The adaptive capacity of Pileni Island community, Viakau Ward, Temotu Province, Solomon Islands

This case study report captures the experiences of Solomon Islands Red Cross and the Pileni community in considering climate change and is a contribution to the PASAP regional overview on climate change.

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Executive summary

This case study will contribute to a Pacific regional overview publication on climate change which aims to assist the region better understand vulnerability to climate change and develop adaptation plans. Solomon Islands Red Cross began working on climate change in 2007 and recognised that it would be necessary to consider climate change in its participatory methodology used with communities. This method is called a 'vulnerability and capacity assessment' and was used alongside a newly created 'Pacific community level adaptive capacity analysis framework' to analyse the ability of a community on Pileni Island to adapt to climate change. The island community is in a remote north-easterly section of Temotu province in the Solomon Islands.

Results from this study show that in many ways, the Pileni community is incredibly resilient and self-sufficient, having a strong sense of identity and traditional practices that are still widely used. While inviting new ways of doing things, new ways are not often implemented due to a lack of technical skills and resources. The community has a low cash income and limited access to government services such as medical assistance. The community is concerned about levels of erosion and inundation from storm surges and high tides, there is also declining water quality from wells on the island. Traditional methods of weather prediction are declining. In conclusion, the main factors that hinder the community's adaptive capacity include geographical isolation and the smallness of the island environment they inhabit. The declining health of the island's environment, both on and off land is hindering the community's ability to provide for itself on the island.

Relocation is often seen as the only long-term solution, but islanders are hesitant to consider this option in the short term. Once relocation is identified as the only solution, the necessary steps to help community's adapt to their new environment and to enable a peaceful transition may require considerable investment. The islands in the Pacific carry an increasing burden from the negative impacts of climate change and there is a greater need to invest in climate change adaptation in a holistic manner.

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List of acronyms

AusAID	Australian Government Overseas Aid Program
COP	Conference of the Parties to the Kyoto Protocol
DRR	disaster risk reduction
EKI	external key informant
IFRC	International Federation of Red Cross and Red Crescent Societies
IPCC	Intergovernmental Panel on Climate Change
Met Office	Solomon Islands Meteorological Office, Temotu office
MoU	memorandum of understanding
NAPA	National Adaptation Program of Action
PASAP	Pacific Adaptation Strategy Assistance Programme
PDMO	Provincial Disaster Management Office
SBD	Solomon Island Dollar
SIRC	Solomon Islands Red Cross
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
USP	University of the South Pacific
VCA	vulnerability and capacity assessment

1. Introduction

The Australian Government's International Climate Change Adaptation Initiative is assisting vulnerable developing countries adapt to the impacts of climate change that cannot be avoided. Under the initiative, the Pacific Adaptation Strategy Assistance Program (PASAP) is helping countries in the region better understand their vulnerability to climate change and to develop adaptation plans. The PASAP regional overview will describe regional trends and variability in climate change impacts, vulnerability and adaptive capacity, and identify common needs. It will synthesise existing knowledge about adaptation in the region, identify lessons learned, relevant good practice and significant knowledge/research gaps.

One component of the regional overview aims to improve understanding of the capacity of communities in Pacific Island countries to adapt to the impacts of climate change (adaptive capacity). The aim of this component of the regional overview is to consolidate and extend existing knowledge about adaptive capacity in the region, focusing on both the drivers of and barriers to adaptive capacity. This report by Red Cross will contribute knowledge to this. Other case studies and a collated report are also being contributed by the Secretariat of the Pacific Community (SPC) and the University of the South Pacific (USP).

2. Background

2.1 Solomon Islands Red Cross

In 2006, the Solomon Islands Red Cross (SIRC) recognised the need to consider the threat of climate change in their programs and during 2007–2009 undertook the 'Preparedness for Climate Change Programme'. The program involves capacity-building (now implemented in 64 Red Cross/Red Crescent national societies globally) that links national societies to climate-change related stakeholders in country, improves understanding of the issues through a national workshop for staff and volunteers. This results in a background document on the humanitarian implications of climate change (SIRC, 2008) and an action plan for integration into programs.

Within the action plan, SIRC recognised that it would be necessary to consider climate change within its participatory methodology used with communities. The vulnerability and capacity assessment (VCA) is used widely in the Red Cross/Red Crescent movement globally to involve communities in addressing their vulnerability to natural disasters and other problems. The Solomon Islands Red Cross has been implementing a pilot project called 'Community-identified Climate Adaptation in Temotu'**.** As a contributor to the National Adaptation Programme of Action (NAPA) in the Solomon Islands, the SIRC has aimed for the project to contribute to the country's adaptation efforts, which are in their infancy, as well as result in lessons for the region and further afield in the Red Cross/Red Crescent.

2.2 Temotu Province

The climate of the Temotu Province is tropical, with average daytime temperatures around 29 degrees Celsius and high humidity. Evenings may be as cool as 20 degrees when cool ocean breezes blow throughout the day. There are no defined seasons but November to May are the wetter months, locally known as *Koburu* (west to north-west winds) and cyclones may occur during this time. The term *Ara* is used to describe the east to south-east winds which typically blow from June to October each year.

Temotu Province consists of 17 wards which are exposed to a large number of geophysical and hydro-meteorological (weather-related) hazards. There is an active volcano called Tinakula near the provincial capital Lata which is used as a geo-referencing point for boat journeys at sea. The 'reef outlier' islands are the worst affected by storm surges and sea-level rise and the Provincial Disaster Management Office (PDMO) has listed the area as vulnerable to tsunamis. Tikopia Island nearer Vanuatu is the most susceptible to cyclones in the province. The population of Temotu Province was 21 362 in the 2009 census (Solomon Islands Government, 2010).

2.3 Selection of Pileni Island site

In the site selection for their pilot project on Community-identified Climate Adaptation, SIRC worked closely with the NDMO and together they chose the Temotu Province as it receives the least attention of the provinces in the Solomon Islands due to its geographical isolation. The Pileni community was chosen for its particular geographical vulnerability (isolation) as well as disaster response needs in recent years related to storm surges and hightide events. Their overall vulnerability was the primary reason for its selection. Matters relating to climate change are evident but used were a secondary reason for selecting Pileni.

2.4 Pileni Island

Pileni is a small, inhabited island (approximately 200-metres wide x 500-metres long) in the Vaikau ward, to the north of the Reef Islands, Temotu Province, Solomon Islands. The island's inhabitants are of Polynesian descent within a predominantly Melanesian country. It is a picturesque island situated three to four hours from the provincial capital Lata by outboard motorboat and has a population of just under 300 people but has increased in recent years (exact numbers from the 2009 census have not yet been released by the government at time of writing and there are no records of the population on the island itself). The population fluctuates due to a number of factors including children being schooled on nearby islands, seeking of work or visiting relatives in the capitals, and health considerations. Pileni was ranked highly by the PDMO as vulnerable to sea-level rise and tsunami.

3. Methodology

Three visits to Temotu province were undertaken. The first was primarily aimed at implementation of the SIRC pilot project and assisting the Pileni community identify, prioritise and implement risk-reduction activities using the VCA toolkit [5]. This trip involved SIRC and its volunteers. The second visit was specifically to research the broader adaptive capacity of the community. The team involved SIRC as well as representatives from International Federation of Red Cross and Red Crescent Societies (IFRC) and the Red Cross/Red Crescent Climate Centre. The third trip was to conduct further questionnaires with the community as well as follow up on implementation of the project. The following section outlines these visits as well as the two broad types of methodology used to collect data. A brief literature review summarised material as it related to the Solomon Islands and Pileni Island in particular. This can be found in Annex 1.

[5] See this link for the VCA toolkit: http://www.ifrc.org/what/disasters/resources/publications.asp

In summary, the three field visits took place in the following order:

1. Pileni VCA by SIRC and volunteers – 22–29 November 2010
2. Field visit to provincial capital Lata by SIRC, IFRC and Red Cross/Red Crescent Climate Centre – 8–12 March 2011
3. Field visit to Pileni by SIRC – 19–22 March 2011.

3.1 The vulnerability and capacity assessment on Pileni Island

The overall aim of the VCA with the Pileni community was to help it identify, prioritise and implement risk-reduction actions. The data generated in that VCA process are used in this report as the basis of a wider adaptive capacity assessment. This section gives an overview of the VCA process.

In order to work with the Pileni community, the SIRC sought the blessing and approval from the Paramount Chief for Vaikau which was granted and then allowed access to the Pileni community. The SIRC undertook a VCA in the community between 22 and 29 November 2010. The team of seven comprised two Solomon Islands Red Cross staff, four volunteers and one boat driver. Two were female and the rest were male, with four of them volunteers from Pileni Island and the surrounding islands; the rest were from the Santa Cruz and Tikopia islands. Using volunteers from Pileni and surrounding islands ensured that discussions could take place in the community in the local language rather than in pidgin. Training for the VCA was done in Lata from 17 to 20 November 2010.

Eight tools (observation, transect walks, historical time line, seasonal calendar, focus group discussions, hazard mapping, interviews and daily routine) were used by the team with the community and active participation from all the members from both the community and VCA team was encouraged (see Section 4 of this report on past history and Annex 4 for results). Males and females were separated during some of the activities and the outcome was encouraging because of the active participation of women. A youth component was originally planned for the VCA but could not be carried out because there was a lack of youths within the community, with the team counting only two in the village (due to the high school being located off island). Another notable observation was the absence of elderly people as there were only two people that could be counted as ‘old’ (most appear to leave Pileni for other islands closer to health facilities as they get older). Most people in the community were middle-aged and young married adults. Children were also present during some of the activities as classes were still in progress.

The first day involved dissemination about the SIRC (including the seven fundamental principles of the Red Cross/Red Crescent[6]) and the purpose of the project, with actual VCA activities starting on the second day. Seven days were required to complete the VCA and in addition to this the team had to spend almost an extra week on the island because of bad weather and rough seas due to a tropical depression in Vanuatu. The purpose of this VCA was to help the community as well as the SIRC better understand the impacts of climate change and help them define and prioritise the most relevant adaptation practices. About 50 people participated in the VCA process at Pileni and decisions relating to the project went through normal community decision-making processes (i.e. The Chief helped facilitate the decision-making and sought people’s input). SIRC stressed the importance of the community owning the project and as per their usual VCA process, the community and SIRC signed a memorandum of understanding (MoU) outlining defined tasks, responsibilities and time frames of the project.

