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ORIGINAL ARTICLE

Variation in perception of environmental change in nine Solomon Islands communities: implications for securing fairness in community-based adaptation

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Abstract Community-based approaches are pursued in recognition of the need for place-based responses to environmental change that integrate local understandings of risk and vulnerability. Yet the potential for fair adaptation is intimately linked to how variations in perceptions of environmental change and risk are treated. There is, however, little empirical evidence of the extent and nature of variations in risk perception in and between multiple community settings. Here, we rely on data from 231 semi-structured interviews conducted in nine communities in Western Province, Solomon Islands, to statistically model different perceptions of risk and change within and between communities. Overall, people were found to be less likely to perceive environmental changes in the marine environment than they were for terrestrial systems. The distance to the nearest market town (which may be a proxy for exposure to commercial logging and degree of involvement with the market economy), and gender had the greatest overall statistical effects on perceptions of risk. Yet, we also find that significant environmental change is underreported in communities, while variations in perception are not always easily related to commonly assumed fault lines of vulnerability. The findings suggest that there is an urgent need for methods that engage with the drivers of perceptions as part of community-based approaches. In particular, it is

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important to explicitly account for place, complexity and diversity of environmental risk perceptions, and we reinforce calls to engage seriously with underlying questions of power, culture, identity and practice that influence adaptive capacity and risk perception.

Keywords Adaptation · Community-based adaptation · Fairness · Risk perception · Solomon Islands · Climate change

Introduction

In circumstances where community-based approaches are prioritised as a means of environmental governance, perceptions of environmental change and risk have important consequences for fair adaptation. While enabling place-based adaptation actions that are appropriate to the scale of environmental impacts, participatory and decentralised approaches do not automatically guarantee the rights or entitlements of poor or marginalised groups (Cote and Nightingale 2012). Studies have repeatedly demonstrated how underlying power relations and cultural values create a complex context in which governance and management interventions can unwittingly contribute to elite capture (e.g. Peet and Watts 2004). Within this, the role played by variations in perceptions of change and risk has particular significance, limiting response options and curtailing the capacity to adapt of marginalised or less powerful groups (Cutter et al. 2003; Cutter and Emrich 2006; Jones and Boyd 2011; Ensor et al. 2015).

Studies of environmental risk perception rarely focus on the "contexts and characteristics of people and places" and "do not adequately account for societies and scenarios in the under-developed world" (Walker et al. 2014:710). At the same time, initiatives aiming to foster adaptive responses to environmental change have tended to overlook the importance of context-specific change and perceptions of risk, focusing instead on a single change, and treating all communities as the same (Dodman and Mitlin 2011; Bennett et al. 2015). While frequently adopted as a scale of study and action, communities are not homogenous units. They can differ in their geography and natural resources, types of livelihood activities and use of different environmental systems and in their sense of place, social-cultural practices, beliefs, norms, histories and politics. All of these factors shape localised constructions of environmental risk and the decisions made in response (Venables et al. 2012; Granderson 2014; Rodríguez-Carreras et al. 2014; Walker et al. 2014). Recent calls for more empirical studies on the local nature of environmental change recognise that science and modelling cannot capture these local processes and that multiple exposures unfold and are experienced differently between and within communities (Bennett et al. 2014b; Walker et al. 2014).

Community-based alternatives to top-down governance are invoked precisely to account for this diversity and to harness local understandings of change (Green et al. 2010), and community-based adaptation approaches in particular have received increasing attention among researchers and practitioners (Ensor et al. 2016; Ensor et al. 2014; Spires et al. 2014; Forsyth 2013; Dodman and Mitlin 2011). Local ecological knowledge can provide information about slow and rapid climate and ecological changes at the community level (Sagarin and Micheli 2001; Couzin 2007; Alexander et al. 2011) and also play an important role in defining the way environmental change is interpreted and understood as risk (Adger et al. 2013; Brook and McLachlan 2008; Naess 2013; Aswani and Lauer 2014). Yet as studies of adaptive capacity have revealed, social, historical, political and institutional variations within and between communities can determine the distribution of benefits and costs that flow from community-based approaches (Ensor et al. 2015). Differences in perception of environmental change and risk interact with these variations, adding to the challenge of developing community-based approaches that are both fair and effective.

In this paper, we illustrate that variability in perceptions of risk and change reveals important avenues of enquiry for research and practice if community-based adaptation is to be both equitable and effective. Our study focuses on perceptions of multiple environmental changes and risks among resource-dependent coastal communities in Solomon Islands. We examine six locally recognised, major environmental and resource systems relevant to the livelihoods of coastal communities. During fieldwork, community respondents were asked to describe changes they had perceived or observed in their lifetime across these systems. Based on these data, individual differences in perceptions of change and risk were investigated in nine communities by combining a detailed household survey with a systematic ethnographic interviewing process. The survey data were analysed statistically to assess how perceived changes depend on characteristics of each respondent. Our approach shows that different groups perceive environmental risks differently, within and between communities.

In the Pacific context, it is widely recognised that cultural and spiritual values, individual experiences, and traditional resource management practices have significant implications for perceptions of risk and the ability to adapt (Granderson 2017; Warrick 2016; Weir et al. 2016; Nunn et al. 2016; Mortreux and Barnett 2009). These factors can vary significantly between communities and across scales, leading to calls for adaptive approaches to be pursued at the community scale. Participation of communities can support the development of culturally appropriate responses to environmental change that acknowledge the significance of spirituality and sense of place in natural resource management decision-making, while supporting traditional decision-making structures to respond

to the pace and complexity of contemporary challenges (Nunn et al. 2014; Nunn et al. 2016, Buggy and McNamara 2015). Crucially, community-based and participatory approaches are seen as a strategy to draw in the extensive ecological and biocultural knowledge which is found on Pacific small islands and which has underpinned localised resilience and adaptability (McMillen et al. 2014; Remling and Veitayaki 2016). Yet, despite this tradition of resilience, the need to understand how best to support effective community-based responses is all the more essential in the Pacific, where climate variability and extremes are common yet the processes that lead to climate change are often not recognised at the local level (Weir 2016; Nunn et al. 2014; Remling and Veitayaki 2016).

The next section reviews the literature on perceptions of environmental change and risk. We then provide a brief background to the environmental systems and communities where the surveys were conducted. The mixed methods approach is summarised in the subsequent section. Since the focus of this paper is on the qualitative implications of the findings, we refer readers to the electronic supplementary material for more detailed information about the statistical analysis. We present our findings and discuss how this may affect small coastal communities' localised responses to environmental change. In so doing, we hope to reveal the complexity of the community as a venue for development practitioners working to foster collective community-based responses and fair adaptation to ongoing environmental changes.

Perceptions of environmental risk and change

Perceptions of change and risk are shaped by people's everyday lives and what they do, their social and political-economic settings and their relationships and networks (Kuruppu and Liverman 2011; Wolf and Moser 2011; Walker et al. 2014). Social hierarchies such as gender may also shape perceptions of change and risk insofar as these designate people's place and power in communities and shape their livelihood practices and access to resources (Lebel et al. 2017; Bee 2016; Razavi 2009; Cole et al. 2014; Sarapura and Puskur 2014). Identity has been found relevant in shaping perceptions of change and risk (Frank et al. 2011; Wester-Herber 2004). Frank et al. (2011) illustrate how farmers might perceive risk through an identity lens, "such that farmers' perception of themselves in relation to others shapes how they interpret threats to their wellbeing and livelihoods" (Frank et al. 2011: 75). Identity is often interlinked with sense of place, which itself may mediate the way change and risks are understood (Fresque-Baxter and Armitage 2012; Rodríguez-Carreras et al. 2014; Sachdeva 2016). Granderson (2014) argues for greater engagement with the interpretive social sciences in offering a more holistic account of risk. She suggests that risk is bound up in people's "shared values and worldviews, their sense of place, justice and accountability, discourses and power, deeply enmeshed in the cultural and political processes at the community level" (Granderson 2014: 59). Such perspectives draw attention to the limitations of assuming risk assessment by individuals, communities and groups as a straightforward responsive pathway to action and that the various barriers to adaptation and behavioural change intervene only after risk is appraised or constructed (Grunblatt and Alessa 2017; Stern 2016; Grothmann and Patt 2005; Tucker et al. 2010; Gifford et al. 2011; Adger et al. 2013).

