and therefore does not explain system behaviour. Furthermore, it conceptualises the shock or stressor as an external variable impacting the system, therefore not including the managerial influence or response over the stressor itself (McCool, Freimund, & Breen, 2015). However, emissions generated by tourism activities (internal to the destination system) contribute to climate change (Lenzen et al., 2018). Hence, climate risk can be influenced by elements internal to the destination system.

Existing frameworks are therefore insufficient to understand destination wide, climate risk reduction, including the implications of tourism adaptation. A holistic climate risk framework needs to consider climatic hazards as part of the system (see IPCC Risk Assessment Framework (Oppenheimer et al., 2014)) to acknowledge the potential for the destination to influence climate risk directly (i.e. by reducing emissions). While this link is crucial not only to develop effective risk reduction measures but also to inform future sustainable tourism development pathways, it is often overlooked in tourism (Becken, 2005).

Systems thinking for destination-wide climate risk reduction

Approaches to reduce climate risk to SIDS may be undertaken at different system scales (Robinson, 2017), involve a large number of stakeholders with varying agendas and priorities (Füssel, 2007; Simpson et al., 2008), and have the ability to affect a large number of interconnected destination elements. This highlights not only that adaptation is context specific (Füssel, 2007), but also that the complexity of adaptation is inherent from both a SIDS (Robinson, 2017) and a tourism destination perspective (Moreno & Becken, 2009).

Systems thinking provides an interdisciplinary approach to understanding complex problems (Meadows, 2008) as it factors in horizontal, cross sectoral links and vertical links across decision-making scales. In larger and more complex systems, a small change can have greater, seemingly distant effects (Dawson, Maher, & Slocombe, 2007). This leads to higher uncertainty on the outcomes of decisions, which makes predictions and overcoming problems more difficult (Beilin, 2012). Systems thinking aims to overcome this issue by going beyond considering problems as isolated phenomena (Boguslaw, 2001). It implies that system outcomes are created by the interplay of a number of interconnected variables and feedback loops, which are closed chains of reactions, creating system behaviour (Kim & Lannon, 1997).

Systems and socio-ecological approaches have increasingly been demanded in tourism research (Dawson et al., 2007; Farrell & Twining-Ward, 2004; Ruiz-Ballesteros, 2011). In its very simplest form, the tourism system has been discussed for many years (Leiper, 2004), but more recently systems thinking has been advanced to include more refined concepts and approaches to assess the vulnerability (Calgaro, Lloyd, et al., 2014; Espiner & Becken, 2014), resilience (Becken, 2013; Dredge, 2019; Heslinga, Groote, & Vanclay, 2017) and sustainability of tourism systems (Farrell & Twining-Ward, 2004; Mai & Smith, 2015). However, limited studies have used

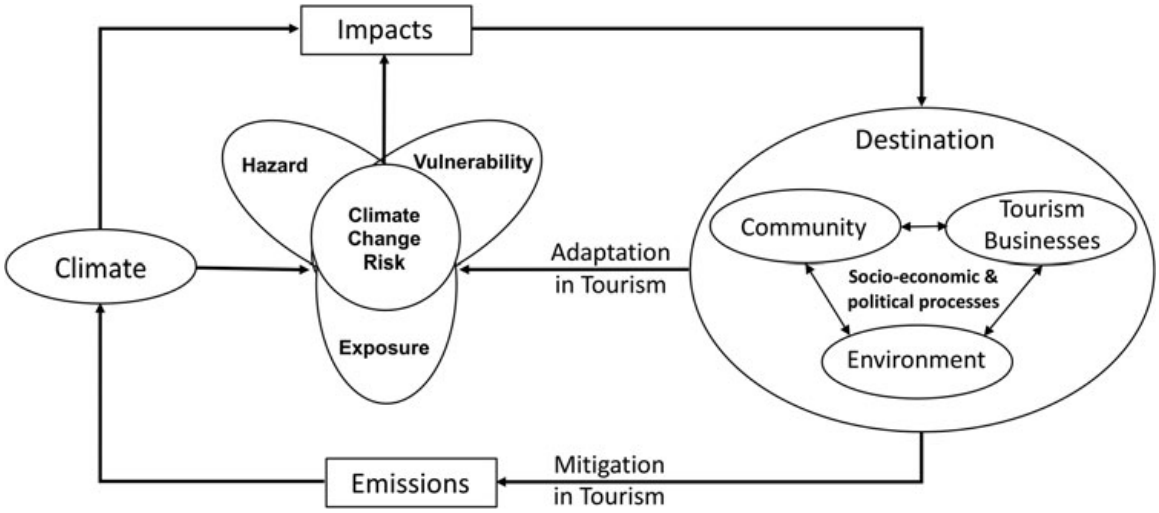

Figure 1. Destination Climate Risk Framework. The climate risk 'propeller' component of the diagram is adopted from Oppenheimer et al. (2014), which is coupled to a representation of the tourist destination social-ecological system.

