



Feature Article

Social capital reduces vulnerability in rural coastal communities of Solomon Islands

Willem Malherbe^{*}, Warwick Sauer, Shankar Aswani

Department of Ichthyology and Fisheries Sciences, Rhodes University, Grahamstown, South Africa

ARTICLE INFO

Keywords:

Social capital
Vulnerability
Rural communities
Climate change

ABSTRACT

Rural island communities are generally regarded as the most vulnerable groups affected by climate change. This perception arises due to them often being in less developed areas with high levels of exposure to stressors, while reportedly lacking the means to cope with these stressors. Studies which use developed-country yardsticks, such as those used in past IPCC-based assessments, when measuring vulnerability in less developed states will however inevitably over-pronounce its effects in such areas. The sustainable livelihoods approach provides an alternate means of determining vulnerability using capital assets such as social capital. The presence of these assets enables communities to pursue diverse livelihood strategies which ultimately serve to reduce their vulnerability. This study seeks to measure attributes of social capital in five marine dependent communities of Solomon Islands. This was done through a questionnaire survey of 110 respondents, which comprised of 15 questions related to social capital. Question scores were equally balanced and also contributed equally to each of the five indicators of social capital identified in the literature—namely community cohesion, gender equity, leadership, decision making, and equal access to services and resources. The results indicated an overall social capital vulnerability score of 0.379, where 0 indicates the lowest possible vulnerability score and 1 the most vulnerable. Community cohesion decreased vulnerability the most within these communities, followed by gender equity, leadership, equal access to services and resources and decision making. Our results indicate a high degree of social capital in Solomon Islands communities, and therefore its importance as an inherent measure for households to cope with both climate and non-climate related stressors. Climate change directed policy should therefore be developed with the aim of preserving social capital as it provides a culturally embedded means of deterring vulnerability, at the risk of more expensive and possibly less pragmatic alternative measures.

1. Introduction

Rural communities, particularly on underdeveloped small islands, are generally regarded as the most vulnerable (Pelling and Uitto, 2001; Boruff and Cutter, 2007). This perception arises from the combined effects of their low income, high levels of resource dependency and their susceptibility to climate (e.g. sea level rise, rainfall variability, increase in storm frequency and intensity) and non-climate (e.g. macroeconomic shocks, gender inequalities and civil unrest) related threats (Adger, 1999; Allison et al., 2009; Cinner et al., 2012; Morzaria-Luna et al., 2014). Additionally, small island communities may also be characterised by limited institutional support, in the form of financial, government or aid agencies (Ahammad, 2011), as well as low numbers of community infrastructure items such as schools and hospitals (Cinner et al., 2013a). Within developed countries these community

characteristics are regarded as important factors when considering vulnerability. But how appropriate are they at measuring vulnerability of less developed communities in small island nations?

Due to the particular nature of each coupled social and ecological system (e.g., differences in feed-back loop characteristics) and the different stressors exerted on those systems, the aim of vulnerability assessments should be to understand the vulnerability of communities within the context of systems (Bennett et al., 2014; Hinkel, 2011; Adger and Vincent, 2005). Overlooking characteristics unique to a community can result in an incomplete perception on the state of vulnerability, and may in turn misconstrue the information passed on to decision makers tasked with addressing it. Local ecological knowledge (LEK) is an example of how unique behaviour specific to particular communities can improve their livelihood strategies. It allows communities to anticipate change in weather (Lauer et al., 2013), and dictates how and when

^{*} Corresponding author.

E-mail addresses: wilfredmalherbe@gmail.com (W. Malherbe), w.sauer@ru.ac.za (W. Sauer), s.aswani@ru.ac.za (S. Aswani).

natural resources are harvested (Colding et al., 2003). Locally relevant LEK has the ability to contribute towards lowering vulnerability within a particular community, but may not necessarily result in similar outcomes being achieved when applied within different socio-ecological systems. It thereby exemplifies the importance of considering vulnerability and its components of assessments within the context of the particular system under study.

Vulnerability is defined as the susceptibility of a system which is unable to cope with an adverse impact or disturbance (IPCC, 2001). The term is regularly used across a number of academic fields, with various connotations (Füssel, 2007). Vulnerability assessments are generally used to “systematically integrate and examine the interaction between humans and their physical and social surroundings” (Hahn et al., 2009). Such assessments have been used in studies primarily focussed on social applications (Adger, 1999; Williams et al., 2008; Hahn et al., 2009; Ahsan and Warner, 2014; Morzaria-Luna et al., 2014), as well as with ecological applications (see De Lange et al., 2010). As per the IPCC’s definition, exposure, sensitivity and adaptive capacity are all functions of vulnerability. The drivers of climate change, such as greenhouse gasses, result in various effects on the chemical and physical environment. These effects, also known as stressors, may lead to impacts on the ecological component of a social and ecological system. The degree of impact, however, depends on the level of exposure the socio-ecological system is adverse to, as well as its intrinsic sensitivity to such stressors. Adaptive capacity of the socio-ecological system constitutes its ability to recover from, or cope with, these impacts (Mumby et al., 2014). While the use of vulnerability assessments is commonplace within climate change research, construction of the methods varies widely. Numerous frameworks have emerged to determine the vulnerability of a system. The most widely used are the IPCC (2001) approach and the sustainable livelihood approach (SLA). Both these approaches have their own definition of vulnerability, and therefore use different indicators to measure it.

The IPCC approach to vulnerability assessment has been widely used (see Allison et al., 2009; Cinner et al., 2013a; Ahsan and Warner, 2014). There are however few similarities between studies other than their measure of vulnerability using exposure, sensitivity and adaptive capacity. The IPCC approach does not supply an objective means by which to determine the vulnerability of a system, but instead relies on the scale of analysis, the sector being addressed, and the types of data available (Turner et al., 2003). The broadness of the IPCC approach means that it covers many components of vulnerability (i.e., those found within exposure, sensitivity and adaptive capacity), but this broadness often lacks depth of scrutiny within these components, while some characteristics of vulnerability may be overlooked (Preston, 2012). This may result in oversimplification of vulnerability components and the broadness of the framework may result in some concepts being poorly defined (Füssel, 2007), which complicates the replication of methods.

Capital assets were first proposed by Chambers and Conway (1991) as a means of determining the sustainability of livelihoods. Within the sustainable livelihoods context, a livelihood constitutes the assets a household are entitled too. Their access to capital assets therefore determines the livelihood strategies employed by households (Allison and Horemans, 2006), where the lack of access may result in failure to adapt to stressors (McDowell and Hess, 2012) and therefore render them more vulnerable to changes. A household’s access to capital assets determines its ability to adapt to changes by, for instance, making use of available skill sets (human capital) and land entitlements (natural capital), to employ an alternate livelihood strategy (Allison and Horemans, 2006). The five capital assets allow the integration of ecological, social, and economic indicators to measure vulnerability of SESs (Table 1). The major criticism of the SLA is that it does not provide a means to measure the level of exposure a system faces from stressors (Kelman and Mather, 2008). Instead, the SLA surmises exposure by relying on private and institutional conditions to facilitate change within the system (Smit and Wandel, 2006). As example, the SLA would surmise that a change in the

Table 1

The asset types and questions used to infer vulnerability for each of the capital assets (after Scoones, 1998).

Capital asset	Example of asset types
Physical	Boats, house, freshwater supply, energy, cooking fuels, waste, and the condition of these assets
Financial	Shared household income, savings, debt, credit, and insurance
Natural	Diversity of marine habitat, and its changing resource base
Human	Local knowledge, health, education, skills, general knowledge, and labour
Social	Community cohesion and networks, gender equity, decision making, and leadership

market price of fish was as a result of external stressors, without providing detail as to how a stressor may have impacted this price.