Perspectives informed by psychological theory have drawn attention to how cognition and emotion lead to systematic biases in how people appraise risk, how they perceive their own capacity to respond and weigh up the costs and benefits of action (Slovic 1987; Grothmann and Patt 2005; Breakwell 2010; Granderson 2014; Frank et al. 2011). Alongside material and structural barriers to adaptive responses (and ignorance of a problem), much has been written about limited cognition and how it can create "dragons of inaction" (Gifford 2011). These include "environmental numbness" (Gifford 2011: 292) when there are too many cues to monitor, valuing the present while undervaluing distant risks, scepticism and uncertainty about change, external locus of control, cognitive dissonance and denial (Kollmuss and Agyeman 2002; Feygina et al. 2010; Gifford et al. 2011; Morton et al. 2011; Smith et al. 2011; Whitmarsh 2011; Navarro 2017).

While urgent, the complexity associated with risk perception should give reasons for adaptation practice to be cautious. Efforts at community-based decision-making may become unfair through elite capture or the marginalisation of the perspectives held by those who are least powerful. Framings of perceptions of risk by more dominant groups may prevail or go unchallenged (e.g. local elites who speak for community members or community members that reproduce elite discourses), leading to exclusion of groups (and their knowledge or values) based on hierarchies of gender, age, ethnicity, religion and socio-economic position that are reinforced through norms and practices of decision making (Dodman and Mitlin 2011; Cote and Nightingale 2012). Moreover, heterogeneity in social-cultural backgrounds and perceptions make community-based collective action challenging (Varughese and Ostrom 2001). Pluralism in experiences and perceptions of environmental change and their risks within communities may raise tensions in aligning constructions of risk and enabling collective responses. Intra-community differences in perceived changes may lead to uncertainty which may reduce the intention to act, increase individualism (Morton et al. 2011) and increase conflict (Rodríguez-Carreras et al. 2014).

In examining justice dilemmas in adaptation to climate change, Paavola and Adger (2006: 594) conclude that fair adaptation requires "putting the most vulnerable first and equal participation of all". The community scale has been

identified as an appropriate venue for fair adaptation, as participatory methods can be used to engage with the poor and vulnerable, resulting in a form of adaptation that is "more attuned to local needs, and consequently better able to reduce vulnerability to climate change" (Forsyth 2013). Community-based adaptation to environmental change (CBA) focuses on "a community-led process, based on communities' priorities, needs, knowledge and capacities" (Reid et al. 2009: 13) that requires practitioners to explore climate and environmental change impacts and responses in partnership with communities, drawing out local knowledge and understanding of the complex relationship between environmental hazards and livelihoods (Pringle and Conway 2012). Community perceptions are relied on to identify local manifestations of environmental change. However, the complexity of this task is often underestimated in the existing literature. For example, a critical examination of perception is absent in a review of literature that focus on the challenges to CBA (Forsyth 2013; Spires et al. 2014), despite agreement that "[e]xisting knowledge and experience of changes within communities need to be acknowledged as starting points for opening up conversations about adaptation." (Spires et al. 2014: 9). Critical engagement with the underlying social and cultural dynamics at play in risk perception is essential if the central role of local knowledge in community-based adaptation is to yield the presumed benefits for equity in adaptation processes and outcomes.

In the following study, we focus on the perceptions of risks and environmental change among different social groups in different communities in Solomon Islands, investigating the extent and nature of variations in perception in and between village settings. In so doing, we illustrate the highly differentiated assessments of risk that community-based adaptation must account for and reinforce calls for adaptation to engage seriously with underlying questions of power, culture, identity and practice that inform adaptive capacity and risk perception, as well as cut across communities and localities in often unexpected ways.

Background

This article draws on a study that was carried out in nine villages across Western Province of Solomon Islands, including in Roviana (Nusa Hope, Kindu, Nusa Banga, Olive) and Vonavona lagoons (Kinda), Marovo lagoon (Niniveh, Bopo, Bareho) and Vella Lavella Island (Leona) (Fig. 1). Lagoon systems are extensive in Western Province and comprise diverse socio-ecological systems. Marovo lagoon in the southeast consists of small islands and a raised double barrier reef (Albert et al. 2007). It is rich in biodiversity and is the largest saltwater lagoon in the world covering some 700 km^2 (Hviding 2005). Roviana and Vonavona lagoons are located in South New Georgia of the Western Province. The Roviana lagoon is shallow, approximately 50 km long, and enclosed by raised coral reef islands between 2 and 3 km offshore (Hamilton and Walter 1999). Vonavona lagoon is smaller than Roviana and has a somewhat different topography.

The sense of identity among Western Province inhabitants is strongly connected to the multiple cultural groups that inhabit the islands, their shared church community and inherited chiefly system that govern a community's land and sea resources (Aswani et al. 2015; Bennett et al. 2015). The islands are home to around 77,000 people speaking up to 16 major languages, 8 of which are found on South New Georgia (Bennett et al. 2015; Hamilton and Walter 1999). The Roviana lagoon is unusual in being populated by closely related tribal groups who speak a common language in multiple villages along the mainland and barrier island (Hamilton and Walter 1999). The common language (Roviana) is also spoken in Vonavona, while the more distant populations inhabiting Vella Lavella Island and Marovo lagoon belong to different language groups (Bennett et al. 2015). Vella Lavella Island is located west of New Georgia, near Ghizo, and the communities here are coastal, exploiting very different land- and seascapes to those living on the lagoons. All the communities in the study area are of Melanesia descent, distinguishing them from Gilbertese communities whose members are Micronesian immigrants brought to the Solomon Islands during the 1960s by the British colonial government. A detailed ethnographic discussion of the communities in this study can be found in Aswani et al. (2017a).

Across the sites, community leaders exercise control over the use of and access to natural resources within their particular customary land and sea territories, although changing demographic and consumption patterns coupled with large-scale resource extraction ventures are increasingly eroding these customary systems. In particular, the economy of the Solomon Islands has long relied on logging royalties based on extraction at up to five times the sustainable rate. Corruption, mismanagement, failures of regulation and enforcement and mistrust among tribal groups have all combined to mean that the benefits of logging have not been felt at the community level. Rather, the industry has driven habitat loss, landslides, erosion and watershed damage, undermining local livelihoods, access to nutrition and women's control over resources (Walters and Lyons 2016). The subsistence economy still plays a central role in the life of people in Western Province, but some livelihood activities, such as coral collection for building materials, fishing pressure and sedimentation from poor land practices and logging, are negatively affecting the lagoon and coral reef systems. There are temporary and permanent marine closures throughout the sites, selected in response to declining marine resources, and to conform to local socio-cultural (e.g. death and feasting) and economic realities (e.g. need for case for school fees). The "success" of community-governed closures has been dynamic and varied,