systems thinking in tourism adaptation and it has not yet been applied to understand risk to destinations holistically. Social-Ecological Systems (SES) describe systems in which humans and the environment are integrated (Ostrom, 2009). SES expand the scope of investigation from actors and human processes to assessing their interconnectedness with ecological processes. The process of adapting to climate risk involves and requires interaction of both human and environmental elements that make up a destination. This paper applies general systems theory and the SES perspective as they shift the focus from linear cause and effect thinking and reactionary approaches to the holistic assessment of factors influencing the underlying system structures leading to risk. Based on the above, a system model developed to foster destination-wide, climate risk reduction should:

- Consider all aspects of risk including hazards and exposure, as well as underlying vulnerabilities;
- Acknowledge uncertainties that exist in complex systems and with climate risk to stimulate the development of innovate and flexible solutions;
- Be holistic, showing feedback and recognising the interconnectedness of variables across scales and interlinked sectors;
- Be context specific;
- Reflect the complexity of the issue while reducing it to a degree so it can be understood by a range of stakeholders from different backgrounds.

The destination climate risk framework

To address the need of a more holistic view on climate risk to destinations, the IPCC Risk Assessment Framework was extended by including destination specific elements, drawing on general system theory and SES. The Destination Climate Risk Framework (Figure 1) defines the destination as a SES and highlights its interaction with climate risk. This framework provides a conceptualisation of high-level aspects to be considered in developing climate responses for destinations and serves as scope for the operationalisation of the context specific system model. Operationalising the Destination Climate Risk Framework and applying a systems approach, the following sections describe the development of the Vanuatu Tourism Adaptation System (TAS), a context specific, systemic representation of factors influencing climate risk to destinations in Vanuatu, what the TAS contains, and how it functions.

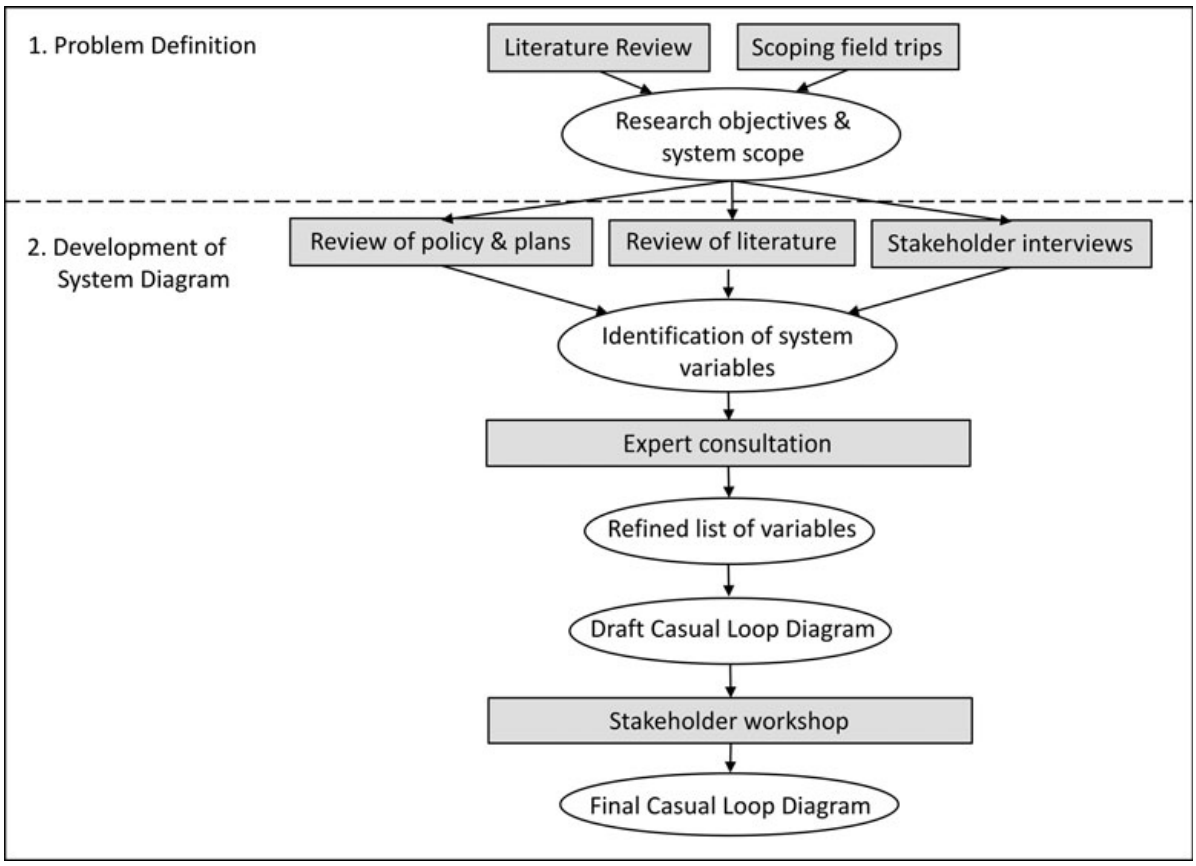

Figure 2. The multi-stage development process of the Vanuatu Tourist Adaptation System (TAS) (Source: author's).

