CoastAdapt

Case Study

# **Choiseul Bay Township Adaptation and Relocation program**, Choiseul Province, Solomon Islands

## Overview

For many Pacific Island nations, climate change impacts are a significant issue, particularly sea-level rise, increased vulnerability to coastal hazards and catchment flooding. The community of Choiseul Bay township, located at the northern tip of the Solomon Islands within Choiseul Province, has prepared a strategy to improve their resilience to climate change impacts.

Working in collaboration with the Australian Government's Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) programme, a team of coastal engineers, environmental scientists and planners assisted the Solomon Island's Government and the Choiseul Provincial Government to prepare an integrated climate change risk and adaptation strategy to build a more climate resilient township in Choiseul Bay. The project involved undertaking highly technical studies to determine hazard exposure, extensive community engagement to identify vulnerability and resilience, and strategic planning to formulate a solution that is cognisant of the local culture and the unique land tenure and land-use planning system. At the centre of the climate change adaptation strategy is the relocation of the capital of Choiseul Province from the current location on Taro Island to the nearby main island of Choiseul.

Planning for the relocation of the capital from Taro Island to the mainland presented some interesting challenges. A key challenge was to understand what this relocation means culturally and socially to a community so closely linked to the sea. Another challenge was to facilitate a well-functioning and completely new provincial capital that is 'split' across two non-contiguous lots, and to understand the implications this has for infrastructure provision and staging of the relocation process. Given that such a relocation of the town will take many years, if not decades, there also needed to be appropriate interim and transitional uses for Taro Island.

This case study draws on the important learnings in preparing a climate change adaptation strategy that requires communicating complex scientific messages in a simple way, and integrating the science and technical outputs of a hazard and vulnerability assessment into meaningful and responsive planning outcomes.

# Background

Choiseul Bay is located at the northern end of the island of Choiseul, within Choiseul Province, Solomon Islands. The current provincial capital is located on the small coral atoll of Taro Island, within Choiseul Bay (Figure 1). The majority of Taro Island is low-lying and less than two metres above Mean Sea Level (MSL). As the largest population centre in the province[1], Taro Island is where many surrounding communities trade and purchase provisions. It is also a key access location for transport, with the airstrip providing links to the national capital and other provinces. Many provincial facilities and services are located on Taro Island, such as the (still relatively small) referral hospital and all government administration.

There are a number of major natural coastal hazards that prevail in and around Choiseul Bay and the adjacent mainland areas, including tsunami, severe coastal storms and shoreline erosion. These coastal hazards will be exacerbated by climate change, and sea-level rise in particular. Despite the hazards, Taro Island has developed rapidly over the past 20 years or so; to the extent that further significant growth of Taro is not possible due to land constraints. Many people now live on the neighbouring Sipozae Island, however this is equally low-lying and vulnerable to coastal hazards. Land on the adjacent mainland (known as Lot 9 and Lot 277) has recently been acquired from customary landowners by the Choiseul Provincial Government (CPG) and is earmarked for future urban expansion.


*Figure 1: Choiseul Bay Locality, showing Taro Island and Adjacent Mainland Sites. Source: Haines and McGuire 2014a.*

# Context

An integrated climate change risk and adaptation plan was prepared to inform settlement planning at Choiseul Bay (BMT WBM 2014).The plan was prepared by BMT WBM environmental consultants in partnership with Buckley Vann town planning consultants and the School of Civil Engineering at the University of Queensland, along with the Australian Government, under the Pacific Australia Climate Change Science and Adaptation Planning (PASSCAP) program. The plan takes a novel approach to natural hazard resilience planning and is underpinned by rigorous assessment and integration between climate change science, engineering, town planning, community engagement and local indigenous knowledge.

# Community engagement

A comprehensive community and stakeholder engagement strategy was employed to garner critical local indigenous knowledge and provide input to the adaptation planning process (Figure 2).

