Global Climate Change Alliance: Pacific Small Island States Case Study

- **Best practice coastal protection in Tonga**

PREPARED FOR

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1. INTRODUCTION

This case study is one of three produced as part of the Global Climate Change Alliance: Pacific Small Island States post-project evaluation[1].

The Global Climate Change Alliance: Pacific Small Island States (GCCA: PSIS) Project is a European Union (EU) funded initiative to assist nine smaller Pacific Island states (Cook Islands, Federated States of Micronesia, Kiribati, Marshall Islands, Nauru, Niue, Palau, Tonga and Tuvalu) to adapt to climate change. The project was implemented by the Pacific Community (SPC), with an implementation period from July 2011 through to November 2016[2].

The overall objective of the project was to support the governments of nine small island states of the Pacific in their efforts to tackle the adverse effects of climate change.

The GCCA: PSIS project consisted of on-ground climate change adaptation activities in specific sectors – coastal protection, marine resources, health, agriculture, and freshwater; supported by mainstreaming of climate change into national and sectoral policies, plans, budgets and procedures. The project also provided technical assistance, capacity building and supported regional collaboration.

The four components and key result areas (KRA) of the project were:

1. Climate change mainstreamed into national and/or sector response strategies.
2. Well-articulated sectoral adaptation strategies that address budget support criteria.
3. National climate change adaptation projects implemented.
4. Streamlined technical assistance that supports national adaptation responses delivered by regional organisations in a collaborative manner.

The case study presented below capture key best practices found by the evaluation consultants during their field trip to Tonga.

[1] The evaluation report is presented as a full report containing all sections, as well as separate executive summary, individual country evaluation summaries and case studies.
[2] The project was granted a one-year extension.

2. BEST PRACTICE COASTAL PROTECTION IN TONGA

The SPC GCCA: PSIS project in Tongatapu successfully implemented two new coastal protection measures. Whilst the long term impact of these measures is still unknown, the processes the project followed to design, implement and monitor the project can be considered best practices that should be replicated in future coastal protection projects.

2.1 Results Summary

Coastal protection design and implementation was informed by historical coastal change studies, feasibility studies, detailed design and costing, Environmental Impact Assessment (EIA) and monitoring plan. The following "hard engineering" coastal protection measures were implemented:

- 20 groynes using concrete sedi-tunnels[3]
- 10 detached breakwaters

Groynes were complemented with sand recharge to speed up the natural sand recharge process. Detached breakwaters were complemented with sand recharge and coastal replanting of mangroves and other plants. The approaches chosen are categorised as 'accommodation approaches' that incorporate aspects of a 'managed advance' that accepts that the measures will only provide short-medium term protection from coastal erosion and rising sea levels. Three parks (playgrounds) were also constructed on the foreshore for communities.

2.2 Best practice design

Site selection

The selection of potential sites for the Tonga coastal protection measures was informed by the 2010 – 2015 JNAP and by a pre-existing coastal engineering study[4] undertaken by CTL Consult that considered:

- the extent of existing and predicted future coastal erosion if no action was taken;
- the number and importance of assets (homes, businesses, essential services) vulnerable to the impacts of coastal erosion. The number of vulnerable people at risk was also assessed
- the root causes of erosion; and
- numerous physical[5], biological[6] and human related parameters[7].

[3] 1 meter cubed concrete block with horizontal hole through middle to allow flow of water and sand.
[4] 'Report of Coastal Feasibility Studies – Coastal Feasibility Studies, Coastal Design and Costing, for six (6) communities on the Eastern Site of Tongatapu', March 2012
[5] Physical parameter - geology, wind, waves, cyclone, tide levels, sea level rise and climate change, sedimentology, groundwater, coastal change

[6] Biological parameter - sea and air temperature, coastal and marine habitats, landscape, environmental status
[7] Human related parameters - land use, community stakeholder issues, planning and legislative policy parameters, statutory laws

Selection of coastal protection measures

Coastal protection measures are sometimes selected based on economic constraints and the preferences of the government, land owners and community. This can limit options. Whilst it is good to consult and work closely with communities, coastal erosion processes and coastal protection are complex topics that require expert design. For example, sea walls are often a preferred choice for coastal protection measures. However, sea walls are not always effective and can in cases increase coastal erosion and inland flooding. They are also very expensive to construct (per meter of coastline protected) relative to some other hard and soft engineering options.