Social capital forms one of the SLA’s capital assets. The initial concept of social capital is attributed to Hanifan who, in 1916, described it as a “tangible substance which accounts for most in the daily lives of people: namely good will, fellowship, sympathy and social intercourse... amongst a social unit” (Woolcock and Narayan, 2000: 228). The concept of social capital has often resurfaced in literature, and it has been used in various disciplines, with different applications, including economics, sociology, anthropology and political sciences. As a result, it features in numerous studies across these disciplines, and its definition is generally restricted to the particular scope of the study and therefore often ignores the progressive conceptualisation of the term which has developed over time.

The contemporary concept of social capital used in development and vulnerability studies gained traction through the works of Bourdieu (1979, 1986), Coleman (1988) and Putnam (1995), and has since become a common component of vulnerability assessments (see Marshall et al., 2010; Cinner et al., 2013b; Ahsan and Warner, 2014). In the context of development theory, Woolcock and Narayan (2000: 226) define social capital as the norms and networks that allow people to act collectively. Through this collective action, communities are able to establish forums by which they can identify and pursue common goals. Within rural communities, the importance of social capital is centred on its function as a support system when faced with economic and environmental uncertainty. Kozel and Parker (1998) found that social groups in India provided its constituents with risk management, protection, and solidarity. Social capital therefore refers to more than the ability to form community groups, but also speaks to the ties, equity and leadership within these communities which results in the willingness of members to help each other (de Souza Briggs, 1998; Holzmann and Jorgensen, 1999).

The presence of social capital as a security network has been reported as a central component of Solomon Island communities as well as in other Pacific Island Nations (PINs). Customary systems of community organization and leadership are recognized as important sources of vulnerability deterrents throughout PINs by promoting cooperation and exchange of goods and services (Campbell, 2009). For example, the rapid organization of a local disaster relief committee ensured that goods and medical aid was successfully disseminated to households after a tsunami struck Simbo in Solomon Islands (Lauer et al., 2013). Although the characteristics of leadership, community cohesion, gender equity, decision making and equal access to resources, among others, has been individually recognized as important community characteristics in Solomon Islands and elsewhere (e.g., Schwarz et al. 2011), it is necessary to pair these as collective attributes of social capital and frame them in the context of vulnerability. In this study, we examine how social capital may reduce vulnerability in five marine dependent coastal communities in the Western Province of Solomon Islands. Thus, we seek to provide a relatively objective measure for determining the importance of social capital to Solomon Islands communities and its overall effect as a vulnerability deterrent.

2. Methods

2.1. Regional context

Rural Solomon Islanders primarily live a subsistence lifestyle which, for the most part, consists of crop production and fishing activities (Bennett et al., 2014). Marine food account for the majority of animal protein consumed, with the national per capita intake regarded as some of the highest in the world (Bell et al., 2009; Connell, 2014). Consumption in coastal communities is even higher and amounts to a considerable 118.3 kg/person/year (Bell et al., 2009). The majority of crops grown in gardens include a number of tubers such as cassava (*Manihot esculenta*), yams (*Dioscorea alata*), taro (*Colocasia esculenta*), and sweet potatoes (*Ipomoea batatas*), as well as various fruits and vegetables (e.g., slippery cabbage and bananas) (Aswani, 1997). These livelihoods are now increasingly threatened by both climate and non-climate related stressors. Foremost of these threats is sea level rise and its associated wave forces. This threat has already been observed to have a significant impact in areas of Solomon Islands where five islands became submerged in recent years (Albert et al., 2016). Related to this is the salinization of water sources and agricultural areas (Bennett et al., 2014). The trend of an increase in sea level for Solomon Islands is projected to remain at a rate almost triple that of the global average (Albert et al., 2016). Decreasing annual rainfall also threatens the water security of communities who depend on rainwater tanks for day to day use (Hadwen et al., 2015). The effects of these stressors on livelihoods are further compounded by macroeconomic shocks, which cause increases in prices of imported staple products such as rice and fuel.

Similar to other PINs, the Solomon Islands rural communities adhere to systems of tribal governance (Hviding, 1996). Rural areas are particularly prone to retain traditional governance as the presence of a formal government is mostly perfunctory. Tribal districts are governed by either a single chief, or a number of elders (e.g., “big men”), who function as administrators of tribal territory. Authority is gained through one’s filial links within the tribe, with priority given to those who are direct descendants of the tribe’s founding figure. Members may participate in conversations relating to the governance of tribal matters, and possess voting power in a territory. Within the New Georgia tribal districts such rights may be gained through both patrilineal and matrilineal descent (cognatic descent) if an individual’s lineage can be traced within the tribe. Those who enter a tribal district from elsewhere, either through marrying into the group or immigration, may possess fewer rights—such as being allowed to use a resource but not participate in discussions surrounding the management of a resource. Since the arrival of Christian missionaries and the abolishment of head-hunting in the early 19th century, intermarriage has resulted in diverse community assemblages and numerous spoken languages. The result of these intermarriages is that New Georgian communities are well connected, both locally and inter-regionally, through tribal affiliations.

Previous indications of social capital in Solomon Islands is provided by Lauer et al. (2013). These authors noticed an increase in sharing of food and building materials within communities after a tsunami struck Simbo Island in 2012. Similar to the researched communities in this study, Simbo is also situated in the New Georgia Island Group of the Western Province in Solomon Islands. Villagers fleeing the destruction of their homes were allowed to settle on high-lying grounds recently cleared for gardening—an act that would usually have been met with hostility. Equally noteworthy was the decrease in prices from local home stores, while some store owners even distributed goods free of charge. Crops were also harvested freely, while building materials for new shelters could be collected from garden plots without asking permission.

In this study, five coastal communities were sampled in the New Georgia Island Group of the Western Province in Solomon Islands. Communities were selected based on their proximity to the ocean, and differed in terms of number of households, their distance to regional centres and overall community infrastructure. All communities are

situated within lagoons, a common feature of many communities in the Western Province. Two communities, Dundee and Nusa Roviana, are located in the Roviana lagoon, while Nazareth, Michi and Chumbikopi are situated in the Marovo lagoon.

2.2. Survey

Primary data were collected through social surveys administered at the household level. Before conducting surveys, consent was first obtained from the village chief or elders. Upon arrival in the village, a household register was requested from the village organizer. The targeted respondents were selected through a simple random sample and were the heads of the household, unless they were unavailable, in which case a household member with knowledge of the workings of the household was interviewed. If no household members capable of answering survey questions were present, any of the un-surveyed adjacent households were approached until a suitable respondent was found. The number of households in each community ranged from 15 for Michi, 48 in Chumbikopi, 85 in Nazareth, 96 in Nusa Roviana and 118 for Dundee. In Michi, 80% of households were sampled, 42% in Chumbikopi, 35% in Nazareth, 29% in Nusa Roviana and 14% in Dundee for a total of 110 completed surveys. Four translators proficient in English and at least two local languages were employed to perform the survey questionnaires. Before heading to the field, translators were trained to ensure questions were asked in a uniform manner by them agreeing upon the wording they would use in the local language. Questions were then translated from English into the local language in the field, and the respondents’ answers recorded in English. In most cases Pidgin English was the local language used, while Roviana and Marovo languages were used to a lesser extent.