[6] These are humanity, impartiality, neutrality, independence, voluntary service, unity and universality.

3.2 Adaptive capacity research

The main methodology for this report was named the 'Pacific community-level adaptive capacity analysis framework' and was created in collaboration between Red Cross, USP and SPC[7]. During a workshop in Fiji in February 2011, seven broad determinants of adaptive capacity in the Pacific region were created. These were based on factors outlined in the Intergovernmental Panel on Climate Change (IPCC) 2007 report and institutional experiences in the Pacific and are outlined below. These factors were then measured using a combination of community household questionnaires, semi-structured interviews with key informants internal and external to the community, focus group discussions and rating on a Likert scale (1–5). A Likert scale is a method whereby questionnaire participants are asked to rank a statement or answer a question from between 1 and 5 where one is low and five is high (see Annex 2 for results). Given that the VCA had already conducted historical analysis and focus groups discussions, these were not repeated. The results section of this report is organised according to the determinants of adaptive capacity and incorporates results from all three field visits.

Pacific community level adaptive capacity analysis framework—seven determinants of adaptive capacity:

1. history of dealing with climate stresses
2. human capital
3. social capital—community cohesiveness
4. belief systems/world views/values
5. resources and distribution
6. information and awareness
7. adaptation options.

The Fiji workshop also suggested that the ideal number of community-based questionnaires to conduct during the field research would be 30 households. Given the island community was so small, the amount of time that it would have inconvenienced the community (a test run showed each questionnaire took 1 ½ hours due to translation and education levels of the community members) and that a VCA had already taken place recently, it was decided by the Solomon Islands research team that a smaller number of surveys would be completed.

Due to a tropical depression in the Coral Sea which created dangerous seas, the entire research team were not able to reach Pileni in mid March and were only able to go as far as Lata, the provincial capital. In light of this, the research team interviewed several key informants such as the Paramount Chief from the Vaikau ward (the head chief of the collection of islands north of the Reef Islands in Temotu Province, of which Pileni is one, also happened to be from Pileni). The PDMO was interviewed as was the Officer-in-Charge at the Solomon Islands Meteorological (Met) Office, the Health Ministry's Environmental Health Inspector in Lata and the Temotu Branch Officer of the SIRC. Given the adverse weather conditions, a number of the Pileni community members were also stuck in Lata which gave the research team an opportunity to interview them. Two males and two females from the community were interviewed during this time (see Annex 3 for list of interviewees).

One week after the research trip to Lata, the Temotu Branch Officer and the SIRC Climate Change and Disaster Risk Reduction Officer were able to reach the Pileni community to undertake more questionnaires and follow up on project implementation. An additional 12 questionnaires were completed during this visit giving 16 in total.

[7] For further information please contact the authors.

The draft questionnaire and interview questions were altered slightly to fit the income and cultural context of the Solomon Islands (see Section 4.5.3 of this report for the adapted income scale for Temotu Province). The questionnaire also asked respondents for a detailed opinion of the implications the project had for their life and that of the broader community. The project in this case that was prioritised by the community during the VCA with SIRC was reinforcement and expansion of a seawall that is protecting houses from high-tide events and storm surges. Given that this project is still being completed, only a limited analysis on the impacts the project has had on the adaptive capacity of the community was possible (see Section 5). The project will be further monitored over time by the SIRC Temotu Branch Officer.

In conclusion, given that SIRC conducted a VCA on Pileni Island that was well documented and included a participatory approach, this report relies on a combination of the results from both this and the adaptive capacity framework developed in partnership with USP and SPC.

Men's group work during the VCA

VCA training for Temotu province volunteers

4. Results

This section outlines the results of the three field trips to Temotu Province and two trips to Pileni Island. The results are organised according to the adaptive capacity factors contained in the Pacific community level adaptive capacity analysis framework that is outlined in the methodology. Information gathered from key informant interviews, community questionnaires and participatory activities are interspersed.

4.1 History of dealing with climate stresses

From the discussions with the respondents and interviewees, the Pileni community has faced numerous problems, many of which can be totally or partially related to weather and climate: high tides/inundation, lack of safe drinking water, drought, cyclones, heavy rain, coastal erosion, declining fish stocks, decline in agricultural food production, and coral bleaching. Of these problems, the results show that high sea-level events (and associated erosion) are one of the greatest concerns for the community members, followed by declining fish stocks, water quality, agricultural production as well as the changing frequency of storms which were once easily predictable. The problems often result in damage to households and damage to crops (mainly banana and breadfruit, as coconut trees are more resilient).

A traditional method of dealing with high winds and cyclones on the island is for large coconut leaves to be placed on the roofs of the houses to increase structural weight, making it less vulnerable to being blown over. The secondary plan after that is to relocate to the other side of the island to seek shelter from the offending winds and water. Another method often used during times of disaster, is a reliance on the preservation of famine foods, such as wrapping taro in coconut husks, storing alite nuts and drying breadfruit, as an emergency source of food. However, these methods are largely dependent on the yield of the community's crops which are declining and the seasons that they are available are shrinking. The community is prepared for disasters in a traditional sense, however it is not prepared for disasters in a modern sense such as reliable access to a two-way radio. There was mention of a project in Temotu Province that is bringing two-way radios to communities like Pileni and respondents thought that Pileni should benefit from this soon.

Despite the number of emergency response services being available in the larger islands and capitals increasing over time in the Solomon Islands, there is still difficulty in the community of Pileni accessing those services. This often makes the burden of recovering from disasters greater as there is not immediate help. However, the community has shown it can 'carry on' as best as it can in the aftermath of these events, even if assistance takes time to arrive.

4.1.1 Past experience of dealing with climate stresses—historical timeline

The approach taken in using the historical calendar was to place males and females into separate groups. Female volunteers questioned the females and the males were interviewed by the male team members. As can be seen in tables 1 and 2, there is not much difference in the results between the two groups with the main difference coming from the women's perspective on the dates and time of the events taking place. Most women have limited education thus the exact date of significant events within the community has to be in relation to any major event that has taken place in the community or the country. Some events used as reference include the arrival of Christianity, construction of the church building as the community has the first church built anywhere in the Reef Islands (it was built in 1930), Second World War, Independence and major disasters that have taken place.

Traditional values and knowledge are still highly regarded and used by the Pileni community. Specific beliefs still held by the community include:

- Superstition – that if children laugh and are generally happy during bad weather it encourages or increases bad weather
- Noah tree – the tree grows on the beach, the tree tips are taken to the beach and put in the direction of the storm surge and it will calm the sea.

The Met office observes that elders know traditional methods of predicting the weather but younger ones do not and that traditional knowledge is being lost.

Table 1 Historical timeline for women

1920s	Changes in language
1930s	Set up first church
1942–1945	People scared of warplanes
1950s–1960s	Experience scabies
1983	Students move to the new school at Nifiloli
1990	Tsunami or tidal wave
1993	Cyclone destroys some houses
2002	Set up extension school in Pileni
2007	Experiencing big waves and strong winds
2008–2010	Experiencing food shortages – fruit trees not bearing according to their usual seasons – been getting worse

Table 2 Historical time line for the men

1942	Experienced sickness (e.g. sores as a result of the Second World War)
1950s	Struck by big cyclone
1985	Struck by big cyclone
1993	Last cyclone to hit Pileni

2000–2010	High tides and waves start to dig up and destroy our nice beach Wells start to taste salty Shortage of shellfish and fish Fruit trees started die out from the effect of salt water (n.b. community reasoning) Seasonal fruits are destroyed by insects, worms and other creatures Sea corals are dying out – heat affected at low tide, fish not going there High and low tide of the sea are out of the usual pattern or order No economical services

4.1.2 Observed changes

According to the Met Office in Temotu, the rainfall and temperature have increased since records began in Temotu Province in 1971. The Met Office also observes that there has been a lot of traditional knowledge used for weather prediction in the province and that most islands are talking about the unpredictable nature of the weather these days.

The Pileni community in particular has observed many changes. According to a recorded interview with the island Chief these include:

- The fruit season in general used to come three times per year but now only once per year.
- Now they are finding the currents are stronger and changing directions, the community believes that this is destroying its fish habitats.
- Changes have occurred on the island, the most visible being sea-level rise, hence the increase in storm surges resulting in damage to the island's foreshore.
- One example is the low and high tides that have for the past years followed a different pattern that is still not fully understood by the people.
- The root crops hardly bear any fruit these days, they only bear flowers.

In an amendment to the use of the seasonal calendar tool, SIRC got the community to document these changes in the use of the tool in Table 3.

Table 3 Climatic changes to the seasonal calendar

Month	Weather	Health	Food
January	Slight changes in wind pattern to low wind and big waves (storm surges)		No season of fruit trees (e.g. breadfruit/nuts/Oki) compared to the past
February			
March			
April	Change in rain pattern and wind sometimes in place (i.e. they expect rainy but instead windy)		

May	Change from usually windy to now fine weather		
June	Some changes in wind and rain	Usually get cold and flu in cyclone season but now appears in dry season	No breadfruit and Hilte fruit
July	Sun (really hot) in place of wind (coming from the wrong side)		
August			
September	April onwards tide should be lower, but now high tide still the same (not going down)		Main harvest time for fruit trees etc. but harvest is in small quantity (2008 worst year nothing to eat – just fish and dried coconuts – province had to give bags of rice to families)
October			
November	Usually high-tide time Nov/Jan/Feb		
December			

4.1.3 Understanding of climate change

The people's understanding of climate change is quite broad in that they recognise the changes that are happening around them and their environment (as documented above). In some ways, their remoteness, reliance on traditional food sources and knowledge make the community an excellent benchmark for documenting observed changes. SIRC gave the community the knowledge that these changes are occurring everywhere around the world and shared anecdotes of changes that people in other parts of the Solomon Islands are talking about.

