

The ‘Pacific Adaptive Capacity Analysis Framework’: guiding the assessment of adaptive capacity in Pacific island communities

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Abstract Community-based adaptation (CBA) is becoming an increasingly popular approach to climate change adaptation in the Pacific islands region. Building adaptive capacity should be an important component of projects supporting CBA. The literature establishes that adaptive capacity is highly context and culture specific. However, to date, there has been little research into the factors and processes that enable adaptive capacity in Pacific island communities. This paper discusses the Pacific Adaptive Capacity Analysis Framework, a theoretical framework developed to guide assessment of adaptive capacity for the purposes of supporting CBA projects. The framework identifies seven broad factors and several sub-factors of Pacific-specific adaptive capacity: (1) human capital; (2) social capital; (3) belief systems, worldviews, and values; (4) resources and their distribution; (5) options for

adaptation, livelihood, and food supply; (6) information and awareness; and (7) history of dealing with climate stress. The paper presents a case study of adaptive capacity from a community in the Solomon Islands and concludes that unlike many adaptive capacity determinants identified in the broader international literature, function-based (factors shaping ability to access and use resources) and cognitive (for example, values and belief systems) determinants are of particular relevance in the Pacific community social and cultural context. The key to building upon cognitive and function-based aspects of adaptive capacity is increasing the ability of people to liaise with external support organisations to plan and acquire resources for adaptation on their own terms.

Keywords Adaptive capacity · Climate change · Community-based adaptation · Pacific islands · Solomon Islands

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Introduction

Pacific island communities increasingly need to adapt as a result of the changing climate. Warmer land and sea temperatures, changes in the frequency and intensity of rainfall events and tropical cyclones, sea-level change, and damaging flooding and drought events will have a significant impact on people’s lives and livelihoods—especially for the majority of the region’s population who are inherently dependent on their natural environment for food, water, and income (Nurse et al. 2014). Given the geographically dispersed nature of many Pacific communities, participatory community-based adaptation (CBA), community-based disaster risk reduction, or variants thereof are now a

popular approach to reducing risks associated with climate change.

Many Pacific communities are taking their own initiatives to adapt their lives and livelihoods to changing risks; the strong adaptive capacity possessed by many Pacific communities is being increasingly recognised by donors and their implementing agencies supporting CBA in the region. Adaptive capacity is broadly defined as the ability of a human system to deal with climate-related exposures and risks (Smit and Wandel 2006; Adger et al. 2007). Despite the increased focus on adaptive capacity in CBA-related projects, there remains little analysis of the factors shaping adaptive capacity in Pacific communities and subsequently few methods for assessing it.

The literature establishes that adaptive capacity is a complex and ‘fuzzy’ concept that is highly context specific and does not lend itself easily to assessment (Engle and Lemos 2010; Engle 2011; Hinkel 2011). Nonetheless, it is difficult for donors, governments, and implementing organisations to support adaptive capacity-building initiatives without (1) understanding what capacities need to be strengthened and why, and (2) an appropriate assessment framework to demonstrate the success of adaptive capacity-building initiatives against a baseline. A consequence of this is that beyond rhetoric, many community projects and programmes aimed at increasing adaptive capacity are often restricted to measures that reduce exposure to climate risks. This situation represents missed opportunities, as building adaptive capacity enables a community to be more innovative, flexible, and independent in adapting to increased or changing risks.

In this paper, we discuss the Pacific Adaptive Capacity Analysis Framework (PACAF), a theoretical framework developed by a group led by the University of the South Pacific to guide assessment of Pacific-specific adaptive capacity at the community level. Although the concept of adaptive capacity has gained some attention in the international literature (Carina et al. 2011; Engle 2011; Kuruppu and Liverman 2011; Hill and Engle 2013), there is little Pacific-specific literature on the subject and therefore no appropriate assessment framework exists for application in the Pacific community context (although Gero et al. 2014 use the concept of adaptive capacity to examine the efficacy of humanitarian organisations in the Pacific). The ‘Results’ section of this paper presents the theoretical framework. Following this, we present a case study from the Temotu Province of the Solomon Islands where the framework was implemented. The ‘Discussion’ section concludes with a comparative analysis on Pacific adaptive capacity vis-a-vis factors identified in the literature and provides some recommendations for organisations funding and supporting CBA.

Literature review

Definitions of adaptive capacity

The term ‘adaptive capacity’ has variable definitions between and within different scholarly and policy communities (Thywissen 2006; Hinkel 2011). Although there is little consensus in the literature on a single conceptual definition, it is generally agreed that adaptive capacity is closely related to the concepts of adaptability (as used in biology and natural resources management research), capacity, capability and coping capacity (as used in hazards and disasters research), and resilience (as used in ecology and socio-ecological systems research) (Fussel 2007; Fussel and Klein 2006; Brooks 2003; Adger and Kelly 1999). In the context of climate change, definitions of adaptive capacity often explicitly emphasise the ability to both proactively and reactively respond to perturbations (Gallopín 2006; Nelson et al. 2007; Adger et al. 2007; Hinkel 2011; Ford et al. 2013; Hill and Engle 2013).