Methodology

Developing the TAS was an iterative process developed to create a qualitative conceptual system model of climate risk to Vanuatu destinations. Sterman (2000) described five common steps to develop a model of a system, whereby this study focuses on the first two (Figure 2): (1) problem articulation and (2) formulation of a dynamic hypothesis. Each of those steps is explained in more detail below.

Problem definition and system scope

The first phase, problem definition, involved determining the objectives and scope of the system (Jakeman, Letcher, & Norton, 2006). This phase commenced with an extensive literature review, and two scoping field trips to Vanuatu (March 2017) and Samoa (June 2017). The field trips were conducted as part of a wider adaptation project in the South Pacific (Mackey et al., 2017). To better understand the problem and objectives of the system, unstructured interviews with tourism and climate change stakeholders and community members were completed, and observations were made and recorded.

The system scope is defined based on the Destination Climate Risk Framework introduced in Figure 1, which specifies the system outcome as reducing climate risk to the destination. Geographically, a destination focus was chosen, a common approach in tourism (Calgaro, Dominey-Howes, et al., 2014), limiting the TAS to the country of Vanuatu. As decisions in relation to addressing climate risk are made at different levels within the system, system variables influencing risk to Vanuatu destinations at the international, national, through to the local level were included to provide a holistic picture.

Development of the Tourism Adaptation System diagram

The second phase focused on developing the dynamic hypothesis of the system in form of a casual loop diagram (CLD) to visualise how drivers are linked to other variables and outputs (Chen & Pollino, 2012; Mai & Smith, 2015). The conceptual model includes the identification of key system variables that either directly or indirectly influence system outcomes (climate risk reduction), as well as the processes that link them (Chen & Pollino, 2012). While not predictive, it aids problem understanding and provides insights to "the underlying structure of a messy, complex situation" (Vandenbroeck, Goossens, & Clemens, 2007, p. 6). Triangulation of data, derived from both primary and secondary data sources, as well as a range of qualitative methods (Anney, 2014), were applied to develop the system.

Identification of variables

To identify variables impacting climate risk to Vanuatu destinations, tourism and climate relevant policies and plans (n = 19) were reviewed, including priority actions identified for climate risk reduction in tourism. The revision of policies and plans to inform systems analysis has been recommended by Moreno and Becken (2009). In addition to relevant Vanuatu documents, a number of selected Samoan tourism and climate change specific strategies and plans were analysed. These were included as Samoa was deemed as a South Pacific leading example in tourism adaptation due to the number of projects, policies and strategies developed specifically to address climate change in tourism. Two further documents from the broader South Pacific were also included.[1] This helped ensure variables that may have been missed or not yet considered in the Vanuatu documents were included. This process also enabled the researcher to better understand the formal decision-making processes within the tourism sector in Vanuatu and identify a range of stakeholders, their roles and formal connections within the system.

To ensure the inclusion of additional variables influencing climate risk to destinations that were not named or considered in policies and plans, the academic peer reviewed literature was reviewed. A search on 'adaptive capacity' and 'tourism', 'vulnerability' and 'tourism', 'climate hazards' and 'tourism' was conducted to identify relevant literature.[1] In addition, literature on tourism and adaptation and community vulnerability, resilience and adaptive capacity in the South Pacific context were considered.

Following the review of secondary data, interviews were conducted with tourism and climate change stakeholders in both the private and public sector in Vanuatu (n = 20). The aim was to identify further factors influencing climate risk and resilience of Vanuatu destinations. Interviews were semi-structured and established a conversation with the interviewee, encouraging broader discussion of experiences and perceptions (Brinkmann & Kvale, 2015). Interviewees were purposefully selected (Liamputtong, 2013) based on their experience with climate risk in Vanuatu's tourism sector and involvement in tourism climate change projects, as well as using the snowball sampling technique (Jennings, 2010). Interviewees were made up of business owners/managers (n = 9), consultants (n = 4), government representatives including both tourism and climate change (n = 5), and representatives of major NGOs (n = 2). Interviews were conducted in English, following participants' free informed consent (Griffith University Ethics number 2017/108), and were audio recorded and transcribed.