The Tonga coastal feasibility study was followed up by a Coastal Design and Costings Report (2012) that assessed in more detail the appropriateness of various hard and soft coastal protection measures for each unique segment of coastline. Recommendations for coastal protection measures were justified at the conclusion of the report.

Why is coastal erosion occurring in Eastern Tongatapu?

Historical sanding mining, removal of mangroves, damage to coastal reef flats, and high wave events during storms and cyclones are among the causes of coastal erosion. Sea level rise and heightened storm surge events attributed to climate change were projected to increase both coastal erosion and its negative impacts.

Detailed design

Following recommendations in the Coastal Design and Costings Report, in 2013 the Tonga project sought the services of a coastal engineer to review the recommended solutions in light of more current data before detailed engineering drawings were produced. The 2013 design work also included a review of historical data (aerial photographs) and recent studies (including the CTL reports) pertaining to erosion of Eastern Tongatapu. A final detailed design document was produced in mid-2013 that included technical engineering drawings for the selected coastal protection measures[8]. The detailed design also included estimated long term maintenance works and costs that may be required. Consultations were held with community leaders and members to inform them about the preferred design and to hear their views.

2.3 Best practice implementation

Project management unit

The Project Management Unit (PMU) was effective in its role. Factors contributing to the PMU's effectiveness include a capable project manager with excellent communication skills, a capable finance assistant and an experienced engineer on secondment from the Ministry of Infrastructure to oversee the coastal works. This oversight ensured works were undertaken according to the detailed design and that recommendations raised by the EIA were followed.

Project oversight

In addition to on-ground oversight of the civil works, the project also had effective oversight at a higher level from the Tonga JNAP Technical Working Group (TWG). The TWG met monthly, was briefed regularly about the project status, reviewed reports, provided input and guidance, and raised questions to challenge assumptions. The design coastal engineer also visited three times during

[8] 'Final Design of Two Coastal Erosion Options for Eastern Tongatapu, Tonga', e-Coast, 2013.

implementation to provide general oversight and advice, consult with the PMU and make any adjustments if necessary.

Environmental impact assessment and monitoring plan

An Environmental Impact Assessment (EIA) was undertaken in 2013 following CTL's Coastal Feasibility Study. As final coastal protection measures had not yet been selected, the EIA reviewed the impact of the shortlisted approaches at the target sites. A comprehensive 130-page EIA report was produced and used to guide environmental considerations in the final design and a monitoring plan that was also developed by the coastal engineer.

2.4 Best practice monitoring

Tonga's Geology Division situated within the Ministry of Lands, Survey & Natural Resources committed to undertaking quarterly monitoring (focused on beach profiles) during and beyond the end of the project completion date to determine the effectiveness of the coastal protection measures over time. A monitoring plan created as part of the detailed design process was used to guide what and how to monitor. This work started with baseline monitoring before the civil works started. One site monitoring assessment has been undertaken since the coastal works have been completed. Initial results look promising in terms of demonstrating the effectiveness of the measures. However long-term monitoring is required to determine the impact of the coastal protection project.

2.5 Conclusion

The Tonga coastal protection project demonstrated best practices during design, implementation, and monitoring. These best practices should be replicated and followed in future projects. Key elements of these best practises are summarised below.

Design

Select target sites and coastal protection measures based on:

- historical analysis of sites;
- coastal process and feasibility studies;
- detailed design and costing studies undertaken by an experienced costal engineer; and
- detailed designs to include a monitoring plan and long-term maintenance tasks and costs.

Implementation

Ensure PMU has a competent project manager with good communication skills and an experienced engineer to oversee civil works.

Use an oversight committee that meets regularly with required expertise to advise the project and question assumptions.

Comply with government requirements such as to undertake an EIA before works begin to assess and minimise environmental risks and monitor compliance with the recommendations of the EIA.

Monitoring

Plan and obtain commitment for long-term monitoring of coastal sites to assess the effectiveness of coastal protection measures over time.

Whilst the Tonga GCCA: PSIS project has demonstrated many best practices, one area where improvements could be made are to put in place measures to ensure government funds are available for the maintenance of the new coastal protection assets. The establishment of the Tonga Climate Change Trust Funds may be one source of future funding to support asset maintenance.