Further to definitional debates, the relationship between the concept of adaptive capacity and the concepts of vulnerability, resilience, and coping capacity is also contested. Although beyond the scope of this paper, overviews of these conceptual contestations are provided by Smit and Wandel (2006), Gallopín (2006), and Fussel (2007). Climate change vulnerability and adaptive capacity are integrally linked; enhancing adaptive capacity reduces vulnerability and vice versa (Smit and Pilifosova 2001, 2003; Grothmann and Patt 2005; Brooks and Adger 2004; Adger et al. 2007; Ensor and Berger 2009; Birkmann et al. 2013).

Adaptive capacity is therein a prerequisite, enabling adaptation (Smit and Wandel 2006; Nelson et al. 2007; Hill and Engle 2013). The IPCC defines adaptation as the ‘process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities’ (Mach et al. 2014). The concept of adaptive capacity became prominent following the shift towards ‘vulnerability-led’ approaches to adaptation to complement ‘impacts-led’ approaches over the past decade (Burton 2009). A focus on adaptive capacity enables greater input from social sciences in vulnerability and adaptation assessment and action and, in particular, greater consideration of non-climate stressors that shape ability—or not—to adapt to climate change (Ford et al. 2013). By emphasising adaptive capacity, vulnerability-led approaches frame people as ‘active agents’ (Hewitt 1983; Wisner 2004) who are ‘adaptive’, possessing ‘capacity’ with which to withstand and respond to climate change. Eriksen and Kelly (2007) note that a common question emerging from vulnerability-led approaches is ‘what can be done to

strengthen people's own capacity to respond and adapt?', rather than 'what can be done to protect the population?' (Eriksen and Kelly 2007: 505).

Despite these definitional differences, the term adaptive capacity broadly indicates the ability of a human system to maintain (and ideally increase) quality of life despite stress and change.

Determinants of adaptive capacity

While the determinants of vulnerability to climate change have been the focus of much research, the determinants of adaptive capacity have received less attention (Engle 2011). This may be attributed to the highly context- and scale-specific nature of the factors and processes shaping adaptive capacity. Indeed, Smit and Wandel (2006) and Brooks and Adger (2004) emphasise there can be no certain or universal determinants beyond broad categories, because these exist and function differently in different contexts. As a result, only broad types of factors and processes that determine adaptive capacity are classified throughout the literature. Most classifications are strongly influenced by the groups of determinants given by Smit and Pilifosova (2001) in the Third Assessment Report of the IPCC and by Yohe and Tol's (2002) derivative list of underlying determinants (included in Table 1 below) (Carina et al. 2011). As is summarised in Table 1, adaptive capacity is generally framed as being determined by a combination of (1) the availability of resources and (2) people's access and ability to use these resources for adaptation (Brooks and Adger 2004). In particular, the role of institutions and governance in determining adaptive

capacity has been frequently emphasised in the recent literature (Engle and Lemos 2010; Hill and Engle 2013; Gupta et al. 2015).

It is generally accepted in the climate change and disaster risk reduction field that the factors and processes influencing adaptive capacity (particularly generic ones that are not directly linked to a specific climate stimuli) coincide with those that facilitate and constrain sustainable development (Yohe et al. 2007). Adaptive capacity and development cannot be considered separately.

Adaptive capacity determinants in the Pacific: a research gap

Barnett and Campbell (2010) and Barnett (2001) argue that, often, mainstream determinants of adaptive capacity that are selected for climate-related assessments do not sufficiently reflect the circumstances of Pacific island communities. Mainstream determinants [e.g. as emphasised in the IPCC reports (Smit and Pilifosova 2001; Adger et al. 2007)] tend to be skewed towards Western ideals of development such as strong economies, gross domestic product, technological capabilities, and strong state support systems. As highlighted by Barnett et al. (2008), the selection of adaptive capacity indicators for use in assessments often reflects the values and worldviews of those creating an assessment methodology rather than those who will populate it and benefit from it.

While important, a notion of adaptive capacity that largely focuses on economic and technological development de-emphasises or excludes imperative positive contributors to adaptive capacity in Pacific islands. Many

Table 1 Determinants of adaptive capacity commonly identified in the literature. From Adger and Kelly (1999), Smit and Pilifosova (2001), Yohe and Tol (2002), Adger et al. (2003), Ford and Smit (2004), Adger and Vincent (2005), Grothmann and Patt (2005), Adger

et al. (2007), Engle and Lemos (2010), López-Marrero and Yarnal (2010), Kuruppu and Liverman (2011), Ireland and Thomalla (2011), Hill and Engle (2013) and Larson et al. (2013)

Category	Determinant	Includes
Availability of resources	Economic resources	Economic assets, capital resources, financial wealth, income generating options, savings, aid, financial instruments (e.g. insurance and credit)
	Natural resources	Environmental quality, ecosystem goods and services, water resources, food resources
	Information and technology	Technology transfer, adaptation options, expertise, communication networks, climate data, early warning systems
	Infrastructure	Transport, communications, buildings, water infrastructure, sanitation, energy supply
Ability to access and use resources	Social capital	Local and extra-local networks, organisations, state-civil society relations, property and land rights, policies (economic and social), participatory decision-making, management, governance, and leadership
	Human capital	Knowledge and skills (scientific, technical, traditional/local, political), education, literacy, health, labour, innovation potential
	Collective action	Social cohesion, activity coordination, information sharing, development of institutions (social, cultural, political, management)
	Cognitive elements	Values, belief systems, risk perception, past experience with climate events, perceived self-efficacy, perceived adaptation efficacy, and cost

communities have successfully maintained their well-being in a highly variable and uncertain environment for generations. Thus, features of society such as kinship, reciprocity (both locally and between islands and countries), traditional values, and resilient subsistence livelihood systems are important contributors to adaptive capacity and should be reflected in the planning of adaptation initiatives (Campbell 2006; Mercer et al. 2007; Lazrus 2012).