More broadly, some of those interviewed in this study note that after the Conference of the Parties to the Kyoto Protocol (COP) 15, the climate change issue came to the forefront in the Solomon Islands. They put this down to the fact that more people from the country attended the international climate negotiations meetings, especially youth and sectoral representatives. News filtered back and knowing what is going on in the world on climate change had an impact on awareness levels in the country. It was noted that during the research period, numerous articles on climate change appeared in the national newspaper, these highlighted the scope of the global problem and called upon developed countries to act.

4.1.4 Influence of the 'ring of fire'

The Pacific region is part of the 'ring of fire' that rims the Pacific and creates a hazardous environment for human populations living in these areas. In some cases, earthquakes and tsunamis can be responsible for raising entire islands, such as the elevation and exposure of reefs that occurred after the 2007 Solomon Islands earthquake and tsunami. When asked

whether they thought tectonic plates or sea-level rise due to other factors was to blame for the erosion and inundation on Pileni, the PDMO and the Officer-in-Charge at the Met Office in Temotu Province both stated that the sea level is rising. The Pacific Islands Applied Geoscience Commission (SOPAC) was also contacted for clarification on the influence of tectonic plates in Temotu Province, especially the Reef Islands area. In their response, SOPAC (2011) outlined that the Reef Islands are located on the Pacific plate and more specifically in the boundary between the Pacific plate and the Australian plate to the south. This boundary area has the potential to generate earthquakes and local tsunamis; volcanic activity that is evident in the area can also result in tsunamis. It was said that 'there is not much evidence (to their knowledge) of progressive emergence or submergence due to plate tectonics' and 'the area could be considered relatively stable' in these terms.

4.2. Human capital

4.2.1 Traditional and modern skills

The people of the Pileni Island have traditional knowledge and skills used in daily life that has been practised over many years and which continue to be used. Examples of traditional methods employed include preserving and drying foods such as keeping taro in coconut husks for its longevity as well as drying breadfruit. Another prominent part of their tradition is using weather features, patterns and conditions to determine forthcoming weather events or optimal sailing conditions. This knowledge is being questioned by the people themselves as it was discovered during the VCA that the people of Pileni can no longer predict the weather or future events with the same level of accuracy or certainty as they used to. They have noticed significant changes to wind patterns, predominately the northern and southerly winds which sweep through the island. It was noted from the island Chief that trust is being lost in traditional methods. When asked in the questionnaire, the majority of respondents thought that the community saw 'some' or 'quite a lot' of value in traditional knowledge (Figure 1).

SIRC also noted during the VCA that individual members of the community had previously built seawalls with available material from the islands using traditional stacking techniques, but they would require regular maintenance (at least once per year) as they would often crumble. SIRC suggested merging the traditional knowledge of building seawalls with commercially available construction supplies (such as wire mesh cages) to ensure a stronger wall to protect the community that did not require as much maintenance once built. The knowledge of tides is being used to establish the best possible times for construction of the seawalls. The community also has skills in implementation and planning, despite these sometimes not being realised in projects due to a lack of cash income on the island.

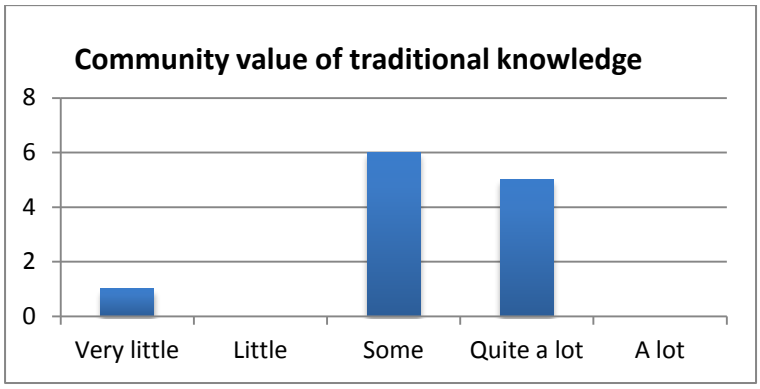

Figure 1 Community value of traditional knowledge and way of life

4.2.2 Health security

There is a relationship between weather and health in the Temotu province, for example increased periods of rain can disturb the yield of crops and therefore the nutrition of the people. Climate impacts the water supply because the pressure that they expect from the streams may not be realised.

The Ministry of Health mentioned that water and sanitation is problematic in the Temotu Province and is the largest environmental health concern. As a demonstration of this need, the people's largest request to the environmental health division is for improved water supply. It was noted that the overall level of health in the region is declining as a result of less donor money funding environmental health projects than in the past. As an example, there used to be approximately up to 10 environmental health projects per year, whereas now there is only funding for one to two projects per year. Water supply systems are generally expected to work for 15 to 20 years, however in some case they may only work for as little as three years. Reasons given include a lack of ownership by communities, technological know-how and the need for systems to be more suitable for local settings. An example of this is the failed attempt to install flushable porcelain toilets on Pileni Island.

According to national health data, 70 per cent of people in Temotu Province have access to safe drinking water, however this may not mirror the reality on the ground. Although bigger islands in the province have streams and rivers, the low-lying atolls do not, hence they depend on rain tanks and water wells. Many communities in the region rely heavily on coconuts as a daily source of hydration due to the abundance of coconuts on the islands. The Environmental Health Inspector noted in some communities that there is evidence of malnutrition in children and this was also supported by the Viakau Paramount Chief. In this case, malnutrition of children is defined as not receiving the right amount of calories and nutrients from the various food groups.

The Ministry of Health has funding to visit Pileni approximately one to two times per year. Apart from that, the community needs to get to its nearest health centre at Nuaba, in the Reef Islands should anything go wrong. This health centre is a one-hour outboard motorboat ride and is only accessible in fine weather. This would take approximately 20 to 25 L of fuel which is very expensive and is particularly an issue for an island that has a very limited cash income. Fuel generally costs just under 30SBD (US$3.40) per litre.

The main environmental health problem on Pileni is that there is no proper means of solid waste disposal, including human waste. Access to clean drinking water is limited by the rain and the lack of rain causes people to seek water from the wells. There is no testing of the wells to ensure they are safe to drink and the communities do not boil the water because they assume it is safe. Children are therefore susceptible to diseases such as diarrhoea. It has also been noted that the well water tastes saltier in more recent times and the community believes that large and king tides contaminate crops and water. The Environmental Health Inspector suspects salt water is seeping into the land due to sea-level rise, however it is difficult to determine how much pressure the population is placing on what could be a fragile groundwater lens.

Despite its health problems, the Environmental Health Inspector ranks the overall health of the community as four out of five (relatively high) on the Likert scale due to its resilience. He went on to suggest that the community does not see gaps in its environmental health needs as the people continue to live the traditional lifestyle they have for many years. Community members noted the main health problems to be cold/flu, pneumonia, malaria and no proper access to water and sanitation.

4.2.3 Agents of change in the community

It was noted from the different respondents and interviewees that the people of Pileni do not have trouble in coming up with solutions or ideas to localised problems relating to daily life of

the community and generally often for broader issues facing them as well. Ideas are often formulated by individuals and also through the numerous committees. However, it was noted that there is an inability to obtain resources and technical expertise required to implement ideas and projects.

4.3. Social capital – community cohesiveness

4.3.1 Community diversity

Respondents noted that there is a strong sense of identity within the community and a common sense of belonging. Demographically the island comprises seven different clans with intermarriage between the clans. Migrants to the island consist only of those who have married people from the island and settled in Pileni. It was observed that these people find the transition difficult to begin with given the subsistence and at times challenging existence of the community. The only religion present on the island is the Anglican Church of Melanesia. There was some variation between respondents and interviewees regarding the wealth and education level among the households as it would only slightly differ from household to household. In the long run, those who leave and go to the bigger islands for higher education or for financial gain do not often return to the island. In observations of the women's and men's groups during the VCA the majority of new ideas came from men.

4.3.2 Village leadership

In the leadership system there are a number of chiefs in the village with one that is the overall Chief of the island community. Any agreements or disagreements concerning the community have to be facilitated by all in the Committee of Chiefs. While most chiefs tend to be men, land is traditionally passed down through women. The island Chief has a large say in arranging and calling people together and acted as a go-between for the community and SIRC before, during and after the VCA. The leadership has been deemed as quite effective by external key informants (EKIs) as the chief acts as a spokesperson and facilitator. The decision-making process is effective because he did not make the decisions relating to the VCA himself, the community has good input into the decision-making processes. Most community members interviewed deemed that the community leaders are always important in solving community problems (Figure 2).

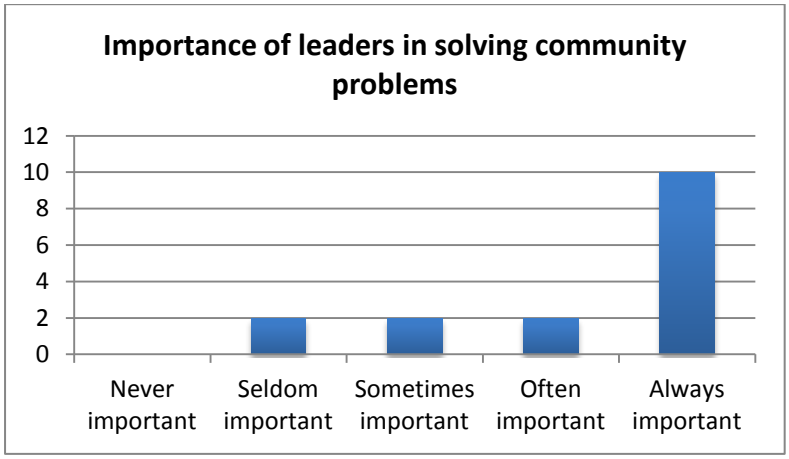

Figure 2 Importance of leaders in solving community problems

4.3.3 Strength of collective action

The majority of questionnaire respondents said that the community works together 'sometimes' (Figure 3) and nearly all households interviewed were involved in at least one committee in some capacity. The community has numerous committees that contain different members. There are church, school, projects/village, Chief, women's and youth committees. The Projects Committee is primarily concerned with transport issues and any new initiatives the community is considering. Despite the existence of these committees and the ability of the community to come up with ideas, there are still major limitations on access to external services, expertise and funding which severely hinders implementation.