The survey questionnaire was assembled using an integrated framework approach outlined in Aswani et al. (2018). This approach was developed to include the five capital assets of the Sustainable Livelihood Approach (Chambers and Conway, 1991) with the three vulnerability categories (exposure, sensitivity and adaptive capacity) of the IPCC (2001), along with other selected components found throughout literature (resource dependency, flexibility, and attitude and perceptions). The resulting integrated framework was a comprehensive survey comprising 311 questions, with the social capital component the focus of this particular analysis. For a full description of the integrated framework approach developed, and indicators used, refer to Aswani et al. (2018). Social capital forms one of the five capital assets used to determine livelihood strategies employed by households through their access to these assets (Scoones, 1998). Indicators within social capital relate to the social resources upon which households draw to maintain and pursue specific livelihood strategies. To measure social capital, *community cohesion* (Siegel and Alwang, 1999; Cinner et al., 2012), *gender equity* (Cutter et al., 2003), *decision making* (Cinner et al., 2009), *leadership* (Cinner et al., 2009b), and *equal access* (Cutter et al., 2003) were used as proxies, and indicators were developed around these proxies (Table 2).

2.3. Vulnerability scoring

Scoring was done based on the equation used in Hahn et al. (2009) and Ahsan and Warner (2014), which standardizes answers on a scale ranging from zero to one. Of these, zero indicates the lowest possible vulnerability and one the highest possible vulnerability. Rating and multiple-choice questions were standardized for scoring while open ended questions were used for qualitative interpretation of the data (Table 2). This scoring method allows a visual presentation of responses whereby it can be judged on a scale ranging from least to most vulnerable. The equation is shown as:

$$\text{index}_{I_c} = \frac{I_c - I_{\min}}{I_{\max} - I_{\min}}$$

Table 2
Social capital indicator questions asked and the choices offered if closed-ended, otherwise choice is listed as “open”.

Social Capital indicator	Questions asked	Choices	Indicator rationale	Reference
Community cohesion	1.1 When I need help financially or in terms of food or basic needs I ask for assistance from:	Family; Friends; Neighbours; Local organizations; Take loans; Other	More confidence in their ability to call on someone for help indicates better the financial support to face adverse situations.	Siegel and Alwang (1999)
	1.2 If you needed cash today for an emergency – would you be able to get that cash?	Yes/No	Access to cash indicates higher capacity to respond to change.	Siegel and Alwang (1999)
	1.3 How confident are you that you can call on someone (friend or family) if you need help financially?	Very confident; Confident; Slightly confident; Not at all confident	Higher confidence in one’s ability to call on financial help indicates higher capacity to recover from shocks.	Speranza et al. (2014)
	1.4 List any three community organizations that are active in your village/town that come to mind?	Open	More organizations active in the community indicate better capacity of the community to engage in dialogue and find solutions.	Cinner et al. (2009a,b); Cinner et al. (2012)
	1.5 List any community organizations you are an active participant in?	Open	The more community organizations the household participate in the greater the interest in finding solutions to community problems.	Cinner et al. (2012)
Gender equity	2.1 Are any women in leadership roles in this community?	Yes/No	Women in leadership positions shows greater community equity and the diversity of opinions to deal with problems.	Cutter et al. (2003)
	2.2 How equal is women’s access and control over livelihoods and resources compared to men?	Totally equal; Nearly equal; Quite unequal; Not at all equal	Higher levels of equality indicate an equal distribution of power between men and women.	Cutter et al. (2003)
Decision making	3.1 How involved are you in community decision making?	Very involved; Involved; Slightly involved; Not at all involved	More involvement in community decision making indicates greater interest in finding collective solutions.	Cinner et al. (2009a,b)
	3.2 How involved are you in regional decision making?	Very involved; Involved; Slightly involved; Not at all involved	More involvement in regional decision making indicates greater interest in finding regional solutions.	Pelling (1998)
	3.3 How involved are you in marine protected area management?	Very involved; Involved; Slightly involved; Not at all involved	More involvement in the management of primary resources indicates greater potential to look after one’s own long term interest.	Pelling (1998)
Leadership	4.1 How strong is your community leadership?	Very strong; Strong; Somewhat strong; Not strong at all	Stronger leadership in the community indicates greater ability for mobilization and impact of actions.	Pelling (1998)
	4.2 Would you say you trust the management of the community to do the right thing by the community?	Totally trust; Trust a lot; Trust a little; Do not trust at all	More trust in the management personnel of the community indicates greater representation of the community interest.	Pelling (1998)
	4.3 How often can you talk to (have access to) a community leader if you need to?	Always; Often; Sometimes; Never	More access to community leaders indicates greater consideration of member concerns and therefore greater representation of community interest.	Pelling (1998)
Equal access	5.1 Would you say that everyone in this community is vulnerable or are some people more vulnerable than others?	Everyone; Most people; Some people; No-one	Higher levels of equality in community vulnerability indicate the potential for the community to work together to overcome stressors.	O’Brien et al. (2009).
	5.2 How equal is access to resources in your community?	Totally equal; Nearly equal; Quite equal; Quite unequal; Not at all equal	Higher levels of equality in the access to resources within the general community indicate an increased ability for food and income generation.	O’Brien et al. (2009).

where I_c is the observed value from community c , while I_{\min} is the minimum value observed for the adjudged indicator and I_{\max} the maximum value observed for that indicator.

Before scoring, rating questions were first coded according to its overall effect on vulnerability. For example, question 1.3 in Table 2 (how confident are you that you can call on someone if you need help financially?) has rating options of ‘very confident’; ‘confident’; ‘slightly confident’; or ‘not at all confident’. Of these, ‘very confident’ indicates the lowest vulnerability, while ‘not at all confident’ would indicate the highest vulnerability. A respondent answer of ‘very confident’ would therefore be coded as one, making the observed indicator (I_c) one. The highest available choice (I_{\max}) is four (‘not at all confident’), while the theoretical minimum (I_{\min}) answer is one. The score for this example can be determined by the calculation $(1-1)/(4-1) = 0$, and indicates a low level of vulnerability based on these criteria. A balance weighted approach was then used to aggregate all questions relating to a particular indicator into one score (Sullivan, 2002). The balance weighted approach was used to arrive at the aggregated indicator scores and then again to the aggregated social capital score presented in Table 3. Due to the low levels of aggregation and the combination of qualitative analyses for responses the typical critiques of a balance weighted approach was therefore bypassed (Hahn et al., 2009).

For question 1.1, family, friends and neighbours were given the

lowest possible score of 0, while ‘other’ in this case identified as churches, and local organizations were both given a score of 0.5 and loans were given the highest possible score of 1. Although access to credit has been described as a positive contributor to vulnerability (Kelly and Adger, 2000), the possibility of debt traps renders the use of family, friends, neighbours and churches as comparatively safer options. For respondents who call on more than one type of assistance the scores are averaged.

2.4. Data analysis

Prior to the aggregation of the five Solomon Islands communities’ vulnerability scores into one Solomon Islands average, a Chi-squared test was conducted on raw community data to determine whether or not there was an existent statistical difference between the respondent answers of the separate communities. Following this a Principal Component Analysis (PCA) was done to determine the multivariate relationship between indicators from the five components of social capital. Euclidean distances were used amongst indicators, while a covariance matrix was used as the scores were already standardized from 0 to 1. Individual indicator scores of the 13 quantitative variables comprised the data used in the PCA. Finally, we used a one-way ANOVA to compare variation between the five components of social capital,

Table 3

Average Solomon Islands vulnerability score aggregated up to the Social Capital component. A score of 0 indicates the lowest possible vulnerability, while a score of 1 indicates the highest possible vulnerability.