The shortcomings of mainstream approaches to assessing adaptive capacity have been recognised in several studies focused at the local scale. For example, and the World Resources Institute (2009) identify that even though access to wealth and technology is essential for adaptation, adaptive capacity measures need to be more function- and process-based as opposed to asset-based if they are to reflect the realities of local-scale lives and livelihoods. In a Pacific island (Kiribati) case study, Kuruppu and Liverman (2011) highlight that cognitive aspects of adaptive capacity—for example, value systems and perceived self-efficacy—crucial to the success of CBA have thus far been largely excluded from research and implementation.

Method of developing the PACAF

A framework for analysis of community adaptive capacity in the Pacific was developed by individual representatives of three organisations: University of the South Pacific (USP), the Secretariat of the Pacific Community (SPC), and the Red Cross Red Crescent Climate Centre. These organisations have a long history of supporting communities CCA, disaster risk management, and natural resource management, and the individuals involved all regularly worked with communities. This experience includes the Fiji Climate Adaptation Project (implemented by USP) (see Dumar 2010), the Red Cross Red Crescent Climate Centre's 'Preparedness for Climate Change' programme (see Barnett and Campbell 2010), and the 'Coping with Climate Change in the Pacific Islands Region' Programme (implemented jointly by SPC and the German Society for International Cooperation). Drawing from this experience and existing research on human responses to environmental change in Pacific island countries, the individuals developed the PACAF framework. First, a literature review was undertaken to identify broad adaptive capacity determinants commonly applied in assessments internationally (see Table 1). Second, the research team held a meeting to compare various determinants identified in the literature with their own experiences working with communities. Determinants deemed relevant to the Pacific community were selected and modified. This process also drew upon concepts of Pacific community-level adaptive management established in the Locally Managed Marine Area Learning

Framework (LMMA) approach, as many concepts from this initiative held relevance to climate change-related adaptive capacity. (LMMA 2003). Third, the framework was peer-reviewed by a dozen researchers and practitioners in the Oceania region. If time and resources had allowed, involving community representatives at this initial stage of developing the framework would have been optimal. As this was not possible, however, the framework was field tested with a community in Fiji that USP had an existing relationship with. The field testing was to test the relevance of each factor before finalisation and to test a questionnaire and interview questions designed around the factors (see online supplement). Some modifications were made to the factors to reduce repetition.

The PACAF was applied in 12 communities in eight Pacific island countries. The results of one of these assessments are presented in a case study in this paper.

Determinants of Pacific island community adaptive capacity

Seven broad categories of adaptive capacity factors relevant to the Pacific island context were identified: human capital; social capital; belief systems, worldviews, and values; resource distribution; options; information and awareness; and past experiences of climate stress. For each factor, sub-factors were identified to specifically reflect the situation in Pacific island communities. For clarity, each sub-factor was clearly defined and text developed on how each sub-factor potentially affected community adaptive capacity. (See Table 2).

Case study: Pileni Island community, Solomon Islands

The PACAF guided an assessment of community adaptive capacity on the island of Pileni in the Temotu Province of the Solomon Islands in 2011. The adaptive capacity assessment formed one component of a Solomon Islands Red Cross (SIRC)-led pilot project called 'Community Identified Climate Adaptation in Temotu' and was undertaken by SIRC, the International Federation of the Red Cross and Red Crescent Societies (IFRC) and the Red Cross Red Crescent Climate Centre, one of at least 13 IFRC reference centres, which is hosted by the Netherlands Red Cross in The Hague (McNaught et al. 2011: 5–6). This case study illustrates the drivers of and barriers to adaptive capacity in Pileni, illuminating the complex and site-specific nature of adaptive capacity.

Pileni is located north of the Reef Islands in the remote Solomon Islands Province of Temotu, about 3–4 h by motorboat from the capital of the province, Lata (see