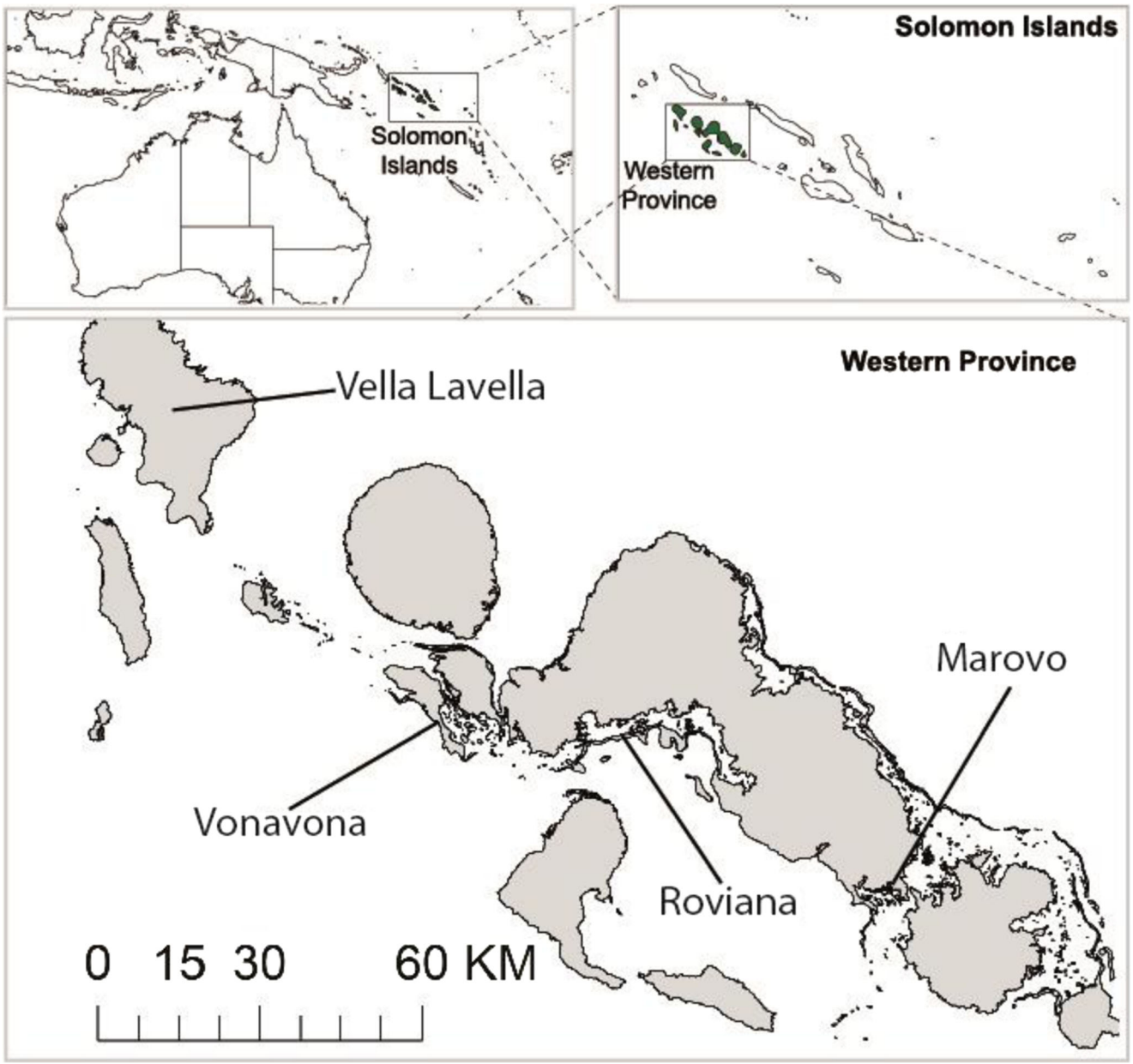

Fig. 1 The Solomon Islands archipelago and Western Province research area

due to political, religious, leadership and tenure disputes and competing priorities. Hence, some closures have been socially and biologically successful while others have not (Aswani et al. 2017).

Methods

Fieldwork concentrated on six locally recognised, major environmental and resource systems relevant to the livelihoods of coastal communities in western Solomon Islands. These included the following: open sea (ocean outside the lagoons and coral reefs), outer reef (outside lagoons and intertidal zone of the barrier islands), lagoon (pools, channels, shallow and mid-depth coral reefs and reef drops), terrestrial (non-agricultural ecosystems such as forests and mangrove), agriculture (plots and gardens) and weather. A total of 231 semi-structured interviews were conducted across the nine villages in 2011 in the local "lingua franca" known as Solomon Islands Pijin. The project leader and team were aware that for some, Pijin would not be the language they are most familiar with. The risk that this could be exclusionary was ameliorated as the leader and team were people local to the region with extensive experience working with the majority of these villages for over two decades. Interviews (50 per village; 25–60 years old and not from the same household) were conducted one-to-one using techniques to encourage less confident

participants (women and youth). Respondents were selected from across age ranges identified as important life stages. Overall, 40% of respondents were female and the mean age of respondents was 43 (SD ± 12) years. It is important to note here that our sample was purposive, and generalisations beyond the communities at the sites are limited.

Respondents were asked to describe and list the changes they had perceived or observed in their lifetime across the six environmental and climatic systems. A "free-listing" approach was used (Bernard 2011), where respondents were asked to spontaneously list as many perceived changes as they could for each system. The goal was to identify locally significant definitions and examples of change. An assumption was made that the first responses were the most important and relevant change recognised by the respondents. Questions were asked about perceptions of change rather than perceptions of risk to allow for responses to be either negative or positive and because the term "risk" can have "multiple rationalities, imaginaries and practices attached to it" (Granderson 2014). To account for risk, a follow-up question was asked about whether the change was considered to be a problem or an opportunity. However, between 95 and 100% of changes were classed as problems in each system (open sea = 97.3%, outer reef = 100%, lagoon = 100%, terrestrial = 94.9%, agriculture = 98.9%, weather = 97.7%). Changes were each coded into a common set of responses.

Data were collected on the characteristics of individual respondents, including their age, educational level and gender, so that it could be determined statistically whether these characteristics affected the changes each person perceived. Further details about these characteristics can be found in the Electronic Supplementary Material (ESM) at Appendix 1. These data were then used to build multinomial logit models (MLMs) to examine differential perceptions of change within and between the communities and their systems. Each environmental system was modelled separately, resulting in six final models that are presented in the results section and in Appendices 4 and 5. MLMs were selected because they are capable of assessing how perceived changes depend simultaneously on functions of multiple variables (in our case, the respondents' characteristics) (e.g. Croissant 2012). The results in the following section are therefore presented in terms of the probability (generated by the MLMs) that a particular respondent will perceive a particular change (for example, the probability that a male respondent would perceive "no change" in their environmental and resource system). Moreover, additional variables can be considered, allowing exploration of, for example, the probability that a male respondent would perceive no change in their environmental and resource system at different distances from a market town. In each case, the probability is model-generated (by the MLM). Additional information about the statistical analysis can be found in the ESM at Appendix 2.

Results

The results of all MLMs are summarised in Table 1. In the table, the top 3 changes for each system are shown and the probability of perceived changes identified according to gender, distance to market town and so on. As Fig. 2 illustrates, the visual analysis of the models provides a more detailed analysis of the effect of the multiple variables. In the following, the open sea system is analysed via Fig. 2 and a narrative description of findings. In the interests of brevity, the remainder of the results is presented in terms of a narrative description only, with visual analysis similar to Fig. 2 available for each system in the ESM at Appendix 4. The detailed statistical output for each model is available at Appendix 5 (ESM).

For the open sea system, only gender and distance to market town were statistically significant. The detailed impact of these variables is shown in Fig. 2 and the detailed statistical output in Appendix 5 (see ESM Appendix 5 Table 5). Neither age nor educational level influenced any of the responses from research participants. As Fig. 2 illustrates, males were more likely to have perceived change than females, who were much more likely to offer a no change response. Distance to market town had a substantial influence on choice, and, as the distance from the market increased for each village, both men and women were more likely to report having seen a change. The largest change reported by men was that there were "less fish or that fishing was more difficult". The probability of men saying that they had seen this change increased the further away from market they lived. The other important change that men reported having seen was that "currents were getting stronger". The probability that men reported this also increased with distance to market town.

In the outer reef system model, only gender was statistically significant (see ESM Appendix 4, Fig. 4 and Appendix 5 Table 6). Women were more likely to say that there had been no change than men. Men considered "habitat damage" to be the next most important change, followed by "less fishing/fishing more difficult" while these two observed changes were reversed among the female respondents.

In the lagoon system, only years of education and distance to market were statistically significant (ESM Appendix 5 Table 7), age and gender having little discernible effect. Greater distances to market towns made people more likely to say there had been no change in the lagoon. The interviewees were also more likely to say that there had been no change if they had had less education. More varied reasons were cited for change in the lagoon than in the other systems examined. The two main reasons for change examined in this system ("dirtier/more turbid water" and "less fish/fishing was more difficult") were both relatively rarely cited (~ 10%), and the probabilities that these would be chosen diminished with distance to market.