Social Capital indicator	Question asked	Average Solomon Islands question score	Aggregated indicator scores	Aggregated Social Capital score
Community cohesion	1.1 When I need help financially or in terms of food or basic needs I ask for assistance from:	0.016	0.168	0.379
	1.2 If you needed cash today for an emergency – would you be able to get that cash?	0.159		
	1.3 How confident are you that you can call on someone (friend or family) if you need help financially?	0.331		
Gender equity	2.1 Are any women in leadership roles in this community?	0.088	0.267	
	2.2 How equal is women’s access and control over livelihoods and resources compared to men?	0.447		
Decision making	3.1 How involved are you in community decision making?	0.517	0.575	
	3.2 How involved are you in regional decision making?	0.598		
	3.3 How involved are you in marine protected area management?	0.611		
Leadership	4.1 How strong is your community leadership?	0.375	0.439	
	4.2 Would you say you trust the management of the community to do the right thing by the community?	0.464		
	4.3 How often can you talk to (have access to) a community leader if you need to?	0.479		
Equal access	5.1 Would you say that everyone in this community is vulnerable or are some people more vulnerable than others in the community?	0.554	0.443	
	5.2 How equal is access to resources in your community?	0.332		

namely *community cohesion, gender equity, decision making, leadership and equal access to services and resources* (henceforth referred to as equal access). A Tukey’s post-hoc test was then used to find differences between different components of social capital.

3. Results

Of the 110 surveyed household members, 75% were male and 25% female. The age of respondent ranged from 19 to 79, 72% of these falling between the ages of 30 and 60 years old. All respondents had some form of education save for one. The majority (57%) had primary level schooling, while 37% received secondary level schooling. Household size was variable, with Dundee and Michi both under the Solomon Islands mean of 6.1, and the rest being above it. Out of the thirteen quantitative variables assessed, a chi-square test revealed no significant difference between scores of different communities. A PCA was run based on the covariance matrix as the individual indicators were already standardized into a vulnerability score. The scree plot shows the relative high number of principal components (PCs) necessary to account for the variance in data (Fig. 1). The first three PCs account for 60% of variance, while the first six PCs account for 82%, and ten of 13 PCs explain 97% of variance. The PCA therefore shows the relative importance of each individual indicator for determining the specific vulnerability score achieved in this study. Interestingly, the lowest scoring indicators featured more strongly in the higher PCs. Question 1.1 (when I need help financially or in terms of food or basic needs I ask for assistance from ...), 1.3 (how confident are you that you can call on someone [friend or family] if you need help financially?) and 2.1 (are any women in leadership roles in this community?) dominate factor loadings in PC 13, PC 7 and PC 4 respectively. The reason for their strong presence in latter PCs may be explained by the homogenous scores for these three questions across all observations. Both questions 1.2 (if you needed cash today for an emergency – would you be able to get that cash?) and 2.1 are the only ‘yes/no’ questions in the set, while 1.1 answers are mostly restricted to low scoring answers across all observations. Community cohesion achieved the lowest aggregated indicator score, followed by gender equity, leadership, equal access to services and resources, and decision making. Following is a breakdown of responses for each indicator (Table 3).

3.1. Community cohesion

Of the 110 respondents, 100 included the use of family when requiring assistance for food or basic needs, 33 included friends, nine make use of assistance from neighbours and one also asks for help from the church, defined as “other”. When requiring cash to deal with an emergency, 90% of respondents stated that they would be able to access it. Concerning the confidence of respondents to call on someone if they require financial help, 26% of the 110 respondents felt very confident that they can do so, 55% felt confident, while 12% felt slightly confident and 7% not at all confident. Youth, women’s, and men’s groups were mentioned by more than 80 respondents as the three most active community organizations in each village. These were followed by the ‘council of elders’, ‘church groups’ and a ‘fishing group’ which ensures seafood is caught for feasts. Similarly, when asked which group the

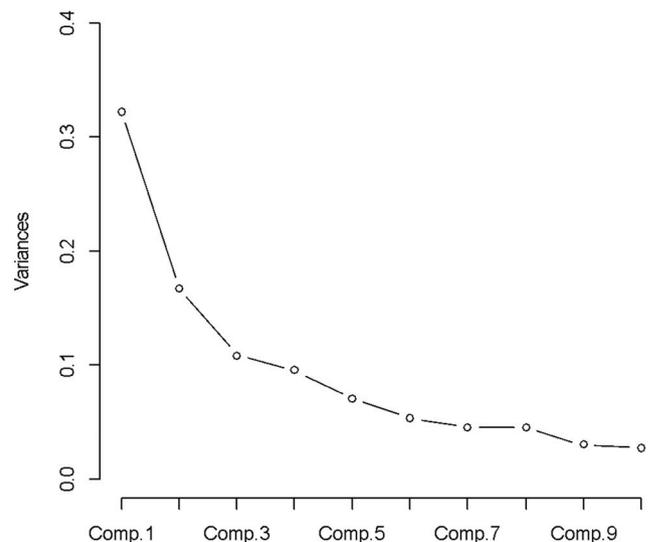


Fig. 1. Scree plot showing relative importance of the first ten Principal Components in explaining variance in data used to achieve indicator vulnerability scores for social capital.

respondent themselves are most active in, the most common responses were that of men's-, women's- and youth-groups respectively.

3.2. Gender equity

According to 90% of respondents, women did hold leadership roles within each community. When asked what positions women held, the most common response was that of 'housewives', followed by 'members of the women's group', 'teachers', and 'church leaders'. Fourteen percent of respondents stated that women's access and control over livelihoods and resources were totally equal compared to that of men, while 41% said they were nearly equal, another 41% said quite unequal, and 5% said they were not at all equal.

3.3. Decision making

When asked how involved they were in community decision making, 16% of respondents replied that they were 'very involved', 34% said 'involved', 26% said 'slightly involved', and 24% said 'not at all involved'. Two percent of respondents said that they are 'very involved' in regional decision making, 42% said they are 'involved', while 28% said they are 'slightly involved' and 28% 'not at all involved'. Regarding marine protected area management 11% of respondents said they are 'very involved', 30% said they are 'involved', 23% said they are 'slightly involved', and 36% said they are 'not at all involved'.

3.4. Leadership

When asked how strong the leadership was within their respective communities, 24% of respondents replied that it was 'very strong', 41% said 'strong', 33% said 'somewhat strong', and 3% said 'not strong at all'. Regarding their trust of the management of the community to do the right thing by the community, 15% of respondents said that they 'totally trust' the management, while 35% said they 'trust a lot', 44% said 'trust a little', and 6% said they 'do not trust at all'. Fifteen percent of respondents said they 'always' have access to community leaders, 32% said they 'often' have access, 43% said they 'sometimes' have access, and 10% said they 'never' have access to community leaders when they need to.

3.5. Equal access

From all respondents, 6% stated that everyone in the community is equally vulnerable, 22% that 'most people' are equally vulnerable, 72% said some people are more vulnerable than others, and 0% respondents said 'no-one' is equally vulnerable. Regarding the equal access of community resources, 26% of respondents said that resource access is 'totally equal', 51% said they are 'nearly equal', 20% said they are 'quite unequal' and 3% said access to resources are 'not at all equal'.

3.6. Summary

Community cohesion achieved the lowest vulnerability score, followed by gender equity (Table 3). Decision making scored the highest vulnerability score of the social capital indicators, followed by equity and leadership. A one-way ANOVA found significant differences to exist between the different indicators of social capital ($<2e^{-16}$). Tukey's post-hoc test on the results of the one-way ANOVA suggests that all social capital components other than equity and leadership differ significantly.