Community and stakeholder engagement was designed to:

- Be culturally responsive and involve the whole community—including tribal leaders, women, children, men, Choiseul Provincial Government, Solomon Islands National Government (SIG), business owners, church representatives, NGOs, funding partners, etc.
- Draw out, understand and validate community and stakeholder views, aspirations and concerns and to show how their feedback has been reflected in the adaptation options developed and embedded in the planning and vision for the new town (Figure 3).
- Build capacity among the local community and key decision makers using simple approaches to communicating the science of climate change impacts and risk of natural hazards, using mapping, symbols and images wherever possible.

[1] In 2009, the population of Taro Island was approximately 900, while the population of the entire Choiseul province was approximately 26,000.

Seven in-country visits were carried out over the course of eight months, with four of these including extensive visits to Choiseul Bay and Taro Island. The degree of engagement, and the consistency of team members involved in the process, built trust and rapport with the stakeholders and community members. The Premier of Choiseul Province, the Honourable Jackson Kiloe, praised the consultation undertaken for the project:

"*The project involved extensive engagement with the Choiseul Provincial Government, the Solomon Islands National Government and our island communities throughout Choiseul province. The way the project was carried out, the extensive and responsive community engagement and the training of national and provincial government officers as part of the project handover, has increased our resilience and engendered support for future adaptation actions. The project followed the ways of our traditions- talking with people, listening to people and reflecting the desires of the people.*" (Jackson Kiloe, Premier, Choiseul Province, Solomon Islands).

*Figure 2: Consultation with a group of women during development of the Adaptation Plan. Source: Haines and McGuire 2014a.*