In the terrestrial (land ecology) system, the most appropriate model included distance to market town, gender and

Table 1 Summary of the top three changes perceived by Western Province communities for each environmental system and the statistically significant explanatory variables selected by the stop-wise model-selection process (AIC). General descriptions of the trend are given using >, <, or ~ to indicate greater than, less than, or no difference. NS = not significant. M = men, W = women, Near = nearer to market town, Far = further from market town, E6 = 6 years education, E9 = 9 years education, F = fisher, NF = not a fisher

System		Top 3 changes	Probability of perceived environmental change selected				
			Gender	Dist. to market town	Education	Occupation	Age
Open sea	1	No change	M < W	Near > far	NS	NS	NS
	2	Less fish/fishing is harder	M > W	Near < far			
	3	Stronger current	M < W	Near < far			
Outer reef	1	No change	M < W	NS	NS	NS	NS
	2	Less fish/fishing is harder	M < W				
	3	Habitat damage	M > W				
Lagoon	1	No change	NS	Near < far	E6 > E9	NS	NS
	2	Turbid water		Near > far	E6~E9		
	3	Less fish/fishing is harder		Near > far	E6~E9		
Terrestrial	1	Less vegetation	M > W	Near < far	E6 < E9	NS	NS
	2	No change	M > W	Near ~ far	E6 > E9		
	3	Logging increase	M < W	Near > far	E6 > E9		
Agriculture	1	Lower crop productivity	NS	NS	E6 > E9	F < NF	NS
	2	More pests			E6 < E9	F < NF	
	3	No change			E6 < E9	F > NF	
Weather	1	More rain	NS	Near < far	NS	NS	NS
	2	Unpredictable seasons		Near > far			
	3	No change		Near > far			

education level (ESM Appendix 5 Table 8). The age of the respondent did not significantly affect perceptions. No change was the most frequently selected. Women were more likely to say there had been no change than men. Similarly, people with less education were slightly more likely to say there had been no change. The most likely change reported was that there was "less vegetation" and women were slightly more likely to say this, as were people who lived further away from the market town. The other common change reported was that "logging had been introduced". There was little effect of gender on this, but people who lived closer to the market town were more likely to give this response.

In the agricultural practices system, occupation (i.e. whether the respondent identified him/herself as a fisher or not) and educational level were the only significant variables influencing perception of change (ESM Appendix 5 Table 9). Neither gender nor distance to market had any significant effect on choice, and it should also be noted that in this system, very few changes were noted by the respondents overall in comparison to the other systems we examined (ESM Appendix 3

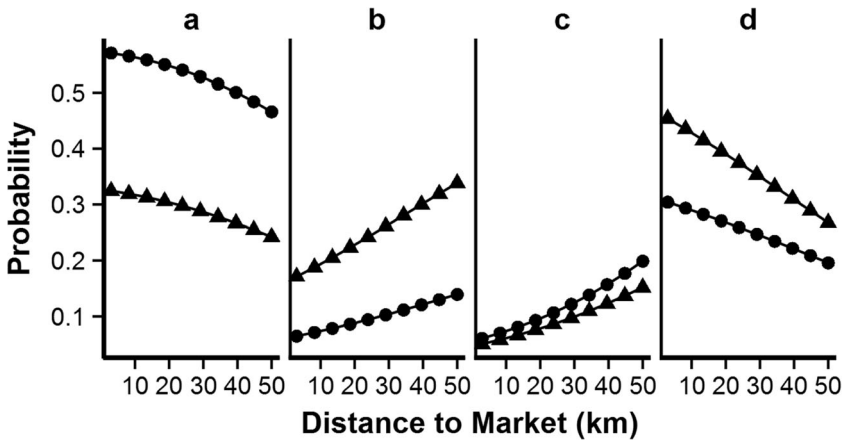

Fig. 2 Open sea: probabilities for perceived changes made by male (triangles) and female (circles) respondents, from villages of varying distances to market town (km). Perceived changes were (a) no change, (b) less fish/fishing is harder, (c) stronger current and (d) other

Table 4). Those who identified themselves as fishers were more likely to say there had been no change than people who did not fish. Also, those with more education were also more likely to say there had been no change to agriculture. The most common response for both educational levels was that crops were "less productive", and this was affected only weakly by type of employment. The other most common response was that there were "more pests" in agricultural systems. Non-fishers and those with more education were slightly more likely to give this response.

For the weather system, the only statistically significant predictor was distance to market (ESM Appendix 5 Table 10): age, gender, employment and educational level all made no difference. The most likely changes in weather that people reported were that there was "more rain" and that "seasons had become more unpredictable". People who lived further away from the market town were much more likely to say that there was more rain nowadays and less likely to say that "seasons were more unpredictable".

Discussion

This study has documented the local perceptions of environmental change in small resource-dependent coastal communities of Solomon Islands. The aim has been to contribute empirical research and respond to calls for more studies on the local nature of environmental change, and how changes may be perceived differently across communities and among individuals who vary in geography, livelihood activities and social-cultural practices (Bennett et al. 2014a, b; Walker et al. 2014). Interestingly, environmental changes in Western Province were not readily perceived, particularly in marine systems, and perceptions of environmental risk in the different environmental systems were unevenly distributed between and within communities. These findings in turn give rise to questions about the underlying patterns of power, culture and identity, which we explore in the section below. We then follow with a discussion of what these findings mean for community-based and "fair" adaptive responses.

Empirical findings

People of western Solomon Islands were more likely to perceive environmental changes in the terrestrial and agricultural environment and with weather patterns than they were for the marine environment systems (open sea, outer reef and lagoon). When changes in the marine systems were perceived, the variety of changes described by people was greater than for the other systems. The most commonly perceived change in all three marine systems in this study was reduced fish catches, yet only 20% of people gave this response. This is unexpected given documented fish declines, the high dependence on and use of the sea and the detailed and rich knowledge of the marine environment and sophisticated social-ecological habitat classification systems in the communities studied (Lauer and Aswani 2010). In a practical sense, changes in marine environments are less visible than terrestrial environments, but change may also be masked or explained by environmental variability which is not perceived as a risk (Green et al. 2010). The marine ecosystems of Solomon Islands have been shown to be resilient, absorb impacts and rapidly recover from ecological disturbance (Lauer and Aswani 2010; Lauer et al. 2013).

There are multiple potential explanations for this widespread failure to recognise changes in marine resources. In general, people are not very good at perceiving slow and incremental changes (Kollmuss and Argyman 2002), often referred to as "shifting baselines" which "normalise" the environmental changes that are occurring (Pauly 1995; Saenz-Arroyo et al. 2005; Pinnegar and Engelhard 2008; Turvey et al. 2010). This may be compounded by changes in fishing practices and "effort creep" as fishers are travelling to more distant fishing grounds and spending longer fishing (Albert et al. 2015), and there have been marked improvements in gear technology (Lauer and Aswani 2010). Cultural practices may also be relevant here. Communities can attribute variations in catches in the region to magic or charms which bestow success or unluckiness, possibly affecting the way risk is appraised. Variation in catch may also be explained by one's social behaviour, or the behaviour of relatives, especially female kin. While there is a widely held assumption that those people who depend on the environment and live a subsistence lifestyle will readily observe environmental change, this has been shown not to always be the case (Green et al. 2010; Kuruppu and Liverman 2011). These findings give further weight to this alternative narrative of local knowledge of livelihoods resources, suggesting a need for further research effort both to understand the driving forces of risk perception and to build a more realistic picture of the potential for local knowledge to inform community-based adaptation.