4. Discussion

The study's findings indicate the importance of including aspects of community cohesion, gender equity, leadership, decision making, and equal access to services and resources as attributes of social capital and their combined effect on vulnerability in Western Solomon Islands.

Others, such as Kozel and Parker (1998) have previously shown that social capital in rural communities of India can function as a support system. In this context, this study is novel in that it collectively frames these attributes in the context of vulnerability and uses a set of aggregated scores as proxies for understanding the role of social capital in ameliorating vulnerability effects on rural coastal communities.

The sharing of resources and services shown previously within Solomon Islands communities (Lauer et al., 2013) is supported in our study through the community cohesion indicator. Most respondents received help from within the confines of the community, namely that help was asked from family, friends and neighbours. When asked if he owes any money to anyone in the community, one respondent replied that he was given money without the expectancy to pay it back, which is the "Solomon way". Instead the recipient can be asked for a return favour in the future when his situation has improved, particularly among kin. This favour may be either in the form of money, food or labour. All these indicators point towards a society in which a sharing culture is promoted, where, when faced with fellow members in need, collective action is favoured over private wealth. The cohesion of these communities goes further than just the ability to receive help from others when in need, but also the *belief* that help is there when needed. Given the lack of government safety nets in these communities, the reassurance of knowing that help from kin and fellow community members is available when called upon will inevitably serve to strengthen the social bonds between members.

The gender roles within these villages function mostly according to the defined roles dictated by tradition and church. For women, the cultural importance of the most commonly listed vocation, namely that of a housewife, can however not be understated. Firstly, and similar to men, almost all women are fishers in their own rights, who participate in line fishing and gleaning of clams, crabs and other shellfish during low tides. Secondly, it is mostly the housewives who tend the garden crops—something they take great pride in and which provides an important food alternative from marine resources. The importance that women prescribe to their roles within the community is highlighted by Dureau (1993) who notes motherhood as a role which they were born to do.

Similar to the defined roles of women are those of men. Most men engage in fishing and spend many hours on this activity daily, while they may also be responsible for the more physically intensive tasks such as clearing forested areas when new gardens are planned and felling trees for building materials. It is outside of these defined gender roles that conflict emerges. Untraditional vocations, such as teaching, impose global expectations of gender equality on communities where gender roles are traditionally clearly defined. Within the capital city of Honiara, Akao (2008) found that women working as teachers alongside men were subjected to discriminatory attitudes because of cultural patriarchal norms. The defined gender roles extend to leadership positions of men and women. Within the surveyed communities, both men and women are seen to possess leadership roles. Women's leadership roles occur mostly in the church, and community-based women's groups, while certain communities also have women as village elders. Consideration of this finding should however include the fact that 75% of respondents were men. In general, men however exhibit the same functional roles as women: men also possess leadership roles within the church, the men's' groups and as elders, but are exclusively considered for the position of village chief while women are currently not, although ethnohistorical evidence suggests that women may have been chiefs in the distant past (Aswani, 2000). Where local government is absent, a strong and fair leadership group is required to represent the interest of constituents in communities. Governance of these rural communities remain the provenance of tribal leaders (Hviding, 1996), and although intermarriage has resulted in diverse community assemblages, the leaders are still elected based on their heritage within a community. Leaders are therefore tied to the community (or various communities) through generational links which are likely to explain the high levels of leadership, and trust in leadership, shown in this study.

A possible side effect of the tribal governance system is its effect on individual decision making. Instead of actively participating in local, regional and protected area related decisions, community members may choose to rather rely on their leaders to represent their interest. Another possible explanation is that the appropriate channels do not exist for ordinary members to participate in decisions, especially those who have entered a community from elsewhere and therefore do not possess entitlements to local territories- and therefore voting rights. Either by choice or forced, the effect of individuals not participating in these decision making processes indicates that they are less likely to have their own personal interests represented and therefore rely on other agents- either affinal kin or community leaders, governments or NGO groups, to do so. Although it might presently not be a problem, increased pressure as a result of diminishing resources or future macroeconomic shocks will inevitably affect community members. Should their relationships with any of their representatives break down, the current lack of participation and also the lack of participation mechanisms within communities could potentially render them more vulnerable to changes.

Access to resources is understandably equal (albeit asymmetries exist in base of one's tenurial rights to land and sea estates) considering the high level of resource dependency in these communities and a lack of available alternative sources of food and income. Traditionally, even outsiders have been able to utilise resources in their adopted communities if sanctioned by local leaders. Altogether, this apparent 'equal' access provides a high level of social capital and serves to reduce vulnerability. The perception that not everyone in the community is equally vulnerable suggests that there are however some restrictions which prohibit members from partaking in the benefits from these resources. Although all members are allowed to access resources, they may not all be capable of actually accessing them. This may include the elderly or those who do not possess the necessary skills or means required to utilise a particular resource. For example, all community members are allowed to fish, but their access to outboard engines determines which fishing grounds they are able to get to. Although such restrictions may not currently have a substantive impact while marine resources are still readily available, they may become more pronounced when resources become diminished or affected by detrimental events such as harmful algal blooms. This would make the difference in levels of vulnerability between community members more apparent and bring to the fore the underlying tenurial asymmetries between those who are kin and those who are affine, unless it is corrected by other factors, such as sharing of skills or means once the vulnerabilities become realised.

Along with the positive effects on vulnerability listed above, high levels of social capital can also have negative effects on the vulnerability of communities. Communities with high levels of social capital are likely to display an attachment to place and occupation and as a result members may be more vulnerable because they are unwilling to depart from their current way of life and the associated ties they hold with an area, the people, and their own role therein (Marshall et al., 2007). Social capital can therefore be seen as a double-edged sword, since community networks provide an advantage but also restrict members from opportunities elsewhere (Woolcock, 1999). In the Solomon Islands context, such opportunities may include economic opportunities, but also the availability of natural resources, healthcare, better education and assisted labour. If, for example, an elderly parent is unwilling to leave their community and move in with their offspring, but instead force their offspring to relocate into such a community, it may result in the overall wellbeing of the household declining due to the relocation of the primary household contributors into an unfamiliar environment.

Ultimately, however, it can be argued that the net effect of social capital on vulnerability within these communities can be regarded positive since they are continually sustained. As these communities have developed such strong attributes of social capital, it would indicate that, historically, social capital provides a higher contribution to community wellbeing than the pull factors which may have caused community

members to move elsewhere. With the age of globalization improving the opportunity for economic gain in urban areas, it remains to be seen whether attributes related to social capital can continue to bind these communities together, as there is increasing evidence of social discord in communities closer to market centres.

Threats to the high levels of social capital observed in these communities may therefore include globalization processes. Within Solomon Islands, a trend has emerged whereby imported foodstuffs such as rice and canned tuna is viewed as a status symbol, while households are becoming increasingly dependent on fuel for fishing, rather than using their traditional canoe dugouts. This introduces a need for cash in communities which have traditionally had very low monthly income generating capacity (Bennett et al., 2014). As a result, households are shifting their focus away from traditional livelihood practises, such as fishing and gardening, towards income generated through labour in capital extraction industries such as logging, mining and factory work (Aswani, 1997). As many technologies (such as cable television and smart phones with secure internet connections) have recently been introduced in rural communities, it is possible that western status trends may further accelerate tendencies to abandon local traditions in favour of ways of living viewed through these media.