Both secondary data and interview transcripts were analysed in NVivo11 through organising, coding, and categorising data (Saldana, 2016). The initial round of thematic analysis was informed by the Destination Climate Risk Framework, to guide the scope for variables relevant to the system (Elo & Kyngäs, 2008). Nodes were created for any variables influencing climate risk and risk reduction, then further grouped and renamed as analysis progressed (Bazeley, 2007). Interviews were coded using the same process, where the variables identified were added to the initial nodes created from the literature. Any additional variables within the scope of the

framework, were added as new nodes (for example 'private investment'). A large number of variables identified in the literature were also identified within the interviews, which validates their relevance.

The full list of variables was reviewed, and then further combined to group similar variables into broader categories. This process was supported by the input of three experts (Onyango Sahin, Awiti, Chu & Mackey, 2016) in the field of tourism and climate change adaptation and/or climate change adaptation in the South Pacific. The grouping of the variables reduced the complexity of the system but also resulted in a reduction of focus on certain issues, such as the distribution of power. The reduction and combination of variables was guided by the problem definition, system scope, and the researcher's understanding of the system and context gained during field trips.

Development of the casual loop diagram

The CLD was drawn up using the online software Kumu (https://kumu.io). The development of the CLD was conducted in several stages: The first CLD was developed based on the list of variables and their links as identified in the literature review and interviews, as well as the researcher's prior knowledge of tourism and climate change adaptation in the South Pacific. The draft CLD was presented to stakeholders at a workshop in Port Vila, Vanuatu (October 2018), whereby the variables and links were discussed, and feedback was included (e.g. land management practices was added as a new variable). This step was deemed important as it provided an update to those stakeholders involved in earlier rounds of data collection and enabled further validation of results (Tribe, 2018). From this process, the final CLD was produced.

Limitations

While systems thinking acknowledges complexity and uncertainty, developing a system such as the TAS involves simplification and limitations to a predefined scope relevant to the research question (Meadows, 2008). This means that factors outside the scope of the TAS remain unexplored, even if they could be influential to climate risk. The validation with stakeholders, however, helped to ensure that the most important identified variables were included. This process allowed for the combination of specific variables (e.g. 'information, knowledge & education' or 'visitor perceptions (including experience & satisfaction)'), whereas others remained broad (sustainability of development) to achieve a balance between identifying and highlighting the interconnectedness of system elements while reducing complexity. Whilst triangulation of methods aimed to reduce subjectivity, developing a conceptualisation of a complex system is ultimately influenced by the worldviews and understanding of processes of those included in the research.

Results: the Vanuatu Tourism Adaptation System

This section presents the Vanuatu TAS by first introducing the system variables, followed by the system model and structure. The system behaviour of how climate risk to destinations changes is discussed by referring to feedback loops.

The system variables

The Vanuatu TAS is made up of 51 variables that influence destination climate risk. These can be grouped into eight categories, informed by the Destination Climate Risk Framework: (1) the Risk Framework category summarises risk dimensions articulated in the IPCC framework. The next three variable categories summarise the destination SES elements: (2) Tourism & Development,

(3) Community & Culture and the (4) Natural Environment. The interaction of the destination elements are influenced by socio-economic and political variables influencing system capacity to address climate risk, and can be grouped into: (5) Governance, (6) Finance, (7) Information & Education and (8) Human Psychology (Table 1).

System structure and behaviour

All variables of the Vanuatu TAS are interlinked, producing feedback loops which create knock-on effects throughout the system, ultimately reducing or increasing climate risk to the destination. In the following figures of the TAS, a positive relationship between two variables is marked with a '+' (i.e. the two variables increase or decrease in the same direction), a negative relationship with a '–' (i.e. as the influencing variable increases, the recipient variable declines and vice versa). No polarity sign indicates that the variable relationship cannot be determined (for example, variable 'Aspirations & values'). Reinforcing feedback loops (marked as Rx) are self-enhancing and lead to exponential growth until they are restricted by balancing feedback loops (marked as Bx), which are equilibrating (Meadows, 2008). The most important feedback loops creating system behaviour and influencing climate risk to destinations are presented below.

Climate risk to the destination is reduced by managing hazards, vulnerability, and exposure through mitigation and adaptation actions. Their successful implementation depends on actors' willingness for action, which in turn is influenced by the actors' perceptions and values (B1 and B2). Actors are referred to as any person who is making decisions on risk reducing interventions in the TAS, such as community members, business owners, and government representatives. The success of mitigation and adaptation actions are influenced by 'Finance and Governance' variables, and most directly by the variable effectiveness of decision-making & planning (Figure 3). As a destination engages in mitigation actions, it begins to work towards fulfilling the country's international climate change commitments and requirements, this increases access to external climate change funding, which contributes to funding availability within the tourism sector (R1). At the same time, the level of vulnerability of a sector or country also impacts on access to external climate change funding. Funding allocated to climate change in tourism specifically depends on whether tourism is identified as a priority in national (climate change) strategies, or whether climate change is addressed in tourism policies.