People's perceptions of environmental change were quite strongly affected by the community they lived in, specifically the distance their community was to the nearest market town. It was expected that people's perceptions would differ across communities as the use of environments and threats to environments differ (Kuruppu and Liverman 2011; Rodríguez-Carreras et al. 2014). Distance to market town was a significant explanatory variable for four of the six environmental systems: the open sea, lagoon, terrestrial and weather systems. People who lived far from town were much more likely to have perceived a change in the open sea (less fish and stronger currents) but had observed little change in the lagoon. In contrast, people living close to town were more likely to have said they had seen changes in the lagoon (less fish or dirty water). People close to town perceived the greatest change in the terrestrial system to

be the introduction of commercial logging (compared to those far away who perceived less vegetation as the greatest change), which may indicate the localisation of the industry around urban centres, its contribution to urban economies and/or its drawing on local labour. This suggests that "distance to market" is a proxy for, among other factors, proximity to and/or involvement in commercial logging. However, it should be noted that logging is generally a transitory phenomenon, which may last up to a decade, while the market town remains. Elsewhere in the Pacific, distance to market has also been shown to be an important predictor for prevalence of highly extractive fishing practices, suggesting a wider socio-economic significance for markets in the region (Cinner 2005; Cinner and McClanahan 2006). This points to the importance of investigating place and the character of local political ecologies in future studies that aim to understand the way change and risk is perceived (Rogan et al. 2005; Davenport and Anderson 2005).

There was high variation in environmental perceptions within communities. The largest documented distinction in livelihoods within subsistence communities in Solomon Islands is between men and women (Weeratunge et al. 2011); so unsurprisingly, gender was the greatest (statistical) intra-community variable influencing what people say about environmental change. This finding is consistent with theoretical work and empirical studies that have identified the gendered perceptions of change and risk (Gustafson 1998; O'Connor et al. 1999; Combest-Friedman et al. 2012; Tyler and Fairbrother 2013; Wright 2014; Lebel et al. 2017; Bee 2016). Women were less likely to perceive changes in the marine systems outside the lagoon (the open sea and outer reef) but just as likely as men to perceive changes within the lagoon. It is commonly held by government fishery officers that men "fish" and women "glean" (for invertebrates), and the national statistics show 90% of men and 50% of women are engaged in fishing (JICA 2010). However, there are significant variations between provinces and communities (Ramofafia et al. 2007; Prange et al. 2009; Boso and Schwarz 2009). In the lagoons of Western Province (our study site), women are avid fishers. They are reputed for their fishing skills and would be just as likely as men to perceive changes. However, outside the lagoon, fishing is "big game" and the domain of men (Aswani 2014). The statistical data on men and women's perceptions or concerns is thus consistent with their degree of practical engagement in particular livelihood activities.

In the agriculture system, both men and women tend gardens, but women do most of the agricultural work (Weeratunge et al. 2011; Kruijssen et al. 2013). In contrast to the coastal system, where gendered livelihood practices correlate with gendered risk perception, men and women in the terrestrial system have similar risk perceptions. This warns against simplistic assumptions of a relation between the gendered character of environmental knowledge and risk on the one hand and the livelihood practices of men and women on the other. The social and cultural norms that set out the place of men and women in livelihood practices are underpinned by power relations in the household as well in communities and society as a whole (McKinnon et al. 2016; Cote and Nightingale 2012), shaping who has access to and control over resources, knowledge and discourses and thus likely affecting how environmental change is perceived and by whom. For example, in this case, domestic institutions may be at play in mediating gendered knowledge, resulting in shared of perceptions of change and risk around (shared) gardening activities. Thus, institutional relations and the deep-rooted social and cultural norms that inform and are reinforced by them need to be explored alongside more readily observable characteristics of gender and livelihood.

Fair adaptation

Securing fairness through a focus on vulnerability and participation in communities means recognising that adaptation unfolds in complex social settings. Social and cultural relationships, embedded in the transactions that shape everyday life and often overlaid on discriminatory or poorly resourced state services, entrench differences in people's capacity to adapt, within and between communities (Ensor et al. 2015). Our findings illustrate further complications that arise due to variations in perceptions of change within and between groups that are differently situated in social, cultural and political terms (Kuruppu and Liverman 2011; Wolf and Moser 2011; Walker et al. 2014). Evidence from our study therefore supports existing research that argues for the significance of perception in adaptation (Walker et al. 2014; Granderson 2014; Bee 2016). We draw attention to the role that may be played by deep rooted social and cultural norms, informed and reinforced by institutional relations, in determining when and why risks are perceived as significant and how they are acted on (Granderson 2017; Warrick 2016; Weir 2016; Nunn et al. 2016; Mortreux and Barnett 2009). Examining these in context is best pursued through qualitative inquiry. The challenge for those supporting community-based approaches is therefore considerable: while the interests of fairness suggest that it is necessary to surface the underlying causes of patterns of perception, the process of so doing may reveal or lead to greater heterogeneity in perception within a community setting. This, in turn, may raise tensions within communities, increase uncertainty and reduce the potential for the forms of collective action necessary for community-based adaptations to be enacted (Varughese and Ostrom 2001; Rodríguez-Carreras et al. 2014). Effective community dispute resolution mechanisms can reduce this risk to collective action but are absent in the study area (Aswani et al. 2017).

The subtle processes through which risks are normalised or prioritised according to social, cultural or political influences are not accounted for when CBA focuses on participation in terms of representation and voice. In our results, this problem is illustrated where communities apparently fail to perceive the effects of environmental change. If environmental change

is going unnoticed when it is incremental and/or occurring in communities with a strong sense of place, then CBA's reliance on local experiences of change as a measure of the risk is called into question. Further, how and when gender similarities or differences in risk perception arise (for example, in relation to agricultural systems) must be disentangled, to establish whether they are due to similar experiences of change or a reflection of underlying community power dynamics. Failure to do so may undermine efforts that are intended to deliver fairness, such as through prioritisation of the risks expressed by the most vulnerable groups such as women. Simple inclusion, through the introduction of participatory processes, may well not be enough overcome deep rooted patterns of marginalisation (Cote and Nightingale 2012). Relations of power, when embedded in formal regulations, social and cultural norms and everyday practices may inform and reinforce gender (or other) identities while simultaneously driving marginalisation and exclusion. Supporting fairness and social equity in such situations demands intensive development approaches that attend to empowerment, self-reflection and Freirean "conscientization" (Freire 1970; see for example Dyer 2017 on gender roles and empowerment approaches in Solomon Islands). This is significant not least because such approaches are unusual within CBA (Ensor 2014; Dodman and Mitlin 2011).

The results of our study reveal how risk perceptions can vary significantly within and between small communities that exist within a relatively small locale. Overall, perceived environmental change may be grounded in practical, cognitive and/or social-cultural factors, and it may be related to a lack of or denial of perceived risk to livelihoods (Gifford 2011; Smith et al. 2011). In this context, survey data alone is insufficient for identifying local changes that lead to designing adaptation pathways. Mixed methods, including ethnographic and ecological techniques, may be required to reveal the complex relationships between change, risk and how perceptions are formed and to disentangle environmental variability, shifting baselines and discourses (Ensor et al. 2016). Such an approach would go beyond vulnerability and risk assessment methods currently prevalent in the Pacific region (Hay and Mimura 2013). The observed intra-community variability, particularly between men and women, support the view that communities cannot be assumed to be homogenous in perception (Kuruppu and Liverman 2011; Wolf and Moser 2011; Walker et al. 2014) any more than they are in power (Agrawal and Gibson 1999; Kumar 2005; Dodman and Mitlin 2011; Forsyth 2013). Yet, as Dodman and Mitlin (2011) note, there is a tendency for intra-community variability to be ignored when the focus of participatory development is firmly on the "community". Intra- and local inter-community differences in perception need to be appreciated as part of this picture, with consequences for the design of CBA processes that seek to account for heterogeneity.