This study also highlights the importance of using criteria relevant to the communities in question when considering vulnerability. Some communities are ill suited for certain interventions to be effective. Using an airport in a rural town of 500 or bank services to people who trade in foodstuffs rather than money as proxies for vulnerability is unrealistic and inevitably over pronounces it in such areas. Consideration therefore needs to be given to appropriate measures to determine vulnerability in less developed countries as opposed to the measures used in more developed countries. By their mere existence, rural communities are bound to display mechanisms with positive effects on vulnerability which have been developing inherently over time and have been used to overcome the challenges faced by these communities. Vulnerability is context specific and should be measured using the localised characteristics of a community so that it may recognize the strengths and weaknesses from that specific community, rather than pre-impose vulnerability factors from other regions for the sake of standardisation.

Although this paper does not present the findings of a complete vulnerability assessment, it does report on the findings related to social capital, which in the case of Solomon Islands communities can be considered as a significant driver for the reduction of vulnerability. It therefore provides a case study of how the context specific attributes of socio-economic systems should be considered when conducting vulnerability assessments. The complex nature of such systems may make these assessments a difficult task, particularly when deciding on the appropriate frameworks and methodology required to capture and interpret the relevant contributors. However, by first identifying the context of the system under study and acknowledging the potential for possible drivers which may influence vulnerability, appropriate methodology can be selected.

In the case of the present study, the participation of a researcher with 13 years of experience in the Solomon Islands region ensured that this was achieved. Additionally, the application of the survey in countries with various developmental states, (India, Brazil, South Africa, Madagascar, and Solomon Islands) required a broad spread of vulnerability indicators to be included and resulted in a comprehensive coverage of these indicators which may typically not be suitable for inclusion in any one such study site. In doing so, the potential for revealing any silent or unrecognised drivers of vulnerability was provisioned for. The sole focus of the present paper being on one such indicator of vulnerability, namely social capital at the local scale, allows us to bypass the common critique of IPCC-based assessments being broad in its application to scale and sector, with poorly defined concepts. Where the IPCC approach provided the broad framework for the determination of vulnerability, the inclusion of the socio-centric SLA was needed to adequately identify nuanced components which greatly impacted

vulnerability, but would generally not have been detected by other means.

Logically, inherent mechanisms like those identified in this study, are proportionately of higher importance to these distinct communities than mechanisms and adaptation options identified from elsewhere. Mechanisms such as these are culturally embedded in communities and represent centuries of development through dealings, and overcoming, past challenges. Before exploring external, often more expensive, options for directives such as climate change adaptation options, the identification of these localised vulnerability deterrents should be a priority and a means for their preservation established (Adger, 1999). Once these inherent mechanisms used for deterring vulnerability have been identified and preserved, external practical adaptation options may be developed specific to the needs of the community, and without more disturbance to traditional practise that are necessary (Smit and Wandel, 2006).

5. Conclusion

Solomon Islands communities contain a reservoir of social capital which they rely on to cope with, and eventually adapt to, the changes they face. This conclusion is unsurprising as communities within this region have historically faced numerous stressors ranging from tribal warfare to a multitude of environmental effects such as tsunamis and harmful algal blooms. Throughout these pressures being exerted on them, or maybe because of it, communities have developed into social networks which promote action in favour of the collective, as opposed to that of the individual (albeit the actor will often counter the collective objectives of ‘communities’). This study shows how such collective action may serve to strengthen communities which are increasingly faced by external threats. Exposure to other cultures and open media may undermine values cultivated to promote community cohesiveness, gender equity and other attributes of social capital. Shifting from traditional livelihoods to cash economies drives community members to large cities for work and away from communities where these values are maintained, while untraditional vocations without the defined roles of cultural norms may lead to gender discrimination.

The maintenance of social capital should therefore be a priority for policy makers tasked with addressing vulnerability in these rural

communities. By promoting cultural traditions over western trends, with the aim of maintaining the cultural identity of communities, it may be possible to preserve social capital. Policies such as introducing cultural studies in schools and universities and re-introducing a green economy-whereby goods and services are traded directly, has the power to reduce the negative effects of predatory capitalism so pervasive in today’s ‘globalization’. Not only will these policies strengthen the cultural diversity of developing nations such as Solomon Islands, but it also offers an economical alternative to authorities who seek to improve the state of vulnerability in rural communities relative to options such as infrastructure development or the relocation of villages.

In sum, the importance of social capital as an attribute of vulnerability has long been overlooked in favour of other attributes which are more suited to developed countries and therefore emphasises vulnerability attributes such as credit, education, infrastructure, government and other institutions. Such vulnerability indicators may be easier to survey and quantify than those of social capital but fail to address the importance of human relations upon which rural communities are often built. It is conceivable that where communities continue to sustain themselves under high levels of exposure to environmental and other stressors, while having little access to the support systems found in developed countries, other means of support should be present. For an accurate impression of vulnerability to be garnered for communities on both sides of the development spectrum, it should be established based on the local context of the system under study.

Declaration of competing interest

None.

Acknowledgements

The financial assistance of the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF. I would also like to acknowledge Rhodes University’s Sandisa Imbewu Fund for contributing to the running cost of the study.

Annex A.

1.1	1.2	1.3	1.4	1.5	2.1	2.2	3.1	3.2	3.3	4.1	4.2	4.3	5.1	5.2						
1	1	1	Womens group	Mens group	Youth group	Mens group	-	1	Womens group president	Sunday school leaders	Most housewives	3	3	3	1	1	3	3	2	
1	1	1	-	-	Elder committee	Sunday School	-	2	-	-	-	4	4	4	2	2	1	3	1	
1,2,4,6	1	1	Womens group	Mens group	Youth group	Mens group	Sunday School	-	1	Womens group president	-	Most housewives	1	2	3	2	1	2	2	1
1,2	1	1	Womens group	Mens group	Youth group	Mens group	School board	-	1	Womens group president	Teachers	Most housewives	2	3	1	3	2	2	1	3
1	1	1	-	Mens group	-	Mens group	-	-	1	Treasurer of community group	-	-	3	2	2	1	3	3	1	2
1	1	2	Womens group	Mens group	Youth group	Mens group	School board	1	-	Sunday school teacher	Teachers	-	3	1	2	3	2	2	2	3
2	1	2	-	Mens group	Youth group	-	-	1	Community elders	-	-	1	3	2	2	3	4	3	2	4
1	1	2	Womens group	Mens group	Youth group	Elder committee	Mens group	-	1	-	Teachers	-	3	2	2	2	2	2	3	2
1	1	2	Womens group	Mens group	Youth group	-	Mens group	-	1	Treasurer of community group	-	-	2	2	2	1	2	1	1	3
1,2,4	1	1	Womens group	Mens group	Youth group	womens group	-	1	-	-	Most housewives	-	3	1	4	1	1	3	3	3
1,2	1	1	Womens group	Mens group	Youth group	Mens group	Centenary board	Tribal trust board	1	Womens group president	-	Most housewives	2	1	4	1	1	1	1	3
1	1	2	Womens group	Mens group	Youth group	womens group	Sunday School	-	2	-	-	-	3	4	4	3	3	3	3	1
1	2	4	Womens group	Mens group	Youth group	Mens group	-	-	1	Womens group president	-	-	3	4	4	2	2	3	4	3
1	1	2	Womens group	Mens group	Youth group	womens group	Sunday School	-	1	-	Teachers	-	3	2	3	1	3	3	4	3
2	2	4	Fishers for feasts	-	-	Fishing group	-	-	1	-	-	Most housewives	1	3	2	4	3	3	4	2
1	1	1	Womens group	Mens group	Youth group	Elder committee	Mens group	school board	1	-	-	Most housewives	3	2	3	2	1	3	3	3
1	1	2	Womens group	Mens group	Youth group	Mens group	village organisers	-	1	Womens group president	-	-	1	1	2	1	1	1	1	1
1	1	2	-	-	-	Soccer team	-	-	1	-	Teachers	-	2	2	3	2	4	3	1	2
1,2	1	3	Village organizers	Mens group	Youth group	-	Sunday School	-	1	Womens group president	-	Most housewives	3	3	4	3	3	3	3	2
1	1	4	Womens group	-	Youth group	Mens group	-	-	1	-	-	Most housewives	3	4	4	3	4	3	3	2
1	1	1	Fishers for feasts	-	-	Mens group	-	-	1	-	-	Most housewives	2	1	4	4	4	4	3	3
1	1	3	Womens group	Mens group	Youth group	womens group	-	-	1	Womens group president	-	Most housewives	3	3	3	2	2	3	4	3

A sample of the first 22 rows of coded data used to calculate vulnerability scores.