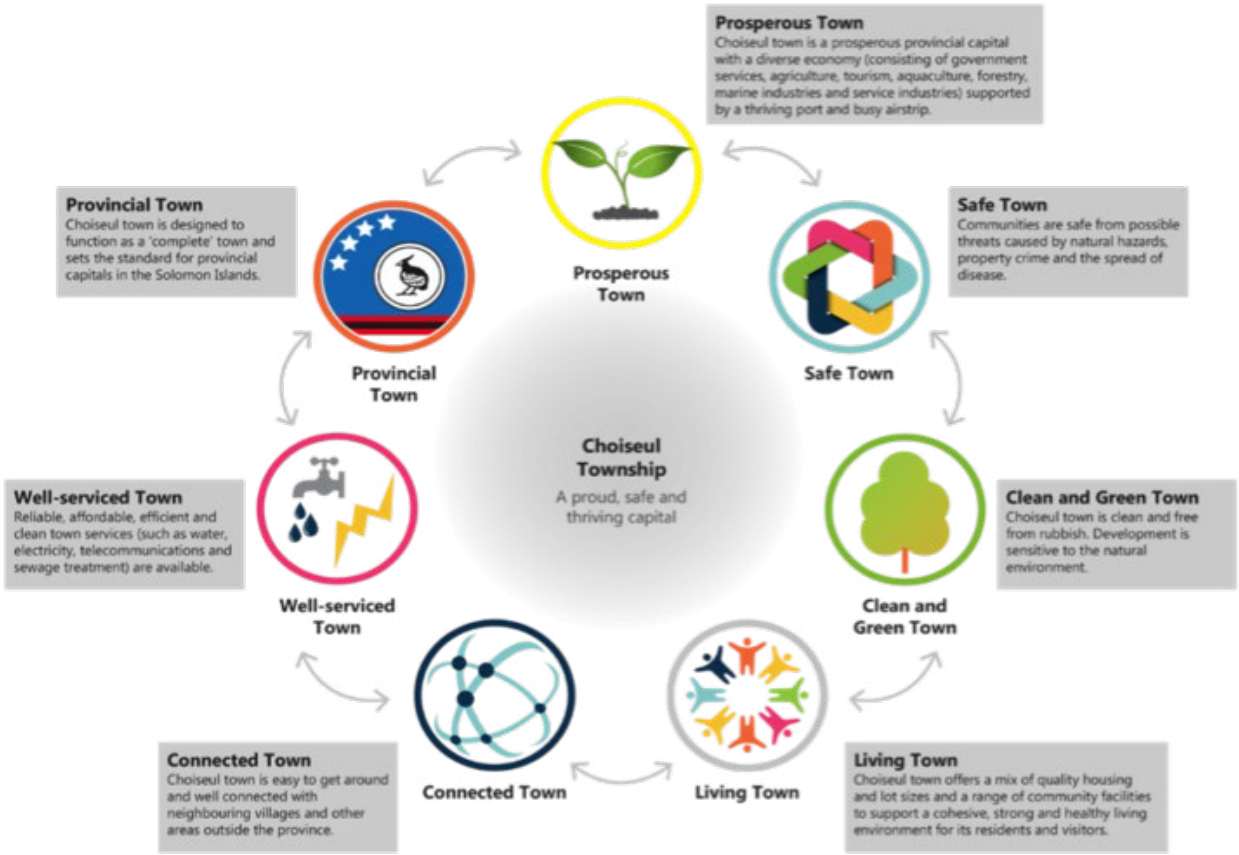


*Figure 3: Vision for the new Provincial Capital of Choiseul Province, developed in consultation with the community and stakeholders. Source: Haines and McGuire 2014a.*

# Climate vulnerability

Choiseul Bay communities are exposed to a range of natural coastal hazards, including tsunami, coastal storm and shoreline erosion. With future climate change, and sea-level rise in particular, the coastal hazards affecting communities are projected to intensify, with coastal erosion and inundation to be more dramatic and occurring more frequently. Future changes in rainfall patterns, as a result of climate change, may also affect local water supplies on Taro Island.

Coastal hazards were determined for present day conditions as well as future time periods of 2030, 2055 and 2090. These were developed using sea-level rise projections based upon the fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC 2013), giving a value of +0.82 m by 2090.

Statistically, tsunami represents the biggest coastal hazard risk to Choiseul Bay, with seven recorded tsunamis since 1950. Tsunamis can be generated within the region, along the South Solomon Trench, about 100 km from Choiseul. A tsunami originating from the South Solomon Trench occurred in April 2007, devastating coastal villages around Gizo with many lives lost. Tsunamis can also be generated from across the ocean (e.g. Japan, Chile). The Great East Japan tsunami in 2011 affected the Solomon Islands, although the largest waves were one metre in height and coincided with low tide resulting in little actual damage.

All infrastructure, housing and services on Taro Island and other low-lying areas around Choiseul Bay are at risk of tsunamis. The analysis undertaken showed that future sea-level rise will increase the extent of potential tsunami inundation and likelihood of impact on existing facilities. Computer modelling of tsunami events was carried out to quantify the magnitude of local wave heights and to determine the extent of inundation under different future sea-level rise scenarios. For present day conditions, a 1% Annual Exceedance Probability (AEP, 1 in 100 chance) tsunami would inundate 95% of the island, leaving just 2 ha of flood-free land for emergency refuge (Table 1). By 2090, flood-free land would be less than 0.5 ha for an equivalent event.

*Table 1: Approximate tsunami risk for Taro Island. Source: Haines and McGuire 2014a.*

| Frequency of tsunami occurrence (Annual Exceedence Probability, AEP) | Magnitude of local seismic event (approx.) – epicentre within about 100 km from Taro Island | Approximate tsunami wave height at Taro Island | Maximum inundation level (m, MSL) @ 2014 | Maximum inundation level (m, MSL) @ 2090 |
|---|---|---|---|---|
| 5% (~1 in 20 years ARI[2]) | 7.9 | 2 m | 2.0 | 2.8 |
| 1% (~1 in 100 years ARI[2]) | 8.2 | 3 m | 3.1 | 3.9 |
| 0.2% (~1 in 500 yrs ARI[2]) | 8.5 | 5 m | 4.7 | 5.5 |

[2]*ARI = Annual Recurrence Interval.*

# Definition and quantification of risk

A risk management approach[3] was used to consider and assess the potential impacts of natural hazards and future climate change on the community of Taro Island and the broader Choiseul Province. Existing coastal hazards at Choiseul Bay are particularly complex, due to the significant effects of tsunamis, which are inherently difficult to predict (including their coincidence with natural tidal variations).