Conclusion

The findings reported here contribute empirical data from Solomon Islands to a growing literature that emphasises the significance of perception in experiences of environmental risk and change. In Solomon Islands, data gathered through mixing household survey and free-listing interviews, and statistically analysed using multinomial logit models, provided insight into inter- and intra-community perceptions. Unexpected findings include a low (20%) perception of reductions in fish catches despite documented declines, among a population that has a high dependence on and use of the sea and detailed and rich knowledge of the marine environment. Perceptions of change were strongly linked to the community in which the respondent lived, yet there were also high variations in perceptions of environmental change within communities and between communities in a particular locale. Gender was a significant predictor of variation, yet gender also operated differently between agricultural and fishery system contexts. This complicated picture of similarity and variation in perceptions of environmental change inevitably intersects with social, cultural and power relations and has particular consequences for those who look to the community scale as a venue for fair adaptation. Community perceptions are relied on in community-based adaption to identify local manifestations of environmental change. Yet, in Solomon Islands, we find that significant environmental change is underreported in communities, while variations in perception are not always easily related to commonly assumed fault lines of vulnerability, such as gender. If community-based adaptation is to prioritise the interests of the most vulnerable through participation, then appreciation of and approaches to analyse heterogeneity within and between communities will have to extend to include perceptions of change.

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References

Adger WN, Barnett J, Brown K, O'Brien K, Marshall N (2013) Cultural dimensions of climate change impacts and adaptation. Nat Clim Chang 3:112–117. https://doi.org/10.1038/nclimate1666

Agrawal A, Gibson CC (1999) Enchantment and disenchantment: the role of community in natural resource conservation. World Dev 27:629–649. https://doi.org/10.1016/S0305-750X(98)00161-2

Albert S, Udy J, Tibbetts IR (2007) Responses of algal communities to gradients in herbivore biomass and water quality in Marovo Lagoon, Solomon Islands. Coral Reefs 27:73–82. https://doi.org/10.1007/s00338-007-0292-0

Albert S, Aswani S, Fisher PL, Albert J (2015) Keeping food on the table: human responses and changing coastal fisheries in Solomon Islands. PLoS One 10(7):e0130800. https://doi.org/10.1371/journal.pone.0130800

Alexander C, Bynum N, Johnson E, King U, Mustonen T, Neofotis P, Oettle N, Rosenzweig C, Sakakibara C, Shadrin V, Vicarelli M, Waterhouse J, Weeks B (2011) Linking indigenous and scientific knowledge of climate change. Bioscience 61:477–484. https://doi.org/10.1525/bio.2011.61.6.10

Aswani S (2014) Investigating coral reef ethnobiology in the Western Solomon Islands for enhancing livelihood resilience. J Polyn Soc 123:237–276. 10.15286/jps.123.3.237-276

Aswani S, Lauer M (2014) Indigenous people's detection of rapid ecological change. Conserv Biol 28:1–9. https://doi.org/10.1111/cobi.12250

Aswani S, Vaccaro I, Abernethy K, Albert S, de Pablo JFL (2015) Can perceptions of environmental and climate change in island communities assist in adaptation planning locally? Environ Manag 56(6): 1487–1501. https://doi.org/10.1007/s00267-015-0572-3

Aswani S, Albert S, Love M (2017) One size does not fit all: critical insights for effective community-based resource management in Melanesia. Mar Policy 81:381–391

Bee BA (2016) Power, perception, and adaptation: exploring gender and social–environmental risk perception in northern Guanajuato, Mexico. Geoforum 69:1–80. https://doi.org/10.1016/j.geoforum.2015.12.006

Bennett G, Cohen P, Schwarz AM, Albert J, Lawless S, Paul C, Hilly Z (2014a) Solomon Islands: Western Province situation analysis. Penang, Malaysia, CGIAR Research Program on Aquatic Agricultural Systems, 35pp. (Project Report, AAS-2014-15). http://aquaticcommons.org/15592/1/AAS-2014-15.pdf

Bennett NJ, Dearden P, Peredo AM (2014b) Vulnerability to multiple stressors in coastal communities: a study of the Andaman coast of Thailand, Clim Dev 7: 124–141. doi: https://doi.org/10.1080/17565529.2014.886993

Bennett NJ, Blythe J, Tyler S, Ban NC (2015) Communities and change in the anthropocene: understanding social-ecological vulnerability and planning adaptations to multiple interacting exposures. Reg Environ Chang 16(4):1–20. https://doi.org/10.1007/s10113-015-0839-5

Bernard HR (2011) Research methods in anthropology: qualitative and quantitative approaches. Rowman Altamira, USA

Boso D, Schwarz AM (2009) Livelihoods and resilience analysis in two community clusters: the Funa'afou and Foueda Artificial Island communities, Lau lagoon, Malaita Province, Solomon Islands. WorldFish, Penang. doi:https://doi.org/10.1016/j.gloenvcha.2014.03.012

Breakwell GM (2010) Models of risk construction: some applications to climate change. WIREs Clim Chang 1:857–870. https://doi.org/10.1002/wcc.74

Brook RK, McLachlan SM (2008) Trends and prospects for local knowledge in ecological and conservation research and monitoring. Biodivers Conserv 17:3501–3512. https://doi.org/10.1007/s10531-008-9445-x

Buggy L, McNamara KE (2015) The need to reinterpret "community" for climate change adaptation: a case study of Pele Island, Vanuatu. Clim Dev 8(3):1–11. https://doi.org/10.1080/17565529.2015.1041445

Cinner J (2005) Socioeconomic factors influencing customary marine tenure in the Indo-Pacific. Ecol Soc 10(1)

Cinner JE, McClanahan TR (2006). Socioeconomic factors that lead to overfishing in small-scale coral reef fisheries of Papua New Guinea. Environ Conserv, 33(1), 73–80. https://doi.org/10.1017/S0376892906002748

Cole SM, Kantor P, Sarapura S, Rajaratnam S (2014) Working paper: AAS-2014-42 gender-transformative approaches to address inequalities in food, nutrition and economic outcomes in aquatic agricultural systems. CGIAR Research Program on Aquatic Agricultural Systems, Penang. http://pubs.iclarm.net/resource_centre/AAS-2014-42.pdf. Accessed 19 Feb 2017

Combest-Friedman C, Christie P, Miles E (2012) Household perceptions of coastal hazards and climate change in the Central Philippines. J Environ Manag 112:137–148. https://doi.org/10.1016/j.jenvman.2012.06.018

Cote M, Nightingale AJ (2012) Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. Prog Hum Geogr 36:475–489. https://doi.org/10.1177/0309132511425708

Couzin J (2007) Opening doors to native knowledge. Science 315:1518–1519. https://doi.org/10.1126/science.315.5818.1518

Croissant Y (2012) Estimation of multinomial logit models in R: the mlogit packages. R package version 0.2–2. https://cran.r-project.org/web/packages/mlogit/vignettes/mlogit.pdf. Accessed 19 Feb 2017

Cutter SL, Emrich CT (2006) Moral hazard, social catastrophe: the changing face of vulnerability along the hurricane coasts. Ann Am Acad Pol Soc Sci 604:102–112. https://doi.org/10.1177/0002716205285515

Cutter SL, Boruff BJ, Shirley WL (2003) Social vulnerability to environmental hazards. Soc Sci Q 84:242–261. https://doi.org/10.1111/1540-6237.8402002

Davenport MA, Anderson DH (2005) Getting from sense of place to place-based management: an interpretive investigation of place meanings and perceptions of landscape change. Soc Nat Resour 18:625–641. https://doi.org/10.1080/08941920590959613

Dodman D, Mitlin D (2011) Challenges for community-based adaptation: discovering the potential for transformation. J Int Dev 25:640–659. https://doi.org/10.1002/jid.1772

Dyer M (2017) Growing down like a banana: Solomon Islands village women changing gender norms. Asia Pac J Anthropol 18(3):193–210. https://doi.org/10.1080/14442213.2017.1301544

Ensor JE (2014) Emerging lessons for community-based adaptation. In: Ensor JE, Berger R, Huq S (eds) *Community-based adaptation to climate change: emerging lessons*. Practical Action Publishing, Rugby

Ensor JE, Berger R, Huq S (eds) (2014) Community-based adaptation to climate change: emerging lessons. Practical Action Publishing, Rugby

Ensor JE, Park SE, Hoddy ET, Ratner BD (2015) A rights-based perspective on adaptive capacity. Glob Environ Chang 31: 38–49. doi: https://doi.org/10.1016/j.gloenvcha.2014.12.005