Table 2 Determinants of adaptive capacity contained in the PACAF

Factor/sub-factor	What is it?
<i>Factor 1 Human capital</i>	
1(A) Traditional and modern skills	'Traditional skills' refer to practices derived from indigenous/local knowledge. 'Modern skills' refer to skills that are derived from external knowledge An abundance of both indicates a high level of adaptive capacity
1(B) Population health	The physical health and well-being of the community
1(C) Change agents	The presence of creative, 'ideas persons' or 'champions' in the community that initiate projects and motivate people to be involved
<i>Factor 2 Social capital</i>	
2(A) Community diversity	Community diversity could refer to: number of immigrants; number of clans or similar social units (for example, <i>mataqali</i> in Fiji), and/or households (<i>vasu</i> in Fiji) without ancestral access to resources; number of religious denominations; and educational and economic equality in a community Low diversity of the above-mentioned factors <i>could</i> mean higher adaptive capacity since it could indicate cohesive leadership and a collective identify. However, the way in which diversity is <i>managed</i> within the community is also crucial to adaptive capacity
2(B) Leadership	A respected person(s) who creates a positive vision for the community and effectively implements projects reflecting it
2(C) Strength of collective action	The ability of the community to regularly work together to achieve community goals. Collective action capacity could be reflected in the number of community groups who have clear roles and responsibilities for key areas and produce effective results. Good collective action capacity increases ability to sustainably manage resources, share information, develop strong institutions and social networks and coordinate project activities (see also Ireland and Thomalla 2011)
2(D) Support services and networks	Community ability to access assistance from a wide range of groups, for example, extended family networks, government and non-government institutions, other communities, funding and technical institutions, private sector organisations. This factor includes both the presence of these groups and the ability of the community to draw upon their support
2(E) Governance	Community decision-making and implementation processes that are effective within the cultural context. In most cases, this will include appropriate input of village people into decision-making and sharing of information needed for this
<i>Factor 3 Belief systems, worldviews, values</i>	
3(A) Traditional values, systems and knowledge (<i>Mana</i>)/modern, Western, and church value systems and knowledge	'Traditional' refers to value systems and worldviews that are strongly shaped by accumulated, indigenous cultural knowledge. 'Modern'/'Western'/'church' refers to value systems that are strongly shaped by Western knowledge. Value system adherence (traditional or modern) creates social capital by guiding behaviour, shaping identity, and building cohesive social groups
3(B) Willingness to accept change	The willingness of the community to take on changes and new knowledge to deal with problems and improve their situation. New ways of dealing with old and new problems could be hindered by a lack of acceptance of new ways of doing things
3(C) Self-agency versus determinism	Perceptions of self-agency. A dominant belief system may be fatalistic (i.e. people believe they have no agency to control the future because the future is determined by forces beyond human control) or, on the other end of the spectrum, people may believe in self-agency or their ability to change the future through their actions. People's perceptions of their own self-efficacy influences motivation to carry out adaptive actions
3(D) Here and now versus future thinking	Short-term versus long-term thinking and actions. Linked to being either a believer of fate (i.e. just being here and now) or a believer that we have control over our futures (longer-term perspective). Long-term thinking indicates that proactive actions to reduce future risks will be taken

Table 2 continued

Factor/sub-factor	What is it?
3(E) Dependence (especially on external organisations) versus independence	A gauge of the attitude of the community in response to stressors: Does the community wait for assistance to come or initiate action themselves? This also triangulates 3(C) (self-agency) as it reflects confidence in abilities to be self-sufficient
<i>Factor 4 Resources and distribution</i>	
4(A) Land access	The availability of land to use for subsistence needs and the distribution of it
4(B) Fisheries access	The availability of fishing area to catch fish for subsistence needs/access to fish for food
4(C) Income access	The amount of disposable income available to purchase basic needs and the distribution of it within the community
4(D) Infrastructure and services	Infrastructure includes accessibility to health services, electricity, transport, telecommunication, main roads linking the village to other areas, shops, schools. Includes the distribution of access to infrastructure
4(E) Water resources	Drinking water includes the supply of safe drinking water made available through pipes, wells, or tanks
<i>Factor 5 Options</i>	
5(A) Adaptation options	Possibilities available to and accessible by communities that will empower communities to learn how to adapt. This focuses on externally conceived options and in particular on technology transfer and innovations
5(B) Monetary livelihood options	The ability of communities to derive income in the face of climate changes. The diversity of means to earn income within a community is an important component of this
5(C) Food acquisition options	Means of access to and availability of a variety of safe food options or sources for communities (including subsistence, imported, famine foods)
<i>Factor 6 Information and awareness</i>	
6(A) Access to relevant information for adaptation	Awareness of, or locally experienced, global warming and climate changes. The ability to link climate change into people's own way of thinking. General understanding of climate change impacts on various sectors of community life. A higher level of understanding about the causes and consequences of climate change should increase a community's ability to make informed decisions on appropriate solutions to reduce their vulnerability. However, often too much emphasis is placed upon the role of 'scientific' climate information in enabling communities to make adaptive decisions (McNaught et al. 2014)
6(B) Ability to analyse information	This sub-factor builds upon sub-factor 5(A) and factors 6(A) and (B). The ability of people to themselves identify and prioritise various adaptation options for an issue such a water supply and to weigh up the advantages and disadvantages of these
6(C) Communicated risks and importance	The role of external communication of risks associated with climate variability and extremes as well as climate change. Risk communication that is accurate and locally culturally appropriate indicates higher adaptive capacity because people are more likely to be encouraged to take action
<i>Factor 7 History of dealing with climate events</i>	
7(A) Past experience of dealing with climate events	Community experience of and ability to 'deal with' periods of significant change and disruption, for example, cyclones, droughts and floods. Non-climate periods of disruption and change are also important to consider (e.g. disease outbreak, earthquake, taro blight year) as much of the capacity employed to deal with these will also relate to climate-related adaptability. A history of effectively dealing with climate and other changes and disruptions may indicate high adaptive capacity. On the other hand, a history of not effectively dealing with climate stresses may reduce adaptive capacity by generating despondency and 'psychological dependency' upon external support institutions