Mitigation and adaptation actions are indirectly influenced by 'Information & education' variables: An increase in funding may lead to enhancing human and institutional capacity. This improves actors and institution's international cooperation and influence and therefore access to external climate change funding, which again may increase the availability of funding for tourism (R2). Similar, improvements in human and institutional capacity enhance the subsidiarity of governance, which positively influences the effectiveness of decision-making on tourism adaptation (Figure 3). However, B3-a,b,c suggest that once vulnerability is reduced, access to external climate change funding slows down as risk to the destination has been reduced and there may be other priority areas (countries, sectors) where external funding is more effectively allocated (Figure 3). While external funding is often critical at times of shock, e.g. after a disaster, being dependent on aid over a longer period of time may come at a price. Interviewees pointed out that external funding is often coupled to specific criteria on where and how the money has to be spend, as well as being tied to often tedious bureaucratic processes delaying implementation. Another limitation of external funding identified by participants of this study is that funds are often aimed at large multi-sectoral projects, with limited funds reaching the community business level, or that application processes tied to large sums available through many of the climate change funds are beyond the capacity of small tourism businesses.

As an alternative to external funding, climate change resources for tourism may be secured and maintained through internal government sources (R11) or through private sector investment

Table 1. The variables that make up the Vanuatu TAS.

Risk	Destination variables			Variables influencing system capacity			
Risk Framework	Tourism & Development	Community & Culture	Natural Environment	Governance	Finance	Information & Education	Human Psychology
Hazard	Sustainability of development	Customary land ownership	Appeal of natural attractions	Subsidiarity of governance	Government resources	Human & institutional capacity	Demand for destination tourism product
Exposure	Energy price	Social & gender equality	Health of ecosystems	Community & industry participation	Availability of climate change funding in tourism	Investment in R&D	Willingness for action
Vulnerability	Marketing	Population growth	Conservation	Tourism priority in strategic plans & availability, enforcement of supporting policies	External climate change funding	Information, knowledge & education	Visitor perception
Success implementing adaptation Actions	Preferred weather for tourism	Land management process		International cooperation and influence	Assets/capital	New technology	Perceived benefit of adaptation (vs. cost)
GHG emissions	Tourism numbers	Traditional knowledge		Effectiveness of decision-making & planning	Private investment		Aspirations & values
Mitigation Actions	Spending per tourist	Social networks		Fulfilment of climate change commitments & requirements	Access to risk transfer mechanism		Risk perception
Climate risk to destination	Tourism benefits	Food & nat. resource security					
	Human activity in coastal zone						
	Quality of infrastructure						
	Poverty						
	Diversification & flexibility						
	Local ownership/ participation in tourism business						

Figure 3. The influence of governance, finance, information and knowledge variables on risk to destinations.

(R12) (Figure 4). In this regard, there are a number of reinforcing loops that increase benefits from tourism: Marketing (R6) and private investment into improving the quality of infrastructure may increase visitor perceptions and spending per tourist (R7-a), as well as tourist numbers (R7-b). In addition, tourism benefits may be increased indirectly through climate change funding in tourism being invested into R&D. This enhances access to new technologies and therefore the sustainability of further tourism development. For example, the use of renewable energy reduces energy prices per guest night over time, which positively affect business profitability (R4). Finally, using benefits from tourism to accumulate assets/capital will enhance operator's access to risk transfer mechanisms such as insurance. Having savings or appropriate insurance provides security in times of crisis, as losses are recouped and assistance is provided, helping the business to recover more quickly (R5). While this benefits the businesses, restoring benefits that flow from tourism after a crisis provides support to the wider community, as it secures jobs and income. In addition to tourism benefits creating climate change funding in tourism, 'Tourism & Development' variables highlight further examples of how tourism can contribute to climate risk reduction. For example, increasing tourism benefits to help reduce poverty, can in turn improve

Figure 4. The role of tourism benefits on destination climate risk reduction.

the flexibility & diversity of the destination's local population. It may thereby further enhance the availability, feasibility, and implementation of adaptation actions for the community (R8).

An increasing climate risk to the destination can affect tourism benefits. Risk from climate change negatively affects the health of ecosystems and therefore the appeal of destinations, as well as having an impact on visitor risk perceptions. Negative visitor perceptions can impact on visitor numbers and spending per tourist (B8-a and B8-b) (Figure 5). This highlights the importance and interest the tourism sector should have in reducing climate risk more effectively.