Risk is defined as the combination of the likelihood of a hazard occurring, and the consequence of impacts when a hazard event occurs (i.e. RISK = LIKELIHOOD x CONSEQUENCE). Likelihoods of events were determined based on the quantification of natural hazards with areas defined as having 'almost certain', 'possible' and 'rare' likelihoods at timeframes of 2014, 2030, 2055 and 2090. Different likelihoods were established for different risks, including coastal recession, permanent tidal inundation and temporary inundation due to storm tide and tsunami (Table 2).

*Table 2: Likelihood scale for tsunami inundation of Taro Island. Source: Haines and McGuire 2014b.*

| Rating | Present-day | 2030 | 2055 | 2090 |
|---|---|---|---|---|
| Almost certain | Mean Higher High Water + 0.5m 1.1 m MSL | As per present-day, but with 0.09 m of SLR (best-estimate of RCP 2.6 in AR5): 1.2m MSL | As per present-day, but with 0.24 m of SLR (best-estimate of RCP 2.6 in AR5): 1.3 m MSL | As per present-day, but with 0.40 m of SLR (best-estimate of RCP 2.6 in AR5): 1.3 m MSL |
| Possible | The highest level of either a 5% AEP storm tide, flood or tsunami event: 2.0 m MSL | The highest level of either a 5% AEP storm tide, flood or tsunami event with 0.15 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 2.2 m MSL | The highest level of either a 5% AEP storm tide, flood or tsunami event with 0.38 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 2.4 m MSL | The highest level of either a 5% AEP storm tide, flood or tsunami event with 0.82 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 2.8 m MSL |
| Rare | The highest level of either a 1 in 100 year ARI storm tide, flood or tsunami event: 3.1 m MSL | The highest level of either a 1% AEP storm tide, flood or tsunami event with 0.15 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 3.3 m MSL | The highest level of either a 1% AEP storm tide, flood or tsunami event with 0.38 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 3.5 m MSL | The highest level of either a 1% AEP storm tide, flood or tsunami event with 0.82 m of SLR (upper end estimate of likely range of RCP 8.5 in AR5): 3.9 m MSL |

[3] The International Standard *Risk management – Principles and guidelines* (AS/NZS ISO 31000:2009) is a recognised and reliable methodology for systematic application of procedures and practices to establish the context, and identify, analyse, evaluate and treat risks. While this standard has been regularly implemented in various contexts, the more recent *Australian Standard Climate change adaptation for settlements and infrastructure – A risk based approach* (AS 5334-2013) has been developed to provide a systematic approach to planning for adaptation to risks resulting from climate change hazards. Both AS/NZS ISO 31000:2009 and AS 5334-2013 have been referred to and applied in the context of the Choiseul Bay Climate Change Project.

The definition of consequences of hazards highlighted the potential impacts on various values of the local and national community, including infrastructure/services, social/cultural values, environmental values/services and finances/economy. Consequences of hazards on values were derived from the outcomes of the comprehensive community and stakeholder engagement carried out for the project. Consequences were rated as 'insignificant', 'minor', 'moderate', 'major' and 'catastrophic', the assignment of levels also noted the nature and magnitude of the impact (including whether the impact is permanent or temporary), secondary consequences in terms of health, disruption etc., and the timeframe for consequences (including expected capacity for post-event recovery). Most existing assets and infrastructure on Taro Island have little resilience to tsunami and other coastal processes.

Likelihoods and consequences of specific events were combined using a standard matrix to derive levels of risks (low, medium, high and extreme) to specific community values and assets. Separate risks were established for the different timeframes considered by the hazard assessment, with risks generally increasing with time given the susceptibility to climate change and sea-level rise in particular.