Ensor JE, Park SE, Attwood SJ, Kaminski AM, Johnson JE (2016) Can community-based adaptation increase resilience? Clim Dev:1–18. https://doi.org/10.1080/17565529.2016.1223595

Feygina I, Jost JT, Goldsmith RE (2010) System justification, the denial of global warming, and the possibility of "system-sanctioned change". Personal Soc Psychol Bull 36:326–338. https://doi.org/10.1177/0146167209351435

Forsyth T (2013) Community-based adaptation: a review of past and future challenges. WIREs Clim Chang 4:439–446. https://doi.org/10.1002/wcc.231

Frank E, Eakin H, Lopez-Carr D (2011) Social identity, perception and motivation in adaptation to climate risk in the coffee sector of Chiapas, Mexico. Glob Environ Chang 21:66–76. https://doi.org/10.1016/j.gloenvcha.2010.11.001

Freire P (1970) Pedagogy of the oppressed. Seabury, New York

Fresque-Baxter JA, Armitage D (2012) Place identity and climate change adaptation: a synthesis and framework for understanding. WIREs Clim Chang 3:251–266. https://doi.org/10.1002/wcc.164

Gifford R (2011) The dragons of inaction: psychological barriers that limit climate change mitigation and adaptation. Am Psychol 66: 290–302. https://doi.org/10.1037/a0023566

Gifford R, Kormos C, McIntyre A (2011) Behavioral dimensions of climate change: drivers, responses, barriers, and interventions. Wiley Interdiscip Rev Clim Chang 2:801–827. https://doi.org/10.1002/wcc.143

Granderson AA (2014) Making sense of climate change risks and responses at the community level: a cultural-political lens. Clim Risk Manag 3:55–64. https://doi.org/10.1016/j.crm.2014.05.003

Granderson AA (2017) Value conflicts and the politics of risk: challenges in assessing climate change impacts and risk priorities in rural Vanuatu. Clim Dev:1–14. https://doi.org/10.1080/17565529.2017.1318743

Green D, Billy J, Tapim A (2010) Indigenous Australians' knowledge of weather and climate. Clim Chang 100:337–354. https://doi.org/10.1007/s10584-010-9803-z

Grothmann T, Patt A (2005) Adaptive capacity and human cognition: the process of individual adaptation to climate change. Glob Environ Chang 15:199–213. https://doi.org/10.1016/j.gloenvcha.2005.01.002

Grunblatt J, Alessa L (2017) Role of perception in determining adaptive capacity: communities adapting to environmental change. Sustain Sci 12(1):3–13. https://doi.org/10.1007/s11625-016-0394-0

Gustafson PE (1998) Gender differences in risk perception: theoretical and methodological perspectives. Risk Anal 18(6):805–811. https://doi.org/10.1023/B:RIAN.0000005926.03250.c0

Hamilton R, Walter R (1999) Indigenous ecological knowledge and its role in fisheries research design: a case study from Roviana lagoon, Western Province, Solomon Islands. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 11 September 1999: 13–25. http://www.spc.int/digitallibrary/doc/fame/infobull/trad/11/trad11_13_hamilton.pdf

Hay JE, Mimura N (2013) Vulnerability, risk and adaptation assessment methods in the Pacific Islands region: past approaches, and considerations for the future. Sustain Sci 8:391–405. https://doi.org/10.1007/s11625-013-0211-y

Hviding E (2005). Reef and rainforest: an environmental encylopedia of Marovo Lagoon. Knowledges of Nature Series No. 1. UNESCO. http://org.uib.no/westernsolomons/docs/Hviding,%20Edvard/Hviding%20(1998)%20Marovo%20Enyclopedia%20STUDY%20GUIDE%20AND%20TEACHER'S%20MANUAL%20(final%20draft).pdf Accessed 17 Feb 2017

JICA [Japan International Cooperation Agency] (2010) Country gender profile: Solomon Islands. http://www.jica.go.jp/english/our_work/thematic_issues/gender/background/pdf/e10sol.pdf. Accessed 17 Feb 2017

Jones L, Boyd E (2011) Exploring social barriers to adaptation: insights from Western Nepal. Glob Environ Chang 21:1262–1274. https://doi.org/10.1016/j.gloenvcha.2011.06.002

Kollmuss A, Agyeman J (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behavior? Environ Educ Res 8:239–260. https://doi.org/10.1080/13504620220145401

Kruijssen F, Albert JA, Morgan M, Boso D, Siota F, Sibiti S, Schwarz AM (2013) Livelihoods, markets, and gender roles in Solomon Islands: case studies from western and Isabel provinces. CGIAR research program on aquatic agricultural systems. Penang. http://pubs.iclarm.net/resource_centre/AAS-2013-22.pdf. Accessed 19 Feb 2017

Kumar C (2005) Revisiting 'community' in community-based natural resource management. Commun Dev J 40:275–285. https://doi.org/10.1093/cdj/bsi036

Kuruppu N, Liverman D (2011) Mental preparation for climate adaptation: the role of cognition and culture in enhancing adaptive capacity of water management in Kiribati. Glob Environ Chang 21(2):657–669. https://doi.org/10.1016/j.gloenvcha.2010.12.002

Lauer M, Aswani S (2010) Indigenous knowledge and long-term ecological change: detection, interpretation, and responses to changing ecological conditions in Pacific Island communities. Environ Manag 45:985–997. https://doi.org/10.1007/s00267-010-9471-9

Lauer M, Albert S, Aswani S, Halpern BS, Campanella L, LaRose D (2013) Globalization, Pacific Islands, and the paradox of resilience. Glob Environ Chang 23:40–50. https://doi.org/10.1016/j.gloenvcha.2012.10.011

Lebel L, Lebel P, Lebel B (2017) Gender and the management of climate-related risks in Northern Thailand. Int Soc Sci J. https://doi.org/10.1111/issj.12090/full

McKinnon K, Carnegie M, Gibson K, Rowland C (2016) Gender equality and economic empowerment in the Solomon Islands and Fiji: a place-based approach. Gender Place Cult 23(10):1376–1391. https://doi.org/10.1080/0966369X.2016.1160036

McMillen H, Ticktin T, Friedlander A, Jupiter S, Thaman R, Campbell J, Veitayaki J, Giambelluca T, Nihmei S, Rupeni E, Apis-Overhoff L, Aalbersberg W, Orcherton DF (2014) Small islands, valuable insights: systems of customary resource use and resilience to climate change in the Pacific. Ecol Soc 19(4). https://doi.org/10.5751/ES-06937-190444

Morton TA, Rabinovich A, Marshall D, Bretschneider P (2011) The future that may (or may not) come: how framing changes responses to uncertainty in climate change communications. Glob Environ Chang 21:103–109. https://doi.org/10.1016/j.gloenvcha.2010.09.013

Mortreux C, Barnett J (2009) Climate change, migration and adaptation in Funafuti, Tuvalu. Glob Environ Chang 19:105–112. https://doi.org/10.1016/j.gloenvcha.2008.09.006

Naess LO (2013) The role of local knowledge in adaptation to climate change. WIREs Clim Chang 4:99–106. https://doi.org/10.1002/wcc.204

Navarro O (2017) Social inequality and environmental risk perception. In: Handbook of environmental psychology and quality of life research. Springer International Publishing, pp 503–518

Nunn PD, Aalbersberg W, Lata S, Gwilliam M (2014) Beyond the core: community governance for climate-change adaptation in peripheral parts of Pacific Island countries. Reg Environ Chang 14(1):221–235. https://doi.org/10.1007/s10113-013-0486-7

Nunn PD, Mulgrew K, Scott-Parker B, Hine DW, Marks ADG, Mahar D, Maebuta J (2016) Spirituality and attitudes towards nature in the Pacific Islands: insights for enabling climate-change adaptation. Clim Chang 136(3–4):477–493. https://doi.org/10.1007/s10584-016-1646-9

O'Connor RE, Bord RJ, Fisher A (1999) Risk perceptions, general environmental beliefs, and willingness to address climate change. Risk Anal 19:461–471. https://doi.org/10.1111/j.1539-6924.1999.tb00421.x