The TAS also shows that 'Tourism & Development' variables can *increase* risk to the wider destination. Growing tourist numbers can lead to increased human activity in already sensitive coastal zones, increasing exposure to climate risk (B7). Tourist numbers also increase the total greenhouse gas (GHG) emissions resulting from tourism, exacerbating climate change. The greater likelihood of climate hazards negatively impacts on visitor perceptions (B8-a), preferred weather (B8-c), and ecosystem health and appeal of natural attractions (B8-b) (Figure 5). The balancing loop B8-b does not only function to restrict tourism growth but also creates further unwanted knock-on effects to the destination as a reduction in ecosystem health reduces food and natural resource security. This has detrimental consequences for local communities relying on natural resources for traditional livelihood activities (which also support small-scale community tourism operations). This may increase poverty, which in turn may reduce community and individual flexibility and diversity and hence their capacity to adapt to increasing climate risk.

The complete Vanuatu TAS highlights how all the elements and feedback loops discussed above interlink. It becomes apparent that while 'Community & Culture' variables are not directly linked to mitigation and adaptation actions, they can indirectly influence the effectiveness of decision-making, as well as to what degree tourism benefits remain internal to the system. For example, social networks and traditional knowledge positively influence access to information,

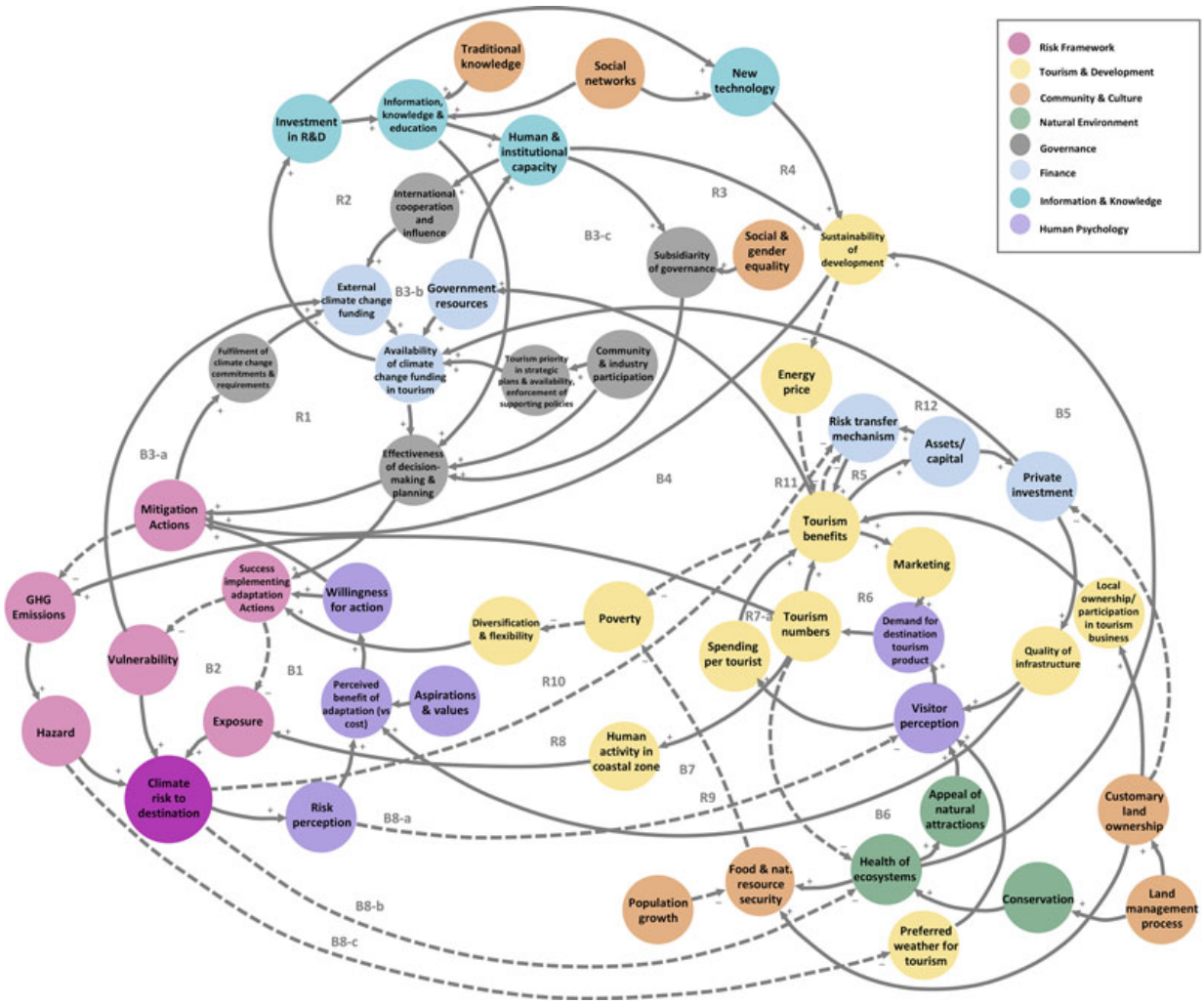

Figure 5. The Vanuatu Tourism Adaptation System represented in a CLD.

knowledge and education and new technology, and land management processes and customary land ownership have an influence on local ownership or participation in tourism businesses and subsequently aid poverty reduction.