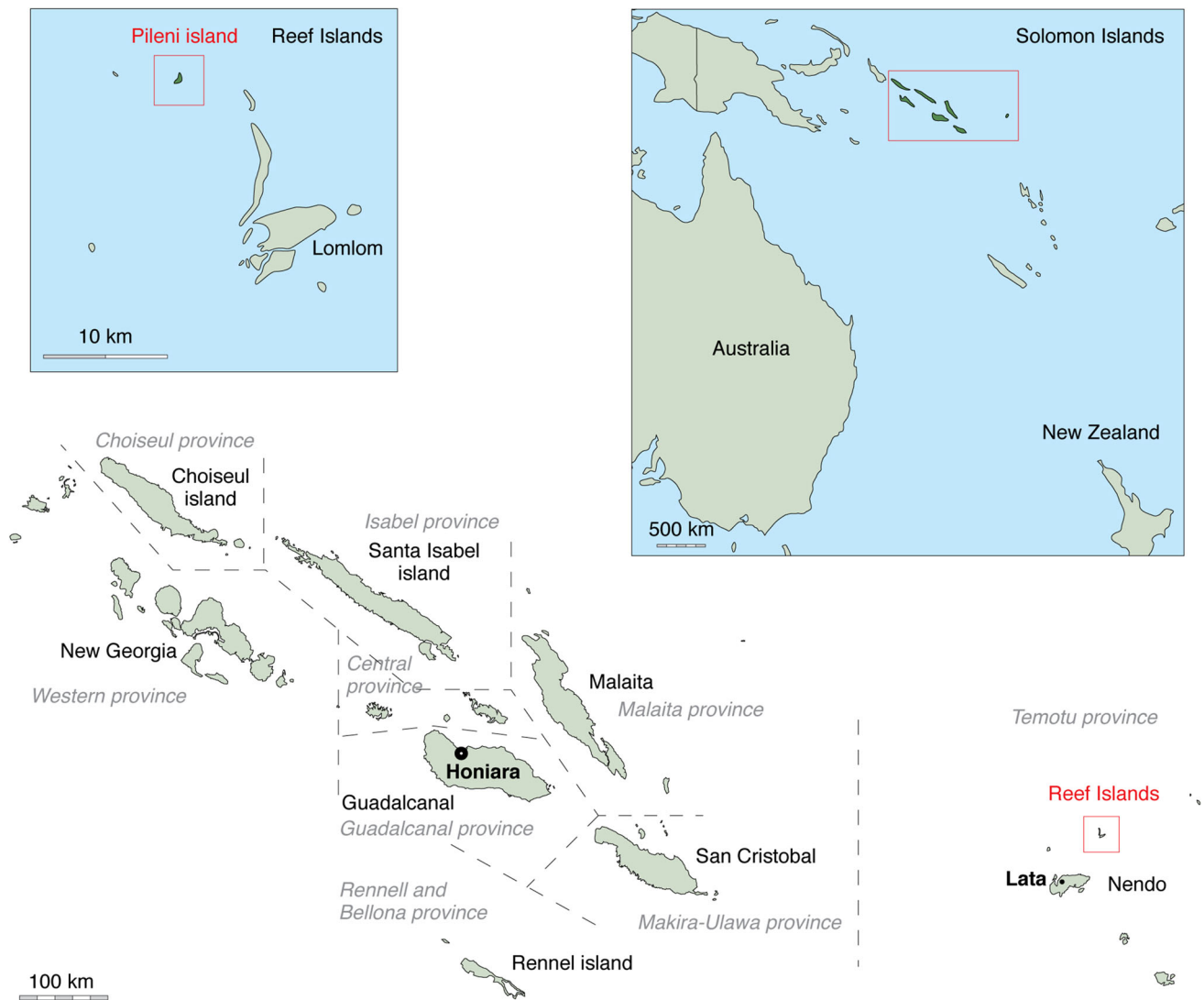


Fig. 1 Solomon Islands, showing the location of Pileni Island within the Temotu Province

Fig. 1). The small island is around 0.1 km^2 , with a population of fewer than 300 people (at the time of assessment) (McNaught et al. 2011: 6). The island is low lying with low soil fertility. A number of hazards impact the area including tropical cyclones during the wetter months. The Pileni community has been significantly affected by storm surge and high tide events, and the Provincial Disaster Management Office (PDMO) has identified the community as highly vulnerable to sea-level rise and tsunamis. Adding to this vulnerability is the community's geographical isolation.

A variety of methods were developed to, in combination, assess the seven determinants (and sub-factors) of the PACAF in Pileni during three field visits to the area. Primarily, determinants were assessed by a combination of questionnaires with community households, and semi-structured interviews with internal and external key

informant community stakeholders (e.g. community and area chiefs, the PDMO, SIRC Temotu branch members). All questions were structured around the factors and sub-factors identified in Table 2. For some questionnaire and interview questions, ratings on a Likert scale were used whereby participants answered a question or ranked a statement from 1 to 5 (lowest to highest) (McNaught et al. 2011: 7). The involvement of Red Cross volunteers from Pileni and surrounding islands enabled most methods to be carried out in the local language.