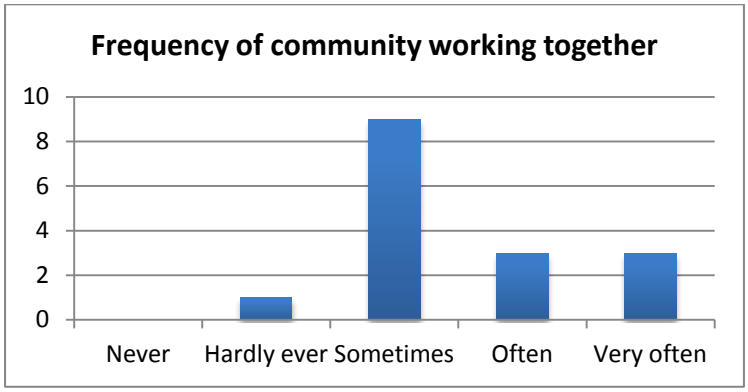

Figure 3 Frequency of people in the community working together to solve problems

It was noted by some EKIs that Pileni is a polling station for elections and disagreements and divisions in the community were more likely during elections because of siding with different contestants. In times past violent conflicts were often played out from canoes on the sea, many resulting from reefs being allocated according to lineage and conflicts arising over boundaries. Today these boundaries are much less defined and in the event of any conflict in the community the church and Chief assist with reconciliation. Due to strong Christian values on the island the church plays a large role in mediation.

In relation to implementation of the seawall project, church leaders, island committees and the island Chief facilitate the implementation of the project. The SIRC Temotu branch and the island Chief will be involved in monitoring the project. EKIs reflected that both men and women spoke about their roles in the seawall project, which indicated that the project may have helped the community work better together. The community noted that previously they had only worked on seawalls as individuals, not collectively as a community for the benefit of everyone. It was also believed that the project helped build the capacity of the project committee in managing projects.

4.3.4 Support services and networks

The PDMO undertook disaster awareness in 2010 to explain the organisational structure of disaster response in Temotu, including the government, to community disaster management structure. This also included awareness around cyclones and tsunamis, planting windbreak trees and working with the community to establish a community disaster plan (still to be produced). The PDMO has a budget to visit Pileni once per year and as was mentioned previously, the health department also visits 1 to 2 times per year.

Despite the existence of committees and the ability of the community to come up with ideas, there are still limitations in the access to external services and expertise that hinders implementation. All community respondents mentioned that they have no or very limited access to external organisations to help deal with problems with one stating that their

geographical location is a big problem. The community has accessed organisations in the past for composting and water/sanitation projects. Failure of some organisations to follow through on projects has left a feeling of distrust in the community that Red Cross had to overcome.

4.3.5 Governance

Respect was evident for the island's Chief and the traditions surrounding chiefly rule on the island. Most community conflict is settled through the Chief if it cannot be settled among individuals. Although the community does not have instances of regular conflict, cases that have created tension in the past have focused around income-generating projects and involve numerous community members. One particular case of conflict occurred when the community began an initiative to hire out one of the community canoes for personal use.

4.4. Belief systems/World views/Values

4.4.1 Traditional values, systems and knowledge

There is strong respect for the island's culture and traditional values within the community. The Paramount Chief acknowledged the changing world around them and the need for new methods of doing things that will benefit them (e.g. strengthen the seawall with external construction supplies). Mindful of this, he mentioned that in a changing world it is a community's culture that binds it together and emphasised the importance of it retaining its identity in times of change.

All respondents believe that the use and respect for traditional values and knowledge has declined in the past 30 years. One EKI observed that this may be due to the fact that young people have to leave the island to obtain an education, they have less interest in the knowledge and elders have fewer people to pass the knowledge on to. Young respondents in the community questionnaire were not aware of traditional knowledge, whereas those in midlife still used it often. The traditional matriarchal system of land succession is still operated by the community.

4.4.2 Religion

Anglican missionaries are generally said to have been more accepting of Melanesian and Polynesian tradition than missionaries from other denominations. Given that the Temotu Province is predominantly Anglican means that traditions are held onto more in this part of the country than others. For example, the Pileni community has traditional Polynesian dancing circles that are still used. According to respondents, the Anglican Church is the only denomination tackling climate change in the Solomon Islands. They have a climate change project with islands on Temotu and Malaita on food security using salt resistant crops. The SIRC approached them before working in Pileni. The Anglicans relate explaining climate change to passages in the Bible. One such example is using the story of Joseph before the famine who told the people of Egypt to prepare for famine and hold enough food for six years. The Australian Government Overseas Aid Program (AusAID) are funding a disaster risk-reduction project with the Anglican Church. People in the Solomon Islands are deeply religious and some people see climate change as 'a sign', therefore it can help using references to the Bible to explain it.

4.4.3 Willingness to accept change

Due to the island's remoteness and isolation, the community has been largely independent for a long time. Although confident to deal with community and traditional problems themselves, they are now being faced with new and emerging threats to the community. This includes, for example, a deterioration in fish stocks and water quality, increased erosion

and changes in the patterns of weather that reduce the community's ability to predict favourable and dangerous conditions. In the last 30 years, the community has become more accepting of changes and new ways of doing things from the outside world. In fact over 80 per cent of questionnaire respondents felt that new ways of dealing with problems are always accepted by the community.

4.4.4 Ability to change the future vs. determinism

Questionnaire results revealed no clear trend when participants were asked if they have control over their future. Some in the community mention that climate change is a sign of the end of the world (in relation to biblical references), but they say they act because of their children.

4.4.5 Here and now vs future thinking

When asked to agree or disagree with the statement 'taking action now will prevent problems in the future' the overwhelming majority of those who responded to the question agreed with the statement. This indicates some degree of future thinking and forward planning.

4.4.6 Dependence (government, aid, remittances)

One respondent suggested that completing anything in addition to traditional life would most likely require outside resources. The PDMO noted in particlular the need for awareness and education of the community on the negative effects of climate change (such as coastal erosion), however government services are limited to two to three visits per year.

The community questionnaires revealed that each household had an average of at least one household member living or studying in Honiara or other towns. This indicates a fairly high level of remittances, especially in the Solomon Islands where the 'wantok' system operates. The 'wantok' system enables a form of social network between relatives and members of the same community to support each other. This practice is still widely used in the islands by some members of the community who have relatives and immediate family members living and working in other parts of the country.

4.5. Resources and distribution

4.5.1 Land

Because of land restrictions due to the small size of the island and the lack of soil fertility, large gardens are not common and the food planted is mainly for household consumption. The PDMO noted that in recent years the island has been experiencing food shortages and has required a food distribution response from the provincial government. As for the food crops on the island itself, it was noted by many respondents that there are barely enough crops to meet basic needs (bananas, coconuts, breadfruit, alite nuts and local cabbage) and nothing more above that as the ground is becoming increasingly infertile from salt-water intrusion. Some taro was planted, however it was not healthy and the community mentioned that it does not produce significant tubers. Respondents indicated that the community still relies heavily on 'famine foods' (foods that are preserved) as a large component of their diet. The island also exchanges fish for kumala (sweet potato) and taro with nearby islands. The community tried composting but found it only works for one crop and it is therefore easier for them to catch fish and exchange with communities who are able to produce vegetables on more fertile islands. There is almost no rubbish on the island at all because most of what they eat is biodegradable.

The western end of the island showing extent of coastal erosion (see coconut trees)

Most of the gardens visited by the team during the transect walk have been planted for household consumption only

4.5.2 Fishing

As relatively small island there is abundant access to fishing grounds for the community to meet their basic needs, though most respondents mentioned that in the last 30 years the yield of the fish has decreased. This is potentially worrying given that most respondents outlined that they rely on fish as their number one source of food. The community noted a decline in marine stocks and that this was also a result of the shifting tides and changing weather patterns. They also believe that warmer sun is resulting in coral bleaching and reef fish decline. When asked if this is because of overharvesting and population increase, most are not sure as there is said to be no threat from overfishing because of the community's relatively small population size (thought there was some reference to population increase during the research). There is no monetary value to their marine stocks (because of the various factors such as distance and time it takes to get their products to the markets), therefore the likelihood of overfishing is not great. The method of fishing is also affected by the fact that fishing practices are often according to the people's understanding of the weather patterns which includes traditional knowledge of their environment. These practices have been interrupted by the changing wind patterns for example.

One of the largest recent impacts on the community is a ban by the Solomon Islands Government on the export of *bêche-de-mer* (sea cucumber). This was previously a source of cash income for the community and now that there is no demand for the product their income from it has ceased. This affected the cash economy of the community greatly and

after the ban the use of a bartering system for exchanging goods became more important. In the past there were small shops on the island selling basic provisions and imported foods such as rice. Now there are only a few 'hawkers' (people selling goods from their houses).

4.5.3 Income

The average monthly income per household was placed to be between 51SBD and 200SBD (US$6.50–US$26.00) (Figure 4). Despite living a predominantly subsistence lifestyle, there are opportunities for community members to earn a small amount of money, mainly through the selling of marine resources (fish, shark fins), pigs in distant markets and handicrafts such as baskets and mats sold to passing tourists in Lata or from remittances. The average monthly wage was estimated to have increased in the last 30 years as a result of better market opportunities and more accessible and faster modes of transport. The rising cost of fuel can hinder market access. As mentioned in the fishing section, the community has suffered a blow to cash income in the past five years due to an export ban on *bêche-de-mer*. If pigs survive the long journey to market, they can fetch a family up to 1000SBD (US$130.00) which is a significant cash boost. Some EKIs indicated that the community does not have adequate cash income as there are expenses such as school uniforms, food when living on other islands for schooling, and school books that would exceed the monthly income of people on the island.