Determining which risks to treat as part of future adaptation planning was based upon the tolerance for risk of the community and stakeholders. In most cases it would be expected that low risks can simply be monitored, rather than demand valuable management resources, while extreme or high risks require more immediate management attention. High risks for near-term (2014 and 2030) and extreme risks for any timeframe (2014–2090) were considered intolerable, and therefore became the immediate focus for risk management. Near-term medium risks and future (2055, 2090) high risks were considered to be second tier tolerable risks, while future medium risks and all low risks were regarded as acceptable risks in the current context.

This form of risk assessment is inherently subjective, as it relies on judgement decisions for assigning both likelihood and consequence levels. To help overcome this subjectivity, community and stakeholder engagement was used to validate the risk assessment outcomes. It became apparent through the consultation process that community members and government representatives possessed an intimate appreciation of the risks associated with their land, assets and infrastructure. The validation process allowed for the refinement of risks, which also took into account existing controls (such as design considerations) that already help manage potential impacts of natural coastal hazards.

## Adaptation options

Irrespective of the potential for loss of land and assets, the existing population of Taro Island (as well as the adjacent Sipozae Island) is at significant risk of fatalities in the event of major natural hazards, such as tsunami. Experience has shown that evacuation of Taro Island to the mainland takes approximately one to two hours. This includes moving all patients and staff from the hospital as well as elderly and infirm villagers from throughout the community. Notwithstanding the ability of the community to evacuate from Taro Island, if a tsunami originates on the South Solomon Trench, significant surge waves would strike Taro Island within about 15–20 minutes (as was the case for the 2007 Gizo tsunami).

Rather than evacuating to the mainland, the most appropriate response by the community would be to seek refuge at the high point of Taro Island (yet only about 2 ha of land is at 3–4 m above mean sea level). Under present-day conditions, this high point would be relatively safe from tsunamis up to about a 1% AEP (1 in 100 chance) level. With future sea-level rise, however, the higher land would become more vulnerable to inundation. Eventually, there would be no suitable refuge location on Taro Island for the significant level of population at risk.

The only viable option for long-term mitigation of risk to life is relocation of the entire population to a safer site on the mainland. Relocation would also address existing and future risks to community assets and services assuming that these facilities would also be relocated to the mainland. Relocation of a provincial capital is an enormous undertaking. Within the Pacific region, relocation of a provincial capital has only occurred once before—at East New Britain Province, Papua New Guinea, when the former capital of Rabaul was destroyed by volcano eruptions in 1994.

As well as the challenge of securing suitable land, the logistics of relocating a provincial capital are very complex as the full range of modern provincial services, infrastructure and community facilities needs to be accommodated. This includes land and sea connections, power, water, wastewater, solid waste management and telecommunications. Additionally, as a new and well-functioning provincial capital, the township would be expected to provide a range of health, vocational, educational, open space, recreation, commercial, retail and industrial opportunities and sufficient residential areas to support a prosperous and thriving community for many generations to come.

A masterplan was prepared for the new provincial capital on the mainland as part of the adaptation planning project to identify and guide appropriate future development, land use and layout. The masterplan was underpinned by a site analysis that took account of future climate change risks (to 2090 as a minimum), as well as other site-based risks, constraints, environmental values and cultural considerations. Cultural considerations were diverse including; land suitability for services, proximity of a new school to crocodile-infested waters, future road access to neighbouring villages, future boat access to islands, pedestrian links to the foreshore and mangroves, deep water access for port uses, adequate separation between the hospital and industrial uses and consideration of amenity issues for adjoining customary lands. It was also necessary to allocate or zone enough land to accommodate expected population growth including land for housing, business, industrial and other employment opportunities (Figure 4).