In addition, the study incorporated the results of a participatory vulnerability and capacity assessment (VCA),¹ used by the Solomon Islands Red Cross (SIRC) and local

¹ The Red Cross Movement-wide participatory approach to involving communities in assessing their vulnerability to, and capacity to cope with, hazards and other problems.

volunteers to analyse the impacts of disaster and climate change, and to identify and prioritise risk reduction or adaptation activities. The VCA consisted of eight tools: participant observation; transect walks; historical timeline; seasonal calendar; focus group discussions; hazard mapping; and daily routine (McNaught et al. 2011: 6–7).

Below is an overview of key drivers of and barriers to adaptive capacity in Pileni, structured around the seven PACAF factors.

Factor 1 Human capital

The study found that the widespread presence of traditional skills enables adaptive capacity in the Pileni community. The community yet relies on a large amount of traditional skills, such as drying and preserving food and using weather patterns to predict weather events or sailing conditions. However, trust in some traditional methods of predicting weather is questionable due to a reduction in peoples' ability to predict weather conditions to the same degree of accuracy they could previously (McNaught et al. 2011: 13).

Pileni has a number of environmental-related health problems that constrain adaptive capacity. Water and sanitation are the main environmental health issues, particularly solid waste disposal and lack of access to safe drinking water. People are dependent on water wells and tanks. When there is low rainfall, people drink untested water from wells, increasing susceptibility to diseases. Environmental health has been dependent upon externally funded projects; however, at the time of the assessment, fewer projects were reaching the Temotu Province than in the past, which the Ministry of Health correlated to increased disease incidence. Furthermore, another contributing factor is the lack of modern skills and technology for the maintenance of water and sanitation systems in the region. Evidence of malnutrition in children was noted by external key informants and access to medical facilities is expensive and difficult (McNaught et al. 2011: 14). There is a view within the community that king tides cause crop and water contamination. While residents are able to act as change agents and produce localised solutions to problems using community skills in planning, there is a lack of resources, income and technical expertise to implement projects (McNaught et al. 2011: 13–4).

Factor 2 Social capital

Respondents noted that a strong sense of identity, well-functioning leadership and well-structured collective action are strong features of social capital. There is one religion on the island and only slight variation in wealth and education across the community. There are several

chiefs in the village and one head Chief. Community leaders play an important role in conflict mediation and reconciliation, and in community decision-making processes via the council of chiefs, which is generally well functioning. The head Chief has a spokesperson and facilitator role, and community input is a part of decision-making (McNaught et al. 2011: 15). Collective action is fairly strong with most households involved in a community committee. A community seawall project was jointly implemented by the Pileni committees, church leaders and chiefs, helping to build collective project management capacity (McNaught et al. 2011: 15–6). However, very limited access to external support services and networks constrains social capital. Limitations on community social, financial and physical resources to carry out community projects include lack of funds, technical expertise and external organisations such as provincial government departments or NGOs. For example, there are only one or two annual funded visits to Pileni from the health department and Provincial Disaster Management Office (McNaught et al. 2011: 14, 16). It is important to note, however, that the presence of Red Cross volunteers in the community is an asset in this regard, providing links to an external support organisation.

Factor 3 Belief systems, worldviews, and values

High value placed on traditional knowledge and cultural values enables adaptive capacity as it maintains traditional skills and allows these to be built upon with modern knowledge. However, respondents noted that traditional values were declining with younger people placing less value on traditional knowledge (McNaught et al. 2011: 17).

The main religion is Anglican and due to missionary history, many traditions are still intact. The Anglican Church tackles climate change through projects and references the bible to explain climate change to the community (McNaught et al. 2011: 17). While remoteness means that the community is accustomed to being independent, they are also increasingly accepting of new approaches to solving problems that come from the outside world. More than 80 % of questionnaire responses indicated a willingness to accept change in managing problems. In analysing beliefs around self-agency and determinism, research participants did not show a clear leaning when asked if they have control over their future. Future thinking and planning was indicated when the majority of respondents agreed that acting now would help to prevent future problems (McNaught et al. 2011: 17). Households in the community had an average of one or more members living in other towns, an indication of widespread access to remittances (McNaught et al. 2011: 18).

Factor 4 Resources and distribution

Adaptive capacity is constrained due to the limited access to certain resources. Access to arable land is restricted by decreasing soil fertility (linked to salt water intrusion) and the island's small size. There are often hardly enough crops on the island to meet basic needs. As a result, there is heavy reliance on traditional preserved foods, and on exchanging fish for vegetables grown on nearby islands (McNaught et al. 2011: 18). Pileni has abundant fishing areas; however, over the last 30 years, yields have declined. Without prompting, respondents cited changes in tides, weather patterns and the 'warmer sun' as predominant reasons for this.

Pileni residents have a mainly subsistence lifestyle; however, they can also earn a small amount of money by selling fish, pigs, and handicrafts in distant markets. The average monthly income per household including remittances is \$6.50–\$26.50 USD, although school-related expenses frequently exceed that (McNaught et al. 2011: 19). At the time of the study, there was hardly any infrastructure and services on the island, including no generators, public phone, two-way radio, computers or televisions, and no medical clinic. There is a one-way radio with limited reception. An outboard motorboat was bought to facilitate access off the island, but fuel costs are prohibitively high (McNaught et al. 2011: 20). As mentioned above, the community has limited access to safe drinking water. Old wells are becoming increasingly saline, and the community's water tanks are often not enough to meet household needs during periods of limited rainfall (McNaught et al. 2011: 22).