Discussion

This study applies a systems approach to climate risk reduction in tourism which goes beyond the traditional tourism policy frame focused on tourism growth (Becken, 2019). It thereby enhances our understanding of the complexity of climate risk to SIDS destinations. As such, the Vanuatu TAS identifies not only how the tourism industry can strengthen feedback loops to reduce risk to destinations holistically, but also highlights how mismanagement and uncontrolled growth of tourism can lead to an increase in risk. It thus contributes to the understanding of the nexus between a resilient tourism industry and resilience of the wider destination, including the community and environment. The TAS provides an enhanced understanding of system structure and behaviour. Following and building on this understanding, a number of trade-offs and policy implications are discussed.

Destination trade-offs

The Vanuatu TAS highlights several trade-offs relevant for tourism development and climate risk reduction. For example, developing tourism (tourist numbers, tourist expenditure, and therefore

tourism benefits) can create risk reducing flow-on effects to the wider system. Studies have shown that if well managed, e.g. regulations and policies put in place which focus on sustainable principles and equity rather than solely promoting growth, tourism can help reduce poverty (Scheyvens & Momsen, 2008). This in turn leads to reduced vulnerability as it increases people's flexibility in terms of reacting to change and potential to accumulate savings or access risk transfer mechanisms, which help in the recovery from extreme events (Jiang et al., 2015). However, benefits to local communities remain low if local participation and ownership in tourism is limited. In Vanuatu, high foreign investment and ownership of tourism businesses are leading to economic growth not having the expected positive impact on the quality of life of the local population (Stefanova, 2008). This highlights a trade-off between foreign investment into the development of Vanuatu as a destination, including improved infrastructure, and tourism's ability to reduce poverty and vulnerability in the face of climate risk.

Growing tourist numbers creates further trade-offs by increasing pressure on the natural environment, thereby increasing risk to the destination, e.g. through increased greenhouse gas emissions associated with international tourism (Lenzen et al., 2018). This is particularly the case for remote destinations including SIDS such as Vanuatu, where the majority of international visitors arrive via plane or cruise ship (Vanuatu National Statistics Office, 2018). As Becken (2019) points out, the amount of GHG emissions associated with passenger aviation "cannot be fully justified with development rationale" (p. 9), which becomes clearer by applying a systems perspective. However, investment decision-making in relation to the development of the tourism sector commonly fails to factor in these consequences. Increased visitor numbers also exuberate pressures on ecosystems, e.g. on coral reefs, through over-fishing, pollution, or the trampling/breaking of coral. Coral reefs as well as other ecosystems provide a range of ecosystem services important to different elements of Vanuatu destinations as links in the TAS highlight. For example, the community relies on fish as a source of food, tourism operators rely on the natural attractiveness, and coastal destinations more broadly benefit from the reef as a natural buffer to large swells and storms (Spalding et al., 2014). To capitalise on the tourism sector, considering these interactions is therefore particularly important for a) SIDS destinations when selecting tourism adaptation measures, and b) destination planning more broadly to ensure the tourism sector delivers benefits to all destination elements under changing climate conditions.

Implications for tourism policy

The Vanuatu TAS highlights important areas where interventions may have wide reaching positive impacts and may be relevant for other SIDS destinations. Being a SIDS and also a least developed country (LDC), Vanuatu receives international climate funding from the Least Developed Countries Fund and a range of national aid agencies (Sovacool, Linnér, & Klein, 2017). As the TAS showed, to attract external funding to address climate risk to destinations, it is important for tourism to be identified as a priority in climate change strategies and plans, and specific sector policies should be implemented to support priority actions. Previous studies on the representation of climate change in tourism policies, both in Vanuatu (Klint, Wong, et al., 2012) and other tourism dependent economies (e.g. Fiji (Jiang et al., 2012) or Australia (Moyle et al., 2017)), found that tourism plans frequently lack any reference to climate change. While tourism may be identified as playing a priority for national adaptation (Republic of Vanuatu, 2015; Vanuatu National Advisory Committee on Climate Change, 2007), the policy review conducted as part of this study did not find an example where tourism was listed as a mitigation priority. This may be due to tourism being seen as a fragmented industry (Wong, Jiang, Klint, Dominey-Howes, & DeLacy, 2013) which is often not included in national carbon reporting schemes (Gössling, 2013), because of a disconnect between tourism and climate change government agencies, or due to a common lack of climate change awareness in tourism government

agencies (Klint, Wong, et al., 2012). There is hence an opportunity for tourism dependent economies, particularly for those of vulnerable nations such as SIDS, to increase the focus on tourism in their national climate change policies and plans, and thereby attract more climate funding. Importantly, as the system shows, policy objectives and funding should be aimed at strengthening feedback loops that enable the destination to reduce climate risk internally and to reduce reliance on external support. Tourism provides an option to strengthening internal funding mechanisms, in particular if leakages are reduced. Additional examples of how tourism can contribute to destination wide risk reduction are investing in education and capacity building, and implementing adaptation measures which work with nature rather than against it.