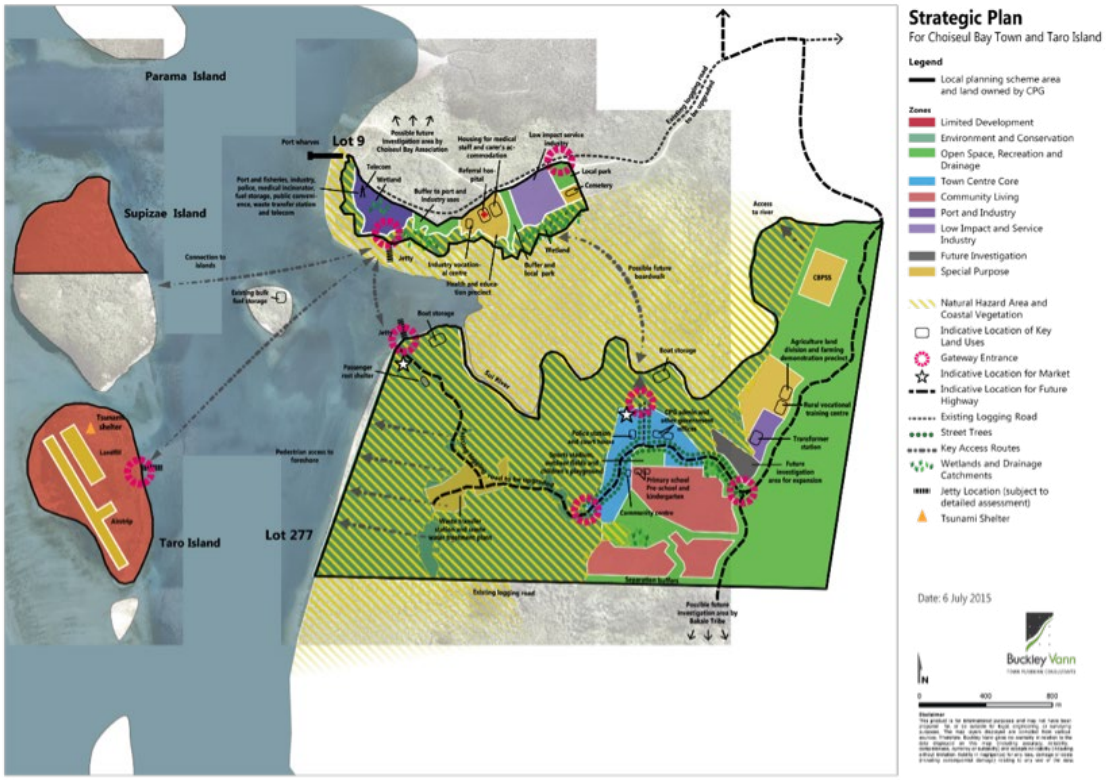


*Figure 4: Strategic map for Choiseul Bay new township. Source: Haines and McGuire 2014a.*

Integration of the science, engineering and risk analysis of natural hazards into the planning policies and framework was essential. The following key tenets that underpin community climate change resilience have been embedded into the adaptation plan:

- acknowledging the relocation of the provincial capital from Taro to the new township site will occur over time and that this is a priority policy outcome
- providing direction on the location of an emergency tsunami refuge shelter for Taro and Sipozae Islands and including design requirements for the shelter, which align with the risks of tsunami inundation
- discouraging further development on Taro and Sipozae Islands whilst encouraging new development on the mainland, as a way of promoting the overall relocation process
- assigning land on Taro and Sipozae Islands to a Limited Development Zone to recognise significant risks from coastal hazards, and specifying design requirements if development and new buildings were to occur
- protecting and enhancing mangroves and reefs for their resilience functions against coastal hazards
- allocating land on the new township site to the Environment and Conservation Zone and identifying land at risk from natural hazards of tsunami, storm tide, coastal erosion, sea-level rise and flooding (up to a 2090 horizon), and providing direction on what types of limited activities or uses can occur on these restricted lands
- encouraging and recognising the importance of not clear-felling all vegetation from the new township site and providing shady places throughout the new town to improve comfort
- promoting principles of water sensitive urban design and using water wisely including requirements for large rain water tanks on public and private buildings.