Factor 5 Options

The study found that adaptive capacity is constrained in many ways by limited options available to the community for sustainable and adaptive livelihoods. For example, increasing access to freshwater is important to the community, but options for addressing this challenge are scarce because of limited access to external resources and support services. Adaptation measures already taken are predominantly based upon local knowledge, including building seawalls to manage tides and inundations, and increasing soil fertility by using compost from pig pens. The above-mentioned seawall project involved looking at options to complement traditional stacking techniques and knowledge around tide times with commercial construction supplies (McNaught et al. 2011: 13). Although still ongoing at the time of the study, the seawall project had already generated significant benefits by demonstrating the complementarity of traditional and modern techniques and by demonstrating a process for collective decision-making about a

community asset. It should be that many respondents noted that the seawall project was a short-term solution to the erosion issues that they face (McNaught et al. 2011: 23).

The community would need ways of raising finance to address many of their adaptation priorities in the absence of substantial external support. However, financing options are limited; monetary livelihood options have not increased in the last 30 years (McNaught et al. 2011). A government ban on harvesting sea cucumber (previously the main income earner) reduced incomes. Access to a diversity of food sources is fair; because of strong traditional knowledge, people have access to some traditional preserved foods, and subsistence crops and food from the sea are generally reliable, given the very low population. However, the island's remoteness, poor transportation networks, and low levels of income mean there is little money to purchase imported food if agricultural production declines (McNaught et al. 2011: 25).

Factor 6 Information and awareness

Accessing information about climate variability and extremes and climate change is a constraint to adaptive capacity. The church facilitates information transfer and sharing. However, external communication capacity is limited by lack of infrastructure and services, and word of mouth is relied upon in addition to traditional methods for predicting the climate. When climate and weather information disseminated by the Solomon Islands Meteorological Service is received via the community radio, it is useful, but reception is unreliable. Although the community has a broad understanding of climate change based on their observations of changing conditions around them, there is a need for more access to information about adaptation options and awareness on future climate change impacts to enable preparation. Focus group discussions during the SIRC VCA indicated a good ability to analyse information, reflect on results, and prioritise options (McNaught et al. 2011: 22).

Factor 7 History of dealing with climate events

It was observed that Pileni residents have experienced a number of weather- and climate-related problems over time. Those of particular concern include high sea levels (and associated coastal erosion), declining fish stocks, decreasing agriculture production and water quality, and changes in storm frequency and predictability (McNaught et al. 2011: 9). Past experience in dealing with climate-related events was reviewed through the creation of historical timelines as part of the VCA (McNaught et al. 2011: 9). Results indicated that although traditional methods of dealing with problematic climate events are widespread,

some are declining in prevalence and changes in weather patterns are rendering some less effective. A seasonal calendar was also populated by the community to document observed climate changes. In Pileni, changes included reduced number of fruit seasons each year, stronger and changing directions of currents (believed to be destroying fish habitats), increased storm surges causing damage to the island foreshore, less productive root crops, and changing low and high tide patterns (McNaught et al. 2011: 11).

Disaster relief from national sources often does not reach Pileni. However, results indicated a mindset of self-sufficiency in dealing with difficult events, in the absence of reliable emergency services.

Discussion

The application of the PACAF in the Pileni Island community illustrates the highly context-specific nature of adaptive capacity. Some of the characteristics enabling and constraining adaptive capacity in Pileni are likely to be similar to other rural, remote communities with mainly subsistence-based livelihoods; however, the Pacific is highly diverse and the relative importance of factors will vary according to place. The PACAF proposes that of the adaptive capacity determinants prominent in the literature, human and social capital, belief systems, access to livelihood resources, availability of sustainable livelihood options, access to information, and history of dealing with climate stress are the most important broad elements of community adaptive capacity in the Pacific. As in the literature (see Table 1), these elements relate to both the availability of resources (asset-based factors) and the ability to access and use resources (function-based factors) (World Resources Institute 2009). However, the results in Table 2 especially emphasise the latter, comprising five of the seven factors: factors 1 (human capital), 2 (social capital), 3 (beliefs, worldviews, and values), 6 (information and awareness), and 7 (history of dealing with climate events). This is in line with the emerging adaptive capacity literature that increasingly examines the role of institutions and governance (shaped by human and social capital and cognitive elements) in determining adaptive capacity (Engle and Lemos 2010; Hill and Engle 2013; Gupta et al. 2015).