Paavola J, Adger WN (2006) Fair adaptation to climate change. Ecol Econ 56:594–609. https://doi.org/10.1016/j.ecolecon.2005.03.015

Pauly D (1995) Anecdotes and the shifting baseline syndrome of fisheries. Trends Ecol Evol 10:430. https://doi.org/10.1016/S0169-5347(00)89171-5

Peet R, Watts M (2004) Liberating political ecology. Liberation ecologies: environment, development, social movements. Routledge, London

Pinnegar JK, Engelhard GH (2008) The 'shifting baseline' phenomenon: a global perspective. Rev Fish Biol Fish 18:1–16. https://doi.org/10.1007/s11160-007-9058-6

Prange JA, Schwarz AM, Tewfik A (2009) Assessing needs and management options for improved resilience of fisheries dependent communities in the earthquake/tsunami impacted Western Solomon Islands: community needs, resource status and recover response to the disaster. Synthesis report to Force of Nature Aid Foundation. Worldfish, Penang

Pringle P, Conway D (2012) Voices from the frontline: the role of community-generated information in delivering climate adaptation and development objectives at project level. Clim Dev 4:104–113. https://doi.org/10.1080/17565529.2012.707608

Ramofafia C, Nash W, Sibiti S, Makini D, Schwarz, AM (2007). Household socio-economics and beche-de mer resource use in Kia community, Isabel Province, Solomon Islands. WorldFish, Penang. http://aciar.gov.au/files/node/10739/FIS-2003-051%20Final%20Report.pdf

Razavi S (2009) Engendering the political economy of agrarian change. J Peasant Stud 36:197–226. https://doi.org/10.1080/03066150902820412

Reid H, Alam M, Berger R, Cannon T (2009) Community-based adaptation to climate change. Participatory Learn Action 60:11–33. https://doi.org/10.3200/ENV.51.4.22-31

Remling E, Veitayaki J (2016) Community-based action in Fiji's Gau Island: a model for the Pacific? Int J Clim Chang Strateg Manag 8(3):375–398. https://doi.org/10.1108/IJCCSM-07-2015-0101

Rodríguez-Carreras R, Úbeda X, Outeiro L, Asperó F (2014) Perceptions of social and environmental changes in a Mediterranean forest during the last 100 years: the Gavarres Massif. J Environ Manag 138:75–86. https://doi.org/10.1016/j.jenvman.2013.08.013

Rogan R, O'Connor M, Horwitz P (2005) Nowhere to hide: awareness and perceptions of environmental change, and their influence on relationships with place. J Environ Psychol 25:147–158. https://doi.org/10.1016/j.jenvp.2005.03.001

Sachdeva S (2016) The influence of sacred beliefs in environmental risk perception and attitudes. Environ Behav:1–8. https://doi.org/10.1177/0013916516649413

Saenz-Arroyo A, Roberts C, Torre J, Cariño-Olvera M, Enríquez-Andrade R (2005) Rapidly shifting environmental baselines among fishers of the Gulf of California. Proc R Soc B Biol Sci 272(1575):1957–1962. https://doi.org/10.1098/rspb.2005.3175

Sagarin R, Micheli F (2001) Climate change in non-traditional data sets. Science 294:811–811. https://doi.org/10.1126/science.1064218

Sarapura S, Puskur R (2014) Working Paper: AAS-2014-45 Gender capacity development and organizational culture change in the CGIAR Research Program on Aquatic Agricultural Systems: a conceptual framework. CGIAR Research Program on Aquatic Agricultural Systems, Penang, Malaysia. http://pubs.iclarm.net/resource_centre/AAS-2014-45.pdf 19 February 2017

Slovic P (1987) Perception of risk. Science 236:280–285. https://doi.org/10.1126/science.3563507

Smith MS, Horrocks L, Harvey A, Hamilton C (2011) Rethinking adaptation for a 4 C world. Philos Trans R Soc Lond A Math Phys Eng Sci 369:196–216. https://doi.org/10.1098/rsta.2010.0277

Spires M, Shackleton S, Cundill G (2014) Barriers to implementing planned community-based adaptation in developing countries: a systematic literature review. Clim Dev 6:277–287. https://doi.org/10.1080/17565529.2014.886995

Stern PC (2016) Sociology: impacts on climate change views. Nat Clim Chang 6(4):341–342. https://doi.org/10.1038/nclimate2970c

Tucker CM, Eakin H, Castellanos EJ (2010) Perceptions of risk and adaptation: coffee producers, market shocks, and extreme weather in Central America and Mexico. Glob Environ Chang 20:23–32. https://doi.org/10.1016/j.gloenvcha.2009.07.006

Turvey ST, Barrett LA, Yujiang HAO, Lei Z, Xinqiao Z, Xianyan W, Yadong H, Kaiya Z, Hart T, Ding W (2010) Rapidly shifting baselines in Yangtze fishing communities and local memory of extinct species. Conserv Biol 24:778–787. https://doi.org/10.1111/j.1523-1739.2009.01395.x

Tyler M, Fairbrother P (2013) Bushfires are "men's business": the importance of gender and rural hegemonic masculinity. J Rural Stud 30:110–119. https://doi.org/10.1016/j.jrurstud.2013.01.002

Varughese G, Ostrom E (2001) The contested role of heterogeneity in collective action: some evidence from community forestry in Nepal. World Dev 29:747–765. https://doi.org/10.1016/S0305-750X(01)00012-2

Venables D, Pidgeon NF, Parkhill KA, Henwood KL, Simmons P (2012) Living with nuclear power: sense of place, proximity, and risk perceptions in local host communities. J Environ Psychol 32(4):371–383

Walker BLE, López-Carr D, Chen C, Currier K (2014) Perceptions of environmental change in Moorea, French Polynesia: the importance of temporal, spatial, and scalar contexts. GeoJournal 79:705–719. https://doi.org/10.1007/s10708-014-9548-8

Walters P, Lyons K (2016) Community teak forestry in Solomon Islands as donor development: when science meets culture. Land Use Policy 57:730–738. https://doi.org/10.1016/j.landusepol.2016.06.029

Warrick O, Aalbersberg W, Dumaru P, McNaught R, Teperman K (2016) 'The 'Pacific adaptive capacity analysis framework': guiding the assessment of adaptive capacity in Pacific Island communities'. Reg Environ Chang (Springer Berlin Heidelberg) 17(4):1039–1051. https://doi.org/10.1007/s10113-016-1036-x

Weeratunge N, Pemsl D, Rodriguez P, Chen OL, Badjeck MC, Schwarz AM, Paul C, Prange J, Kelling I (2011) Planning the use of fish for food security in Solomon Islands. Coral Triangle Support Partnership. WorldFish, Penang. http://www.coraltriangleinitiative.org/sites/default/files/resources/1_Planning%20the%20Use%20of%20Fish%20for%20Food%20Security%20in%20Solomon%20Islands.pdf. Accessed 19 Feb 2017

Weir T, Dovey L, Orcherton D (2016) Social and cultural issues raised by climate change in Pacific Island countries: an overview. Reg Environ Chang 17(4):1017–1028. https://doi.org/10.1007/s10113-016-1012-5

Wester-Herber M (2004) Underlying concerns in land-use conflicts—the role of place-identity in risk perception. Environ Sci Pol 7(2):109–116. https://doi.org/10.1016/j.envsci.2003.12.001

Whitmarsh L (2011) Scepticism and uncertainty about climate change: dimensions, determinants and change over time. Glob Environ Chang 21:690–700. https://doi.org/10.1016/j.gloenvcha.2011.01.016

Wolf J, Moser SC (2011) Individual understandings, perceptions, and engagement with climate change: insights from in-depth studies across the world. WIREs Clim Chang 2:547–569. https://doi.org/10.1002/wcc.120

Wright P (2014) Perceptions of climate change and its impact on human health: an integrated quantitative and qualitative approach. Global health action. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4265652/pdf/GHA-7-26572.pdf#page=33. Accessed 19 Feb 2017