Only the progressive relocation of the Taro Island population to the mainland would fully address risks associated with present and future tsunami events and severe coastal storms. This will take many years or decades to occur and therefore the integrated adaptation plan includes other actions and initiatives to manage climate change and other coastal-related risks to existing development until such time that provincial services have been relocated. Other options include emergency response planning for tsunami events, asset management planning to minimise future damage or disruption to the community infrastructure (covering both existing and future assets), and revegetation works along the shoreline of Taro Island to help build resilience to coastal hazard events. In addition, a range of monitoring activities were recommended to help guide future decision making by the CPG.

## Next steps

Subject to available funding, it is expected most provincial services and development on Taro Island will be progressively relocated to the mainland over the next 10–20 years. Provisions are included in the draft local planning scheme to ensure that any interim development on the islands is appropriately considered, designed and located. Specifically, where new development cannot be avoided (e.g. if relocation of the service is unlikely to occur in the short-term), then new development must be designed to be 'higher and stronger' to better accommodate the risk of inundation from tsunami events.

Whilst the establishment and financial support of a local project office could be accommodated by funds from the National Government, the implementation of major township relocation activities—such as feasibility studies and construction works—will require substantial funding from international donors. As the relocation project covers many elements (e.g. roads, administration facilities, hydropower, water and wastewater, marine infrastructure, hazard risk reduction, disaster relief, etc.), it is expected that a range of donors would potentially be willing to contribute funds to individual development projects that are aligned with their own broader goals and objectives. Suggested donors include, but are not be limited to: World Bank, Asian Development Bank, Australian Aid, NZ Aid, JICA, UN, and GIZ.

## Outcomes

The general outcomes of this project are best summarised by the words of the CPG Chief Planner, Mr Geoffrey Pakipota, to the project team:

*"Your input into the project has been acknowledged as a precious and valuable piece of work (gift) by the Government and people of Choiseul Province. Personally, much was gained and experienced from all of you. Hope to meet all of you anytime soon. This project has been termed by the National Government of Solomon Islands as a forerunner to development and establishment of growth centres throughout the country. This project is truly unique in the country and in the Pacific, or even in the world. It is a blend of scientific, technical skill/expertise plus local indigenous knowledge"*. (Geoffrey Pakipota, Chief Planner, Choiseul Provincial Government).

## Lessons learnt

The adaptation plan shows a clear blueprint for future climate change resilience and there was considerable enthusiasm in the relocation project shown by the communities of Choiseul Bay. However, the slow pace of government decision-making (in both SIG and CPG) has impeded progress and effective implementation of the project since its completion in July 2014. As a result, the community lacks confidence that the CPG will be able to undertake the very big task ahead of managing the relocation process, and it appears unlikely that relocation will be achieved within a timeframe that is considered reasonable and commensurate with the risk exposure.

It is recognised that a lack of strategic foresight and effective enforcement of town planning regulations in Honiara has resulted in considerable inappropriate and illegal developments. The ground-up development of a new provincial capital in Choiseul Bay has the opportunity to set a good planning standard from the outset and avoid a repeat of Honiara landuse issues. Education of planning officers at the provincial and national level, supported by strong enforcement of legislation and a dedicated compliance team, is essential to help achieve good planning practice.

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# Further reading

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**Additional online resources for further reading** (all links accessed 25 May 2017):

http://www.theage.com.au/interactive/2015/the-vanishing-island/

http://www.scientificamerican.com/article/township-in-solomon-islands-is-1st-in-pacific-to-relocate-due-to-climate-change/

http://pacific.scoop.co.nz/2014/08/choiseul-first-climate-change-town-to-move-in-bid-to-beat-tsunamis/

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CoastAdapt

NCCARF National Climate Change Adaptation Research Facility

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