One of the unique features of the PACAF is the emphasis on cognitive elements that are often neglected in the current adaptive capacity literature, in particular traditional value systems, acceptance of new knowledge, perceptions of self-efficacy, and experience of past disasters. In many Pacific communities, people's belief in their own agency to participate in adaptive solutions is especially important since dominant global discourses often

cast Pacific islands as helpless victims (Mortreux and Barnett 2009; Barnett and Campbell 2010; Farbotko and Lazrus 2012). In the case of Pileni Island, cognitive elements formed the foundation of adaptive capacity-enabling factors. Strong traditional values are fundamental as these hold together a collective community identity and enable the maintenance of traditional skills to be built upon for climate resilience. Traditional values also form the foundation of many aspects of social capital. A strong sense of collective community identity and a culture of self-efficacy born from being accustomed to dealing with climate variability with little external assistance are also prominent enablers of adaptive capacity. Self-efficacy is reflected in the community's perception of themselves as able to come up with good ideas to solve community problems and act as change agents. At the same time, the community perceived themselves as being open to 'new' ideas.

Social capital also features prominently in the PACAF, and the identified indicators were community diversity, leadership, collective action, support services and networks, and governance (factor 2). These indicators particularly resonate with the traditional concept of *Vanua* (a Fijian word with a similar translation in other Pacific island languages) that continues to influence Pacific island social systems. The concept implies a focus on relationships that define the complex interdependence between the natural environment, social and cultural systems, and institutions that determine daily well-being. Leadership and collective action within communities as well as the ability of communities to engage effectively with external agents were deemed as important indicators for the social capital component. In the case of Pileni, strong traditional leadership and governance systems enable collective decision-making and information sharing, contributing strongly to adaptive capacity.

However, communities' ability to also engage effectively with external agents in sourcing and utilising adaptation resources (such as finance and technology) in a way that responds to their own immediate and future needs is critical to adaptive capacity. In the Pileni community case, geographical isolation is a double-edged sword; while it has contributed to retention of traditional knowledge, and value placed on self-sufficiency, it also contributes to very limited access to government services, aid support programmes, and adaptive livelihood options. The community lacks resources, technical skill, and finances to implement ideas (McNaught et al. 2011: 26). Lack of outside communication is another challenge of remoteness, which is growing in significance as accuracy of traditional knowledge for weather warnings declines (McNaught et al. 2011: 26).

The asset-based components of the framework, factors 4 and 5, are generally consistent with the broadly defined

asset-based factors of adaptive capacity contained in Table 1, namely, natural resources, infrastructure, finance, and technology. This framework, however, emphasises specifically peoples' basic physical needs, particularly a place to live (land), water, food, and household income—these are also needs that are anticipated to be directly impacted by climate change. A large portion of Pacific island communities are resource-owning indigenous communities that continue to live within a semi-subsistence economy. This way of life is increasingly being replaced by migration to urban and growth centres, and the expansion of informal settlements that are often located in physically vulnerable areas, and where land tenure and other social problems are challenging national sustainable development efforts. Asset-based factors significantly constrain adaptive capacity in the Pileni Island case. Environmental degradation contributes to limited water supply, failing of food crops, declining fish stocks, and therefore reduced ability of residents to provide for themselves (McNaught et al. 2011: 26–7). Lack of access to markets or monetary livelihood options constrains ability to fill the resulting gaps in subsistence livelihoods. The issue of future relocation came up a number of times during the study as one of the only long-term solutions that some participants could imagine (McNaught et al. 2011: 28). Relocation itself may pose a threat to social aspects of adaptive capacity by dispersing the population, causing loss of cultural identity and sense of place and relying on others for land in a country fraught with land issues (Campbell and Warrick 2014).

The application of the PACAF in the Pileni case revealed a number of important factors that adaptation projects or programmes supported by donors would need to consider. Equally important to tackling asset-based constraints is maintaining the foundation of social and cognitive strengths that enable adaptive capacity. Adaptation to climate change needs to maintain and increase the (well-developed) ability of the community to deal with their own environmental uncertainties. This is likely to require initiatives that have little to do directly with climate change or even climate variability and extremes, but that build upon social and cognitive elements of adaptive capacity.

Some organisations are beginning to incorporate methods and tools into their programmes that build capacities, particularly related to information and awareness (factor 6). For example, the Red Cross Red Crescent Movement is increasingly using climate games to build understanding of early warning and early action, climate change impacts, and preparing for uncertainty (Macklin 2014). In the Pacific, a group of agencies, including the Red Cross, have developed an animation geared to the Pacific community cultural context that links climate science about El Niño and La Niña to decision-making and preparedness (Bartlett et al. 2014).

Conclusion

The existing literature generally discusses adaptive capacity at a theoretical and generic level with few providing empirical assessments of the concept. The PACAF provides a structure to help include function-based and cognitive determinants of adaptive capacity in adaptation programming. In particular, it has the potential to be used in the Pacific to monitor and evaluate project effectiveness in building adaptive capacity alongside measures that reduce exposure. It could be applied as a baseline study at project conception phase to aid factors constraining adaptive capacity (particularly those less obviously linked to climate change) to be worked into project design. It could then be applied throughout project implementation to track progress of a project in meeting adaptive capacity targets and as a project end-point evaluation to assess how effective the project has been in building overall adaptive capacity. Many aspects of adaptive capacity take many years and generations to establish, so the limitations of PACAF when used in this way should be recognised.

Application of the PACAF in the Pileni Island community suggests that in a remote, rural island community context, the key to building upon existing cognitive and function-based strengths is to increase people's ability to plan and acquire the necessary external resources for adaptation themselves. Building the ability of communities to effectively liaise with external organisations on their own terms when needed is an important aspect of adaptive capacity.

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