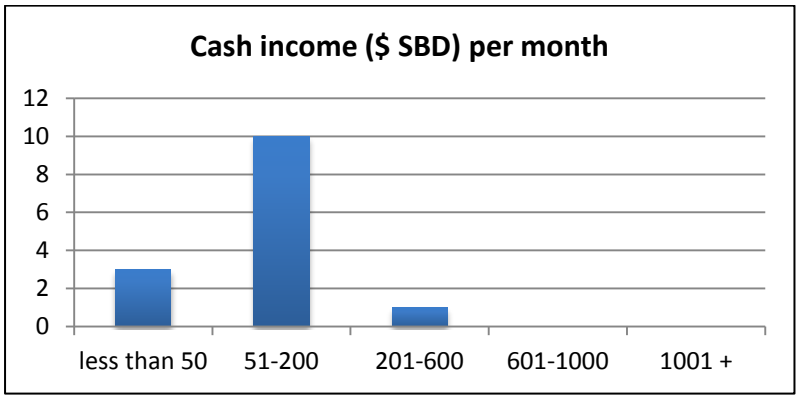

Figure 4 Average monthly cash income (including remittances)

A traditionally built pigpen used to raise pigs as a source of income

4.5.4 Infrastructure and services

Infrastructure on the island is virtually non-existent with the only permanent building being a school classroom, the main reason being the difficulty in bringing equipment and materials to the community because of the distance to the nearest port, which is located in the Reef Islands. There are no generators or installed electricity mains. In recent years several households have had small solar panels installed, although these were a gift from a local politician. The island also does not have a public telephone, two-way radios, televisions or computers, only a one-way radio which is dependent on batteries and has a limited reception capacity (e.g. if there are strong winds, then the island would get little to no reception).

There is no medical clinic or dispensary on the island which further complicates the community's access to healthcare and medical assistance must be sought off the island. Fuel costs are expensive and access is limited due to rough seas. Fuel costs just under 100SBD (US$13) per gallon (3.78 L per gallon) making transport costs incredibly expensive for remote island communities. Particularly as entire households on Pileni earn between 50 and 200SBD (approximately US$6.50–US$26.00) per month. To find transport to Lata and beyond, the community must first get to the Reef Islands. The community purchased its first outboard motorboat in the past five years. Prior to that they were completely dependent on traditional sailing.

As another example of the locational disadvantages the community faces, the ship with materials to do the seawall project could not get into the Reef Islands, so the materials had to be dropped off on one nearby island and then transported by boat to Pileni.

4.5.5 Education

There is one primary school on the island but classes are only from preschool playgroup to grade two as the school is an extension of the primary school on Nifiloli Island. Most children on the island were between the ages of 1 and 10 years. The older children attend school on the next island and live with parents and relatives. The islands of Matema, Niukapu and Nupani also use this arrangement. One respondent mentioned that once children become educated they don't want to come back to the island.

4.5.6 Drinking water and sanitation

This section is also linked closely with Section '4.2.2 Health security' and should be read in conjunction with it. There is no fresh running water on the island and the community depends on wells and water tanks as the main source of drinking water. Over 90 per cent of respondents rely on community water tanks for water. A lack of access to safe drinking water was an issue that came up often with those interviewed. For a long time the community depended on water wells in the ground for their water access. Over time the water is becoming increasingly salty. There are about five wells in the community and more than five water tanks which cater for the community because of its small size. The wells are located on the southern part of the island, that means that they are away from the houses and usual activities of the community. Some are near vegetable gardens and there is sufficient vegetation around the wells to keep them from being exposed to the elements. In the last 30 years, the community has been able to increase its overall access to drinking water through the installation of a handful of community tanks and approximately three household tanks; these are heavily dependent on rainfall to keep them filled.

Water inside one of the wells on Pileni Island

Most of the wells are quite old; most were built more than 30 years ago using rock, the traditional materials. The community says that rising sea water and tides are affecting the underground watertable, as a result water is often salty. There were cited references from respondents that the community wells are sometimes not always safe to drink either. Wells are cleaned once every week by draining the water out (the community has a roster) and then cleaning the area surrounding the wells. This in turn has enabled the community to have regular freshwater. Well water is used mainly for cooking and washing. One notable observation is that some in the community regularly use the sea for bathing. When asked why they use sea water and not freshwater, the answer is always 'it's the island way and has been for many years'. The traditional method of using coconut as a water supply is something that is still strong today as there is currently no shortage of coconut trees on the island.

Sanitation is also an issue being addressed by other organisations, and includes the provision of toilets and building materials for the construction of facilities for the community. At the time of writing and in the past, both ends of the island are being used by the community for toileting with the eastern end being used by the women and the western end used by the men. The proposed sites for the construction of the new toilet facilities have already been chosen and materials and sites are already prepared. However, the community don't have the technical skills to finish the project and it is still to be completed. This has made the community skeptical of some organisations working with it. Although lack of sanitation is not yet regarded by the community as a threat to their immediate wellbeing, the concept for better sanitation among the people is regarded as a priority.

4.6. Information/Awareness

4.6.1 Access/Level of relevant information

As a small community, individual voices are more easily heard. The church is a central meeting place and is a good place to share information and for everyone to get access to the same information. Regarding external communications however, the community of Pileni has a distinct lack of capacity, relying on either word of mouth for general communications with Lata and beyond. They do use traditional methods of reading wind patterns to anticipate weather events. As has been a repeated point raised, it is these traditional predictions that are becoming increasingly inaccurate. The island's one-way radios and their dependence on batteries and low-intensity winds to get a signal do not greatly assist the community in some

disasters. Community respondents indicated that they use and trust meteorological information when they receive it over the radio and use it, for example to decide whether or not to go out to sea or to prepare for disasters. The community also lacks specific information portals such as televisions and computers with the internet to further increase their information and awareness. The community has had access to basic awareness on climate change science and its causes from the SIRC in the additional consultations with the community during the course of the VCA.

The Met Office outlined that communities do not keep weather records. The office also admits that people sometimes complain about the terminology used in forecasts (e.g. hectopascals) but the Officer-in-Charge makes an effort to explain it for them. The Met Office reflected that there is a need for greater awareness on climate change so that communities have the necessary information to prepare. The Met Office is observing that over time people in the province are generally becoming more interested in the Met Office predictions and are concerned about the weather. They are seeing more people trust the information as it is often correct and an increase in disasters has also sparked interest, especially the 1993 cyclone.

4.6.2 Ability to analyse information/options

The focus group discussions during the VCA enabled SIRC to observe the ability of the community to reflect on the VCA results in November. The community successfully and democratically chose and ranked their key priorities, with facilitation from the island Chief indicating an ability to analyse information and options.

4.6.3 Communicated risks and importance

In relation to perceived risk, three-quarters of questionnaire respondents indicated that tides and inundations were their most serious concern in relation to hazards. These events are experienced at least three times per year. Two mentioned declining food crops as their second highest concern. Other concerns included coastal erosion, declining fish stocks, cyclones and drought. All of these problems are experienced more than once per year.

5. Impacts of project on aspects of adaptive capacity

Given the project was still being implemented by the community, it was not possible to do an in-depth analysis of the project's affect on the adaptive capacity of the community. What follows is a description of the project of choice and its current status.

The community is using gabion wire baskets (approximately 2x 1 m) to stabilise rock walls (most places have the traditional walls already, the gabion baskets will keep the walls stronger for longer). The community plans to plant a weedy vine that grows in sand along the wall. SIRC has had experience in using the method previously in Malaita province in a river erosion case. The creation of the seawall on the east side of the island merged traditional methods of building walls with modern resources to strengthen them. The wall itself has not changed traditional values in the community but has demonstrated how modern resources can benefit the community. The creation of the wall has not resulted in any conflict amongst the community either. There is strong acknowledgement in the community that the wall will benefit everyone as opposed to previous walls that were built by individuals without the common consensus. This acknowledgement, it was noted, also

increased the sense of ownership and responsibility for the wall, its construction and any maintenance needed, as was demonstrated by the signing of the MoU with SIRC.

The date for the implementation of the current project was supposed to be in December and January, but due to unreliable weather the community has agreed that only after the cyclone season is over can anything be built or implemented. This is mainly due to the strong storm surges that are experienced from December to April, and the fact that low tide is more predictable in the months following the end of the cyclone season. Materials have been delivered to Pileni and will be used by the community in coming months.

The SIRC believes that the project changed the community decision-making process in a positive way and believes that the VCA process was a good example of how the community can work and make decisions together.

The last house on the eastern end of the island with traditional stone wall on the right of the photo

While the seawall will prevent coastal erosion in the short term, it is not a long-term solution to the problems facing the community. This point was repeated by most of the respondents. The Paramount Chief mentioned his concern after reading an article about the increasing land erosion in the Cataret Islands in Papua New Guinea and the islander's relocation, as it was mirroring the situation faced in Pileni. Unprompted, most of the respondents and interviewees mentioned that the only long-term solution to the problems faced in Pileni was for the relocation of its people.

6. Adaptation options

6.1 Adaptation possibilities

Water remains a major challenge and hasn't been assisted by an incomplete water sanitation project. One of the most obvious adaptation options would be to decrease dependence on groundwater which is declining in quality. This requires adequate technical expertise from external sources. Access to meteorological information via two-way radio would also assist the community deal with the decline in reliability of traditional weather prediction. The community has done some things to adapt to the changes that they are experiencing such as building seawalls and using compost from their pigpens to grow vegetables. The people have resorted to building traditional seawalls on the foreshore which has helped reduce the risks from storm surges. Many community members who

were interviewed thought that seawalls were the adaptation option available to help them to deal with the most frequently experienced hazard of tides/inundations. One felt that it was cheaper than relocation, however two felt that in the long run there was nothing that could be done and that relocation would be the only option.

With changes in income generation due to a *bêche-de-mer* export ban (imposed by the government) and increasingly infertile soil, the people have resorted to moving to settlements in other parts of the province. The people remaining on the island have also discussed the desire to be relocated, but due to the complexities of land acquisition in the country the subject is challenging. Moving to another place is not the most desirable of options to the community either, as they would need to adapt to a new environment. This is because those in the community have indicated that most are used to the lifestyle and the struggles they face, they say that the small island community is part of their life and they have been there for generations. Despite this, the trickle of people moving to other areas for schooling, income opportunities and health concerns may increase as their living conditions become more difficult.