References

Adger, N.W., 1999. Social vulnerability to climate change and extremes in coastal Vietnam. *World Dev.* 27 (2), 249–269. [https://doi.org/10.1016/S0305-750X\(98\)00136-3](https://doi.org/10.1016/S0305-750X(98)00136-3).

Adger, W.N., Vincent, K., 2005. Uncertainty in adaptive capacity. *Compt. Rendus Geosci.* 337 (4), 399–410. <https://doi.org/10.1016/j.crte.2004.11.004>.
 Ahammad, R., 2011. Constraints of pro-poor climate change adaptation in Chittagong city. *Environ. Urbanization* 23 (2), 503–515. <https://doi.org/10.1177/0956247811414633>.

- Ahsan, M.N., Warner, J., 2014. The socioeconomic vulnerability index: a pragmatic approach for assessing climate change led risks—A case study in the south-western coastal Bangladesh. *Int. J. Disaster Risk Reduct.* 8, 32–49.
- Akao, S.M., 2008. *Seen but Not Heard: Women's Experiences of Educational Leadership in Solomon Islands Secondary Schools* (Doctoral Dissertation. The University of Waikato).
- Albert, S., Leon, J.X., Grinham, A.R., Church, J.A., Gibbes, B.R., Woodroffe, C.D., 2016. Interactions between sea-level rise and wave exposure on reef island dynamics in the Solomon Islands. *Environ. Res. Lett.* 11 (5), 054011.
- Allison, E.H., Horemans, B., 2006. Putting the principles of the Sustainable Livelihoods Approach into fisheries development policy and practice. *Mar. Pol.* 30 (6), 757–766.
- Allison, E.H., Perry, A.L., Badjeck, M.-C., Adger, N.W., Brown, K., Conway, D., et al., 2009. Vulnerability of national economies to the impacts of climate change on fisheries. *Fish. Fish.* 10 (2), 173–196. <https://doi.org/10.1111/j.1467-2979.2008.00310.x>.
- Aswani, S., 1997. Customary Sea Tenure and Artisanal Fishing in the Roviana and Vonavona Lagoons, Solomon Islands: The Evolutionary Ecology of Marine Resource Utilization. Doctoral dissertation, University of Hawaii at Manoa).
- Aswani, S., 2000. Changing identities: the ethnohistory of Roviana predatory headhunting. *J. Polyn. Soc.* 109 (1), 39–70. Polynesian Society, Auckland.
- Aswani, S., Howard, J.A.E., Gasalla, M.A., Jennings, S., Malherbe, W., Martins, I.M., Salim, S.S., Van Putten, I.E., Swathilekshmi, P.S., Narayanakumar, R., Watmough, G. R., 2018. An integrated framework for assessing coastal community vulnerability across cultures, oceans and scales. *Clim. Dev.* <https://doi.org/10.1080/17565529.2018.1442795>.
- Bell, J.D., Kronen, M., Vunisea, A., Nash, W.J., Keeble, G., Demmke, A., et al., 2009. Planning the use of fish for food security in the Pacific. *Mar. Pol.* 33 (1), 64–76. <https://doi.org/10.1016/j.marpol.2008.04.002>.
- Bennett, G., Cohen, P., Schwarz, A.M., Albert, J., Lawless, S., Paul, C., Hilly, Z., 2014. Solomon Islands: Western Province Situation Analysis. CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2014-1.
- Bennett, N.J., Dearden, P., Peredo, A.M., 2014. Vulnerability to Multiple Stressors in Coastal Communities: a Study of the Andaman Coast of Thailand. *Climate and Development*, pp. 1–18. <https://doi.org/10.1080/17565529.2014.886993>. February 2015.
- Boruff, B.J., Cutter, S.L., 2007. The environmental vulnerability of Caribbean island nations. *Geogr. Rev.* 97 (1), 24–45.
- Bourdieu, P., 1979. La distinction: critique sociale du jugement. *Minuit*.
- Bourdieu, P., 1986. The forms of capital. *Cult. Theor.: Anthol.* 1, 81–93.
- Campbell, J., 2009. Islandness: vulnerability and resilience in oceania. *Shima: Int. J. Res. I. Cult.* 3, 85–97.
- Chambers, R., Conway, G.R., 1991. Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. IDS Discussion Paper, vol. 296. Institute of Development Studies, University of Sussex, Brighton, ISBN 0 903715 58 9, 29.
- Cinner, J.E., Fuentes, M.M.P.B., Randriamahazo, H., 2009a. Exploring social resilience in Madagascar's marine protected areas. *Ecol. Soc.* 14 (1).
- Cinner, J.E., McClanahan, T.R., Daw, T.M., Graham, N.A.J., Maina, J., Wilson, S.K., Hughes, T.P., 2009b. Linking social and ecological systems to sustain coral reef fisheries. *Curr. Biol.* 19 (3), 206–212. <https://doi.org/10.1016/j.cub.2008.11.055>.
- Cinner, J.E., McClanahan, T.R., Graham, N.A.J., Daw, T.M., Maina, J., Stead, S.M., et al., 2012. Vulnerability of coastal communities to key impacts of climate change on coral reef fisheries. *Global Environ. Change* 22 (1), 12–20. <https://doi.org/10.1016/j.gloenvcha.2011.09.018>.
- Cinner, J.E., McClanahan, T., Wamukota, A., Darling, E., Humphries, A., Hicks, C., et al., 2013a. Social-ecological Vulnerability of Coral Reef Fisheries to Climatic Shocks. *FAO Fisheries and Aquaculture Circular*, vol. 1082. FAO, Rome, p. 63.
- Cinner, J.E., Huchery, C., Darling, E.S., Humphries, A.T., Graham, N. A. J., Hicks, C.C., et al., 2013b. Evaluating social and ecological vulnerability of coral reef fisheries to climate change. *PLoS One* 8 (9), e74321. <https://doi.org/10.1371/journal.pone.0074321>.
- Colding, J., Folke, C., Elmqvist, T., 2003. Social institutions in ecosystem management and biodiversity conservation. *Trop. Ecol.* 44 (1), 25–41.
- Coleman, J.S., 1988. Social capital in the creation of human capital. *Am. J. Sociol.* 94, S95–S120.
- Connell, J., 2014. Food security in the island Pacific: is Micronesia as far away as ever? *Reg. Environ. Change* 15 (7), 1299–1311. <https://doi.org/10.1007/s10113-014-0696-7>.
- Cutter, S.L., Boruff, B.J., Shirley, W.L., 2003. Social vulnerability to environmental hazards. *Soc. Sci. Q.* 84 (2).
- De Lange, H.J., Sala, S., Vighi, M., Faber, J.H., 2010. Ecological vulnerability in risk assessment—a review and perspectives. *Sci. Total Environ.* 408 (18), 3871–3879.
- de Souza Briggs, X., 1998. Brown kids in white suburbs: housing mobility and the many faces of social capital. *Hous. Pol. Debate* 9 (1), 177–221.
- Dureau, C., 1993. Nobody asked the mother: women and maternity on Simbo, western Solomon Islands. *Oceania* 64 (1), 18–35.
- Füssel, H.-M., 2007. Vulnerability: a generally applicable conceptual framework for climate change research. *Global Environ. Change* 17 (2), 155–167.