Stakeholder engagement

The range of system variables across scales highlight that addressing climate risk in tourism requires that it is integrated into long term planning and policy making and should be considered in decision-making at all levels within the tourism sector. For successful outcomes, a holistic approach should therefore involve a wide range of stakeholders. The TAS acts as a tool that can be used to identify and explore potential interventions with stakeholders. This is important as values and interests by diverse stakeholders can affect adaptation outcomes (Eriksen et al., 2011), and perceptions about what may be regarded as a 'successful' adaptation intervention might vary between actors, location or point in time (Adger, Arnell, & Tompkins, 2005). Engagement with broader stakeholders at different levels of the system, such as the local community, tourism businesses, government, and NGOs involved in programs at the destination (such as conservation), can reduce trade-offs and maladaptation (Barnett & O'Neill, 2010). For example, by avoiding an increase in inequalities caused by shifting risk from tourism operators to more vulnerable components of the destination, such as parts of the community or the natural environment, a common barrier to successful climate change adaptation projects is addressed (Buggy & McNamara, 2016; Cinner et al., 2018).

Conclusion

There is a need for islands to adapt to an increasing climate risk. While, implicitly, this should be beneficial for tourism and tourism-dependent communities, this paper took a somewhat different approach in that it investigated the opportunities for the tourism sector to generate wider positive impacts for the destination by reducing climate risk for everyone, not just the business. This study is hence more akin to a 'dark green' interpretation of sustainable tourism, compared with approaches that solely focus on the industry perspective or take a silo approach when assessing risk and vulnerabilities. The IPCC Risk Assessment Framework was extended to develop the Destination Climate Risk Framework. Applying systems thinking, this framework was then operationalised to create the Vanuatu TAS, a novel and holistic approach to assessing and better understanding climate risk to destinations.

This paper presents a case on the direct and indirect benefits tourism destinations, including the community and natural environment, derive from addressing climate risk holistically. The TAS highlights that if the sector fails to do so, it will not only risk re-enforcing existing inequalities, it will face direct consequences in form of reduced ecosystem health, tourist numbers, and benefits, which can have further unwanted knock-on effects within the destination and possibly reinforce climate risk. This emphasises the responsibility the tourism sector has to implement effective and system wide responses to climate change which need to be better integrated into tourism policy and planning. As this study shows, destination wide risk reduction can be driven by tourism's ability to generate export earnings, to upskill employees to enhance human capacity and decision-making, and to strengthen processes supporting ecosystem health and

resource security. As such, islands could capitalise on this strong economic sector in a much broader way than previously understood and measured.

The Vanuatu TAS fills a gap in current literature by presenting a novel decision-making tool for policy makers, investors, and project managers, which can be used to conduct high level tests on how specific adaptation options will affect climate risk, as well as other interlinked elements of the destination. Using the system will help to avoid unwanted knock-on effects, disregarding trade-offs and thus transferring risk to other components of the destination. To address climate change, there is a need for increased cross-sectoral cooperation. The TAS promotes a new way of thinking and thereby opens opportunities to discuss links and feedback between sectors and across scale with a wide range of stakeholders. Enabling tourism and climate change decision makers to gain a more holistic understanding of risks to destinations will enhance effective collaboration, advance integration of projects and policies across sectors, and more generally improve decision-making on the selection and implementation of interventions. This is crucial for the sustainability of destinations under a rapidly changing climate. Applying systems thinking to destination risk reduction is hence relevant to other vulnerable destinations and the Destination Climate Risk Framework provides a scope to assist the development of context specific tourism adaptation systems. These provide destinations with an approach to identify areas for holistic interventions, climate proof destination decision-making, and help ensure tourism becomes a truly climate-resilient development pathway.

Note

1. Supplementary material on the methodology developing the Vanuatu TAS, including the list of policies and academic literature used to inform the identification of variables can be accessed here: https://www.terranova.org.au/repository/the-vanuatu-tourism-adaptation-system-2013-supplementary-material/the-tourism-adaptation-system-2013-supplementary.pdf/view

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The Author declares that there is no conflict of interest.

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