The PDMO has noticed a significant increase in the erosion of the island (especially in the past four years). In the PDMO's view, based on the rate of erosion on Pileni, the island will not be sustainable in the next 20 years. Pileni is not alone in the issues it faces as many of the same problems can be seen on the low-lying atolls in Temotu province, which is causing authorities to start considering relocation options. An option to deal with relocation could be to extend existing Pileni Island community settlements on the bigger islands, for example in Lata. Acquiring land elsewhere in the province is a difficult prospect for both the community and the local authorities. Reports to the provincial government have recommended beginning discussions with landowners on bigger islands around the practical requirements for long-term relocation of the inhabitants of the Viakau ward. One respondent said that past experiences of land issues that sparked riots in the past decade are likely to be making people less likely to allow people onto their lands. One cultural group staying with another was also said to be sometimes very difficult. One reason for hope in relocating is the already good relationships between the people of Viakau and the bigger islands in the province.

Nationally the government has also begun to discuss the idea of possible relocation of the populations on low-lying islands to larger islands, but the complexities of the customary land issues in the country (more than 80% of land is still owned by traditional landowners or communally owned) will be a challenge in the years to come.

6.2 Livelihood options

The community of Pileni has not increased the range of options for making money in the last 30 years. There are also limited livelihood diversity options on the island due to its remoteness, infertility of the soil and lack of land and water available. The technical expertise to adapt to climate change is limited due to budgetary constraints by departments and agencies being able to complete only up to one or two trips a year out to the island. One respondent claimed the need for livelihood diversification has not overly increased as they are still living traditional subsistence lives on the island. In relation to further livelihood options, the PDMO of the region noted the possible creation of a localised fish market in the Reef Islands to create a local economy among the inhabitants. At the moment a bartering system is enabling the community to obtain fresh vegetables from other nearby islands in exchange for fish. The main source of cash income in the community is pigs, but the sea is unreliable for transporting pigs and they often die in transit.

Annex 4 shows a typical day for both men and women on the island. Due to a lack of land, work tending to crops and gardens is uncommon. SIRC noted a larger amount of relaxation time than observed in many other communities with which they work. The community responded that when they had sea cucumber to sell they were always busy. Since the ban

on the harvesting of *bêche-de-mer* the island has seen a drop in income and an increasing threat of food security. There is little cash income to buy imported foods which leaves the community vulnerable if rates of agricultural decline continue. There are no shops on the island (just small hawkers) and everything is bought or bartered either from the provincial capital or from the nearby Reef Islands. Most of the community members interviewed were adamant that if the ban placed on *bêche-de-mer* is lifted, food security would not be much of an issue. Most have stated that there is little prospect of earning income in the community because of the lack of economic activity and resources that would help facilitate income generation within the island community.

6.3 Food acquisition options

The community has access to famine foods (e.g. food preservation), fair access to subsistence foods and poor access to imported food. The foods available to the community from both the sea and from the land crop have remained similar to 30 years ago and imported food acquisition is limited by the islands remoteness and low-level cash income. The community has traditional methods of preserving food, however seasonality changes to these foods is undermining this practice. The same can be said about subsistence production of food, where due to the lack of income and remoteness, the community cannot rely on imported products. Concurrent to an increase in population the island is also experiencing a decrease in the fertility of the soil and fish stocks leading many respondents and interviewees to claim relocation as being the only long-term solution.

7. Discussion/Conclusion

The aim of this case study was to provide an analysis of adaptive capacity at the community level in the Pacific Islands and to learn how to incorporate climate change considerations into the VCA tools. This section will summarise key findings according to whether factors enhance or decrease the Pileni community's adaptive capacity, reflect on lessons learned from the perspective of SIRC as well as discuss implications of this study for the future. Further quantitative analysis of all case studies in this adaptive capacity series will take place by USP and will be collated in a synthesis report.

7.1 Factors enhancing the adaptive capacity of Pileni community

Results from this study show that in many ways the Pileni community is incredibly resilient and self-sufficient. Respondents to the questionnaire indicated that the community has a strong sense of identity, is quite homogenous and while inviting new ways of doing things, is conscious that its traditional culture gives it its sense of identity and is worth holding on to. The community comes up with its own ideas and the chiefly system is operating in a way that allows people to have their say as well as resolve conflicts. The Anglican Church plays a large role in the community's belief system and provides a location for information sharing as well as conflict resolution. The community has active committees, the church being one of them, providing useful mechanisms for enabling group activities including fundraising and project implementation.

Until recently, the community has relied almost entirely on sailing of dug-out canoes for transport to nearby islands. Despite the purchase of an outboard motorboat, the community still relies on this traditional method as it has no running costs compared to the expensive fuel consumption of the boat. Also linked with traditional practices are food preservation

techniques for lean times such as after cyclones. Fishers also use stars, ocean patterns and winds to navigate the seas. The traditional methods of seawall construction are still practised.

7.2 Factors inhibiting the adaptive capacity of Pileni community

While it can be shown above that the community has many factors enhancing its adaptive capacity, these factors are not able to be implemented or are under threat from processes largely out of their control. For example, while the community has the capacity to come up with ideas, and structures such as committees to support them, they often lack the resources to implement them, predominantly because of a lack of cash income on the island. This lack of cash income can be associated with the export ban on *bêche-de-mer* in the Solomon Islands. It was highly likely however, that rates of collecting *bêche-de-mer* prior to the ban were unsustainable anyway and that the higher incomes would not have been sustained over the long term.

Another aspect that threatens the community's ability to cope include reduction in the effectiveness of traditional knowledge. This decline is two pronged. On one hand traditional knowledge is used by adults, but young people in the community do not hold the knowledge to such an extent and the knowledge has declined in the past 30 years. On the other hand, those who hold the knowledge are noticing changes to the knowledge's effectiveness. For example, there are changes in the currents, timing of winds, seasonality of fruits and increased warmth of the oceans and sun. Methods that have been used for generations to warn of strong winds are not working, which is in some ways endangering the community. It is difficult to say with certainty that these changes are caused by climate change, but it would appear that communities such as these, with such long and remote histories, would be a better benchmark than any on observing the climate and weather that they depend on.

With declining reliability of traditional knowledge for warnings of adverse weather conditions, the community may become more reliant on meteorological information over time. However, access to outside communication is currently inadequate given that there is no two-way radio and one-way radio's aren't effective in strong winds. The community's sheer remoteness hinders its access to communication and also means that access to building materials, income sources and government services is also limited. Education is available, but at a cost to families who must move to the islands that have schools. While education might present opportunity, it was mentioned that those who obtain an education rarely return to the island, limiting the amount of knowledge. Those who do return are sometimes seen as troublemakers that impose their outside knowledge.

Water supply on the island is limited to just wells and some rainwater tanks. Those interviewed believe that high tides are causing the groundwater to become salty and to impede on their already limited crops. Whatever the reason, communities will require installation of the water tanks that are currently not used due to an uncompleted water sanitation project on the island. This unfinished project exemplifies that the community lacks the knowledge to implement outside ideas without external technical and financial assistance. Failure of food crops in the past years have resulted in the community needing food-related assistance from the government. Even famine foods such as breadfruit require a decent harvest to be able to have enough to put away in storage for emergencies. The community relies heavily on fish for their consumption as well as for trading for fresh vegetables on nearby islands. Declining fish stocks are therefore of a great concern given that without them, the community will not have anything with which to barter.

In conclusion, the main factors that hinder the community's adaptive capacity include geographical isolation and the smallness of the island environment they inhabit. The declining health of the island's environment, both on and off land is hindering the

community's ability to provide for itself on the island. High tides and inundation are a major concern to the community as it is affecting its limited crops and said to be affecting its water supply.

7.3 Comparison to literature

These results on factors that contribute to or hinder the community's adaptive capacity are largely consistent with other literature on the Solomon Islands. The changes to traditional knowledge that the community are observing are almost identical to those documented by Nodua (2010) on nearby Reef Islands. Although traditional knowledge in Pileni also contributes to its survival mechanisms in times of disaster, these practices are constrained by the degrading environment around them, factors also consistent with Mimura et al. (2007) and Barnett & Adger (2003). Other publications place the blame for water and fisheries degradation on overpopulation of settlements (Barnett & Adger, 2003; Nodua, 2010), but the reasons on Pileni are not immediately apparent and warrant further study so that underlying causes can be addressed. Should the root causes not be addressable, that is, if the causes are out of the community's behavioural control, then the long-term sustainability of the island is questionable. Population movements observed in other literature (Rasmussen et al., 2009) may increase as the environment on Pileni becomes harder to live with.

7.4 Lessons learned from SIRC perspective

This project was a pilot in attempting to consider climate change within the VCA toolkit. In many respects the project was considered a success by SIRC for the following reasons:

- The seasonal calendar tool was adapted to incorporate specific changes in the climate cycle by including observed changes and adding a weather, health and crops focus. As many of the islands in the Temotu Province are facing similar concerns, it is most likely that the tool will continue to be used in future VCAs.
- The project reinforced the strong relationship SIRC has with the PDMO. It is important to continue this being an auxiliary to the Solomon Islands Government in humanitarian affairs.
- This project reinforced the need for SIRC to work towards a more integrated approach that incorporates all of the organisation's expertise in community visits (rather than sectoral visits).
- It can be difficult to get a precise date when discussing things that have happened in the past with communities. It is easier for participants to remember in relation to the proximity to major events rather than specific yearly time frames. (e.g. sometime between the big earthquake and the Second World War).
- Recruiting volunteers to conduct the VCA who are from the community assisted greatly. SIRC was fortunate enough to have trained volunteers from Pileni who were currently living in Lata.
- Having a selection of male and female volunteers allowed for cultural sensitivities to be respected, active participation and for numerous voices to be heard.
- A preliminary visit undertaken before the VCA is undertaken would be more appropriate next time.
- Synthesis and simplification of scientific information regarding climate change impacts should be prioritised so that people in rural communities can get a better picture of the issues and impacts. Likewise, the observations of communities should be documented so that they inform climate change adaptation plans and projects.