- Hadwen, W.L., Powell, B., MacDonald, M.C., Elliott, M., Chan, T., Gernjak, W., Aalbersberg, W.G., 2015. Putting WASH in the water cycle: climate change, water resources and the future of water, sanitation and hygiene challenges in Pacific Island Countries. *J. Water, Sanit. Hyg. Dev.* 5 (2), 183–191.
- Hahn, M.B., Riederer, A.M., Foster, S.O., 2009. The Livelihood Vulnerability Index: a pragmatic approach to assessing risks from climate variability and change—a case study in Mozambique. *Global Environ. Change* 19 (1), 74–88. <https://doi.org/10.1016/j.gloenvcha.2008.11.002>.
- Hinkel, J., 2011. “Indicators of vulnerability and adaptive capacity”: towards a clarification of the science-policy interface. *Global Environ. Change* 21, 198–208. <https://doi.org/10.1016/j.gloenvcha.2010.08.002>.
- Holzmann, R., Jorgensen, S., 1999. Social protection as social risk management: conceptual underpinnings for the social protection sector strategy paper. *J. Int. Dev.* 11 (7), 1005–1027.
- Hviding, E., 1996. Nature, Culture, Magic, Science. *Nature and Society. Anthropological perspectives*, pp. 165–184.
- IPCC, 2001. In: J.T. Ding, Y., Griggs, D.J., Noguer, M., van der Linden, P.J., Dai, X., Maskell, K., Johnson, C.A. (Eds.), *Climate Change 2001: the Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, p. 881pp.
- Kelly, P.M., Adger, W.N., 2000. Theory and practise in assessing vulnerability to climate change and facilitating adaptation. *Clim. Change* 47, 325–352.
- Kelman, I., Mather, T.A., 2008. Living with volcanoes: the sustainable livelihoods approach for volcano-related opportunities. *J. Volcanol. Geoth. Res.* 172 (3), 189–198.
- Kozel, V., Parker, B., 1998. Poverty in Rural India: the Contribution of Qualitative Research in Poverty Analysis. World Bank, Poverty Reduction and Economic Management Sector Unit, Washington, DC.
- Lauer, M., Albert, S., Aswani, S., Halpern, B.S., Campanella, L., La Rose, D., 2013. Globalization, Pacific islands, and the paradox of resilience. *Global Environ. Change* 23 (1), 40–50. <https://doi.org/10.1016/j.gloenvcha.2012.10.011>.
- Marshall, N.A., Fenton, D.M., Marshall, P.A., Sutton, S.G., 2007. How resource dependency can influence social resilience within a primary resource industry. *Rural Sociol.* 72 (3), 359–390.
- Marshall, N.A., Marshall, P.A., Tamelander, J., Obura, D.O., Mallaret-King, D., Cinner, J., 2010. A Framework for Social Adaptation to Climate Change: Sustaining Tropical Coastal Communities and Industries. IUCN, Gland, Switzerland, p. 36.
- McDowell, J.Z., Hess, J.J., 2012. Accessing adaptation: multiple stressors on livelihoods in the Bolivian highlands under a changing climate. *Global Environ. Change* 22 (2), 342–352.
- Morzaria-Luna, H.N., Turk-Boyer, P., Moreno-Baez, M., 2014. Social indicators of vulnerability for fishing communities in the Northern Gulf of California, Mexico: implications for climate change. *Mar. Pol.* 45, 182–193. <https://doi.org/10.1016/j.marpol.2013.10.013>.
- Mumby, P.J., Chollett, I., Bozec, Y.-M., Wolff, N.H., 2014. Ecological resilience, robustness and vulnerability: how do these concepts benefit ecosystem management? *Curr. Opin. Environ. Sustain.* 7, 22–27.
- O'Brien, K., Quinlan, T., Ziervogel, G., 2009. Vulnerability interventions in the context of multiple stressors: lessons from the Southern Africa Vulnerability Initiative (SAVI). *Environ. Sci. Pol.* 12 (1), 23–32.
- Pelling, M., 1998. Participation, social capital and vulnerability to urban flooding in Guyana. *J. Int. Dev.: J. Dev. Stud. Agric.* 10 (4), 469–486.
- Pelling, M., Uitto, J.I., 2001. Small island developing states: natural disaster vulnerability and global change. *Global Environ. Change B Environ. Hazards* 3 (2), 49–62.
- Preston, B.L., 2012. Climate change vulnerability assessment: from conceptual frameworks to practical heuristics. CSIRO climate adaptation flagship working paper No. 16. <http://www.csiro.au/en/Organisation-Structure/Flagships/Climate-Adaptation-Flagship/CAFworking-papers.aspx>.
- Putnam, R.D., 1995. Bowling alone: America's declining social capital. *J. Democr.* 6 (1), 65–78.
- Schwarz, A.M., Béné, C., Bennett, G., Boso, D., Hilly, Z., Paul, A., Posala, R., Sibiti, S., Andrew, N.L., 2011. Vulnerability and resilience of remote rural communities to shocks and global changes: empirical analysis from the Solomon Islands. *Global Environ. Change* 21, 1128–1140.
- Scoones, I., 1998. Sustainable rural livelihoods a framework for analysis. *Analysis* 72, 1–22. <https://doi.org/10.1057/palgrave.development.1110037>.
- Siegel, P.B., Alwang, J., 1999. An Asset-Based Approach to Social Risk Management: A Conceptual Framework. World Bank, Social Protection Unit, Washington, DC.
- Smit, B., Wandel, J., 2006. Adaptation, adaptive capacity and vulnerability. *Global Environ. Change* 16 (3), 282–292.
- Speranza, C.I., Wiesmann, U., Rist, S., 2014. An indicator framework for assessing livelihood resilience in the context of social-ecological dynamics. *Global Environ. Change* 28, 109–119.
- Sullivan, C., 2002. Calculating a water poverty index. *World Dev.* 30 (7), 1195–1210.
- Turner, B.L., Kasperson, R.E., Matson, P.A., McCarthy, J.J., Corell, R.W., Christensen, L., et al., 2003. A framework for vulnerability analysis in sustainability science. *Proc. Natl. Acad. Sci. U.S.A.* 100 (14), 8074–8079.
- Williams, S.E., Shoo, L.P., Isaac, J.L., Hoffmann, A., Langham, G., 2008. Towards an integrated framework for assessing the vulnerability of species to climate change. *PLoS Biol.* 6 (12), 2621–2626.
- Woolcock, M., 1999. Managing Risk, Shocks, and Opportunity in Developing Economies: the Role of Social Capital. Development Research Group, The World Bank. *unpublished paper*, 1(05), 01.
- Woolcock, M., Narayan, D., 2000. Social capital: implications for development theory, research, and policy. *World Bank Res. Obs.* 15 (2), 225–249.