From the perspective of Solomon Islands Red Cross, the project with the Pileni community has:

- increased community knowledge and understanding of the reasons for the changing nature of the climate and weather that they have observed
- identified and prioritised the need for the creation of a seawall on the east side of the island
- assisted the community work together to create solutions to challenges.

7.5 Dealing with future change on Pileni island

Climate change projections for the Pacific region point towards increased intensity and frequency of extreme weather events, warmer waters, rising sea levels and declining fisheries, on top of existing stressors such as unsustainable use of resources, population increases and conflict (Mimura et al., 2007). When reflecting upon the factors for adaptive capacity in the Pacific, the Pileni community fares reasonably well in its adaptive capacity, but however high this may be, they are ultimately severely constrained by the geographical location, both in terms of being remote and having an exceptionally small land mass.

Future solutions may come from increasing access to markets though fish stocks are already said to be declining and there is no capacity to grow more food than they need for themselves. If both the fish resources and the already limited crops are both decreasing, then the community is in a difficult position given an absence of stable cash income other than remittances. An increase in cash income would at least increase the ability to buy imported food should the fertility of the land continue to decline. This has implications on diet and waste disposal but nevertheless would enable the population to continue living on the island.

There are currently a number of water tanks and toilets on the island that are not functioning and require some technical assistance from the organisation to complete them. This would greatly assist in addressing water and sanitation needs. Access to weather-related forecasts could be enhanced to address the declining reliability of traditional weather predictions. The seawall will protect housing to some extent and reduce the ferocity of wave action during storm surges and high-tide events. Due to its remote location, limited land, finite fish resources and increasing changes, rates of population movement to other areas may rise. Nearly all respondents noted that relocation may be the only long-term solution if current rates of change continue, however most were not sure where they could go. Adaptation on the island may have its limitations, however adaptation off the island may in itself be difficult but may have to be considered.

From a broader perspective this island is representative of many others in Temotu and other provinces. The Solomon Islands has strong custodial land ownership, making acquisition difficult. Church land has facilitated some movement in the past and may continue to do so. Certainly studies into the land tenure issues would be warranted. At the time of writing, there is a PhD student undertaking an investigation in Temotu Province on this issue. SIRC noted in its report on the island that relocation is not just about moving to the mainland and that the fears, needs and priorities of relocated communities shouldn't be overlooked.

7.6 Recommendations for broader adaptation in the Pacific

There are many external human-related factors that enhance vulnerability on small island states. These vulnerabilities will only be exacerbated by climate change as interplay occurs (Mimura, 2007). It can be reliably said that if future change occurs from both human and

physical factors at this current rate, the island of Pileni will face numerous ongoing challenges, some of which are addressable through further adaptation and access to technology on the island, some may prefer to relocate from the island over time. The VCA process and the questionnaires provided valuable insights into a community experiencing challenges that are representative of the position of many small, remote island communities in the Pacific. An institution such as the Red Cross will need to play a role in helping facilitate solutions to an increasingly hostile environment.

The Pileni community proved to be the key creators of new ideas, adaptation practices and survival mechanisms. Many of their ideas are crucial for their survival and wellbeing in the short, and especially the long term. However they lack the resources and technical skill to implement them properly. Funding and technical skills will need to reach through to the most remote islands in order to improve the situation of vulnerable communities. The solution of relocation is often seen as the only long-term solution, but not for the short term as islanders are hesitant to consider this option immediately. Once relocation is identified as the only solution, the necessary steps to help communities adapt to their new environment and to enable a peaceful transition may require considerable investment.

The Solomon Islands Red Cross believes that VCAs including climate change are a comprehensive method to help communities identify priorities to enhance capacity and reduce vulnerability. The Red Cross is able to play a role as a facilitator and can help to develop, implement and disseminate good practice experiences. The islands in the Pacific carry an increasing burden from the negative impacts of climate change and there is a greater need to invest in climate change adaptation in a holistic manner.

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Annex 1. A snapshot of the literature as it relates to Pileni Island case study

For a cross comparison to be made between this study and existing literature on the Solomon Islands a literature review was narrowly focused on the Solomon Islands, development and climate variability and change. This body of literature is quite small so a combination of both academic and grey literature (reports that are non-peer reviewed) were searched. The literature has been classified below into sub-themes around the concepts of adaptive capacity, vulnerability, sectors and issues as they relate to the Solomon Islands.

Adaptive capacity

Adaptive capacity is generally considered to be low in small islands, however there is recognition that there has been resilience to environmental change in the past (Mimura et al., 2007). Some studies have investigated past dealings with climate and other hazard-related phenomenon in the Solomon Islands to assess the country's adaptive capacity (Rasmussen et al., 2009; Nodua, 2010; McAdoo et al., 2009). There is often a strong sense of tradition in the Solomon Islands and also a strong sense of identity (Nodua, 2010). Likewise, Indigenous people of Solomon Islands hold traditional knowledge that has been proven to reduce the mortality in disasters (McAdoo et al., 2009). Although traditional knowledge can strengthen resilience, adaptive capacity is often constrained by limited financial resources to enhance it (Mimura et al., 2007).

Vulnerability

In the Pacific region as a whole, vulnerability is widely assumed to be high and adaptive capacity low, however not all places are equally vulnerable as it is dependant on 'location, topography, production systems, economic base and social organisations (Rasmussen et al., 2009). The fragmented nature of the Reef Islands in Temotu province seems to play a role in vulnerability because this makes food imports expensive and services and markets difficult to access (Nodua, 2010; Tisdell, 2002). Marine resources are being overharvested and communities in the Reef Islands mentioned that it was much harder to collect fish, with experiences of spending all day fishing only to return home with a few fish. Some species are no longer seen (Nodua, 2010). Islands in the region have had the need to seek assistance from the government to find alternative sources of food. Small islands in the Pacific are also burdened by climate-sensitive health problems such as extreme events, water and vector-borne disease (Mimura, 2007).

Water

The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report stresses that there is 'very high confidence' that under climate change projections the Pacific, island water resources are likely to suffer. This is in addition to already overstretched resources, especially on islands where rainfall and groundwater extraction are the only means of water supply (Mimura et al., 2007). It has been found in the Reef Islands that wells are relied upon for cooking and washing, and rainfall for drinking water comes from tanks. In the past, well water was more suitable for drinking but it has become salty which correlates with an increase in population pressure on finite groundwater resources. When islanders run out of water on the island of Tuo they use coconuts to survive.

Population movements

In-country migration can occur for any number of reasons. Rasmussen et al. (2009) found that on Tikopia in the south of the Temotu province 'children leave the islands to go to school, adults leave to look for jobs and old people leave to get healthcare'. Nodua (2010)

notes that internal migration and resettlement in the Reef Islands in Temotu Province has increased in the past two decades and that the Reef Islands are displaying stress of an increased population via stripped vegetation and a shortage of land and water resources. Urban centres are also undergoing pressures due to movements of people in small island countries (Mimura et al., 2007). Barnett and Adger (2003) say that it is due to a combination of human and environmental factors that some Pacific islands may not be sustainable for habitation in the future.

Changes to the environment

There is some documentation of changes to traditional knowledge and ways of life that are being experienced by communities in the Solomon Islands (SIRC, 2008; Nodua, 2010). In interviews with Tuo island residents, changes to flows of currents and abnormally warm waters were noted. Elders were documented as saying that temperature is more unpredictable and is confusing to fishers. The community also feels that coral is being exposed during high tide and therefore the heat and sun are affecting it. Fruit seasons are no longer observed to be the same and elders are noticing changes to the patterns in the time when trees flower and fruit. These are relied heavily upon as there is limited room for gardens. The dry season seems to last for longer and water resources run out and plants die more. On the island of Simbo in the Western Solomon Islands it has been noted that changes to wind patterns are making it hard to predict dangerously strong winds (SIRC, 2008).

In some parts of the Pacific, changes in the intensity of extreme events have been observed, and in some cases storm surge wave heights exceeding even the worst-case predictions (Bettencourt et al., 2006). There is high confidence in the IPCC fourth assessment report that subsistence farming will suffer detrimental damage due to climate change. ‘Impacts may be felt through sea-level rise, inundation, sea-water intrusion into freshwater lenses, soil salinisation and decline in water supply’ (Mimura et al., 2007). However, Barnett and Adger (2003) state that it is not the sea-level rise itself that will threaten small islands the greatest, in fact in some cases may be able to keep forming at the rate of sea-level rise. It is the combination of coastal erosion, sea-level rise, coral reef degradation and other human interactions with the environment that may have the most adverse impacts.

In conclusion

Studies indicate that Pacific islands have strong adaptive capacity as it relates to traditional knowledge, however relatively new and enhanced threats such as sea-level rise and the threats to coral reefs ‘may present qualitatively different challenges to than past climate change and variability’, (Rasmussen et al., 2009). As outlined above, problems such as over- extraction of groundwater, increased and moving populations, overfishing and remote locations of island communities are likely to be compounded by changes in climate.

Annex 2. Results of Likert scale in key informant interviews and questionnaires

Internal key informant responses

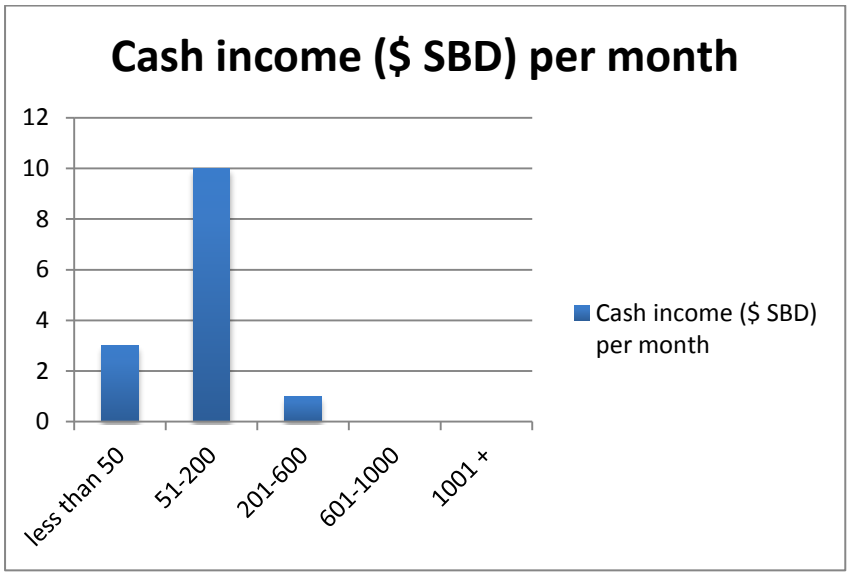
Question	Paramount Chief	Branch Officer	CC/Disaster Risk Reduction Officer
1a	3	3	3
1b	Children 2.5 Adults 4	3	2
1c	3	2	3
2c Group feeling	5	3	4
2c committees	3	3	2
3a	5	3	3
4a	1	n/a	n/a
4b	5	5	4
4c	n/a	2 51–200 most likely	3 201–600 most likely
4d	1	n/a	1
4e	4	3	2
5b	4	3	2
5c	3	Famine food 2 Subsistence 3 Imports 1	Famine food 4 Subsistence 3 Imported 2
7a	n/a	2	2

External key informant responses

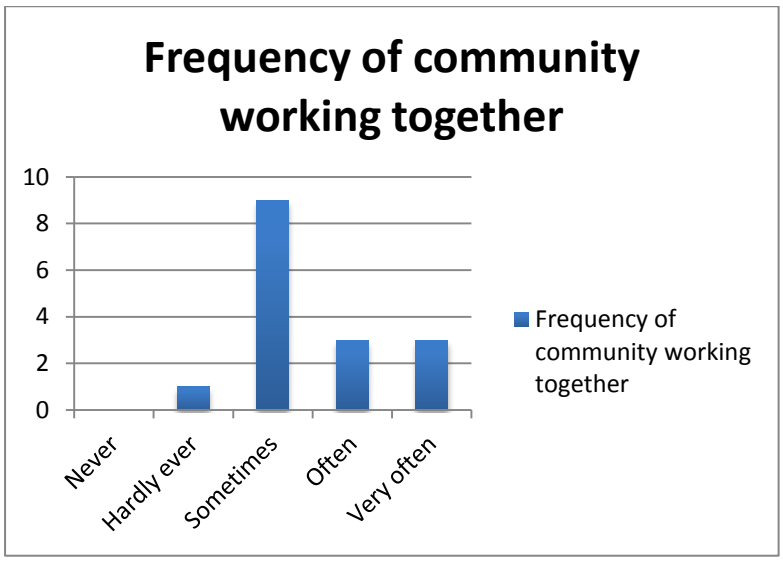
Question	Branch Officer	CCA/DRR Officer
Vision	3	3
Input	4	4

For community questionnaire responses please see below:

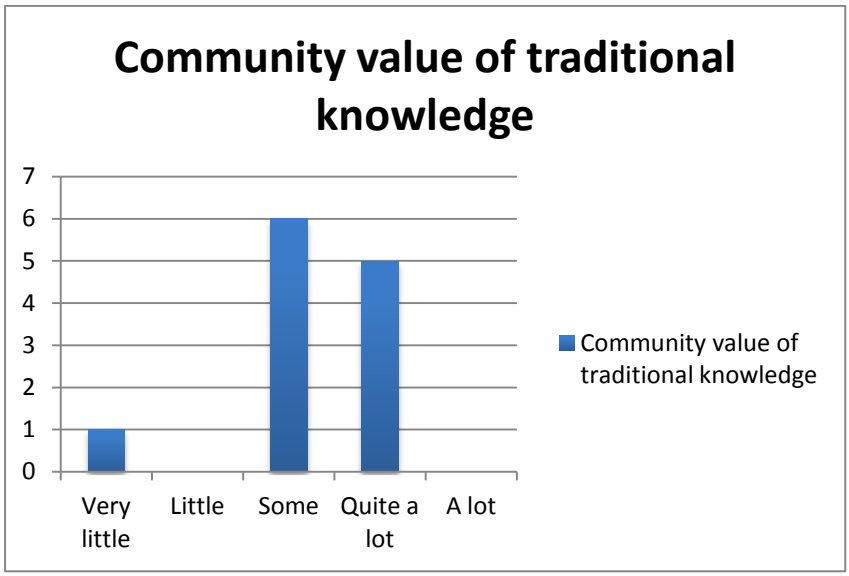
	Cash income ($ SBD) per month
less than 50	3
51–200	10
201–600	1
601–1000	0
1001 +	0



	Frequency of community working together
Never	0
Hardly ever	1
Sometimes	9
Often	3
Very often	3



	Community value of traditional knowledge
Very little	1
Little	0
Some	6
Quite a lot	5
A lot	0



	Importance of leaders in solving community problems
Never important	0
Seldom important	2
Sometimes important	2
Often important	2
Always important	10

Annex 3. List of interviewees during March 2011 research field trip to Temotu province

External key informants

Position	Organisation
Disaster Management Officer	Provincial Disaster Management Office
Climate Change and Disaster Risk Reduction Officer	Solomon Islands Red Cross
Officer in Charge	Solomon Islands Meteorological Office – Temotu office
Environmental Health Officer	Solomon Islands Health Ministry
Temotu Branch Officer	Solomon Islands Red Cross

Internal key informants

Position
Paramount Chief – Viakau ward
Island Chief – Pileni

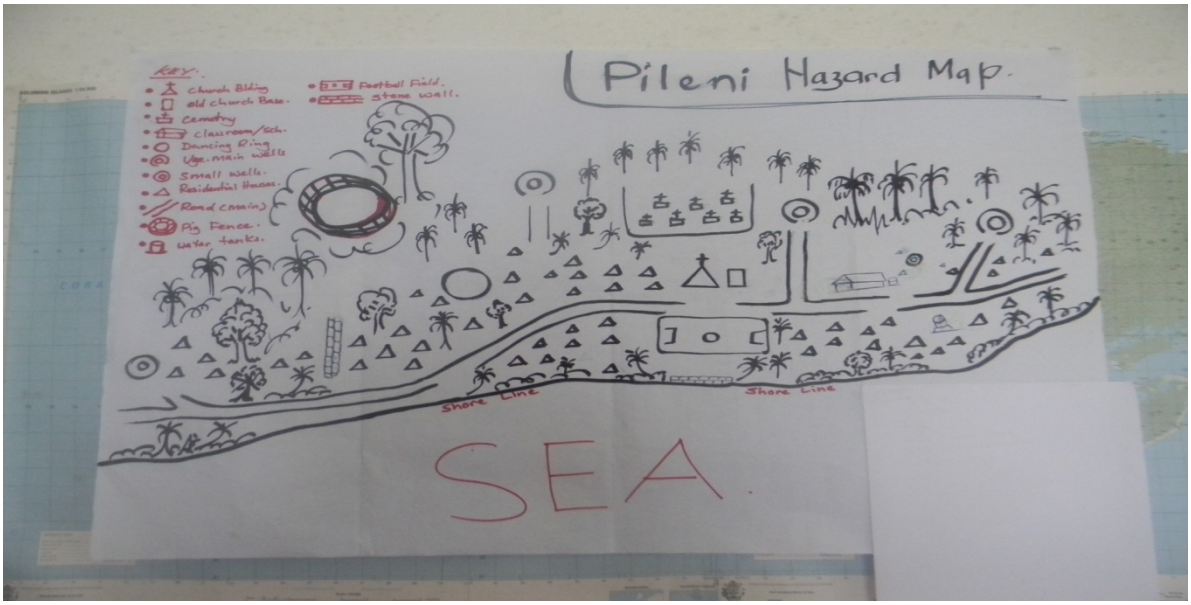
Household questionnaires

No.	Sex	Approx. age (years)
1	**Female**	22
2	**Female**	17
3	**Male**	42
4	**Male**	36
5	**Male**	unknown
6	**Male**	unknown
7	**Female**	unknown

8	**Male**	48
9	**Male**	52
10	**Male**	27
11	**Female**	26
12	**Male**	unknown
13	**Male**	unknown
14	**Male**	39
15	**Female**	unknown
16	**Male**	28

Annex 4. Results of VCA tools

Hazard Map – Pileni Island



Gender analysis – women

Time	Activity
5:00am–6:00am	Wake up, toilet, wash face
6:00am–7:00am	Prayer
7:00am–8:00am	Cook food, breakfast, student go to school
8:00am–11:30am	Wash clothes, fishing, gardening, weaving mats, feeding pigs etc.
11:30am–12:00am	Preparing lunch
Lunch	Drink coconut
1:00pm–2:00pm	Sweep around houses
2:00pm–3:00pm	Relax, sleep
3:00pm–4:00pm	Finding banana for dinner, collecting fish from canoe and do cooking
4:00pm–5:00pm	Ready kids for evening prayer, swim time

6:00pm–7:00pm	Prayer
7:00pm–8:00 pm	Dinner time/*taem fo kaikai*
8:00–9:00pm	Kids in bed
11:00pm–5:00am	Sleeping/Daddy and mummy time

Gender analysis for men

Time	Activity
6:30 am	Wake up Morning worship (church) Breakfast Pig feeding Men set off for the reef islands to barter for root crops and vegetables
8:00 am	Fishing Gardening (banana)
1:00 pm	Returning home from fishing and gardening (banana)
2:00 pm	Rest/Relaxing
6:00 pm	Evening worship (church) Story telling/sleep
7:00pm	Fishing (occasional)
9:00pm	Return from fishing

Seasonal calender

Month	Activity
January	New Year celebrations, Rainy and hunger season Students move to school
February	Planting banana and other fruit trees

March	Searching for sea resources (fish and *bech de mer*) for income
April	Easter celebrations
May	Harvesting fruits
June	Saints day
July August	Hot season Fishing Weaving mats Firewood collection
September	Preparing for Nukapu Saints Day
October	Windy season starts/rough seas, rain
November	Repairing houses, preparing for Christmas, Matema's Saint Day
December	Christmas celebration, dance