

# Situation Report Cook Islands

## Impact assessment of past climate change adaptation actions



Sustainable,  
transformative,  
and resilient for a  
**Blue Pacific** **SPREP**  
**PROE**



# **Impacts Assessment of Past Climate Change Adaptation Actions**

## **Situation Report Cook Islands**

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**Wolf Forstreuter, P.O. Box 3786, Samabula, Suva, Fiji Islands. Email:**  
**[wolf.forstreuter@gmail.com](mailto:wolf.forstreuter@gmail.com) +679-3322193**

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# 1 Introduction

The purpose to employ a GIS and remote sensing specialist is the visualisation and quantitative documentation of climate change adaptation actions impact. A measurable increase of a beach in Tonga due to the establishment of breakwaters is one of the very few feasible examples. Impact will be visible over time but not directly after the establishment of infrastructure elements.

However, the quantitative<sup>1</sup> documentation of elements such as water tanks, seawalls, groynes, etc. is essential and must be monitored<sup>2</sup>. These elements must still exist before the impact can be monitored. If for example coastal protection structures partly disappear the impact is reduced. The first documentation has to record the time of establishment, location and dimension. To document the location only is not sufficient; the dimension and time of establishment is essential. For such a baseline quantitative documentation for the outer islands of Cook Islands data seem to be missing.

It is recommended to establish for every island a database with spatial components showing the elements and annotation data of dimension and quality. However, this most probably exists in Cook Islands from where a PCCAA database can copy.

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1 Quantitative = documentation of dimensions such as length, width, height, etc. in opposite to descriptive.

2 Monitoring is the measurement and documentation in regular intervals to record changes.

## 2 Climate Proofing of Coastal Development at Mangaia Island

### 2.1 Mangaia Island

Mangaia is the most southerly of the Cook Islands and the second largest, after Rarotonga. It is a roughly circular island, with an area of 51.8 square kilometres, 203 kilometres from Rarotonga. Originally heavily populated, Mangaia's population has dropped by 75% in the last 50 years.

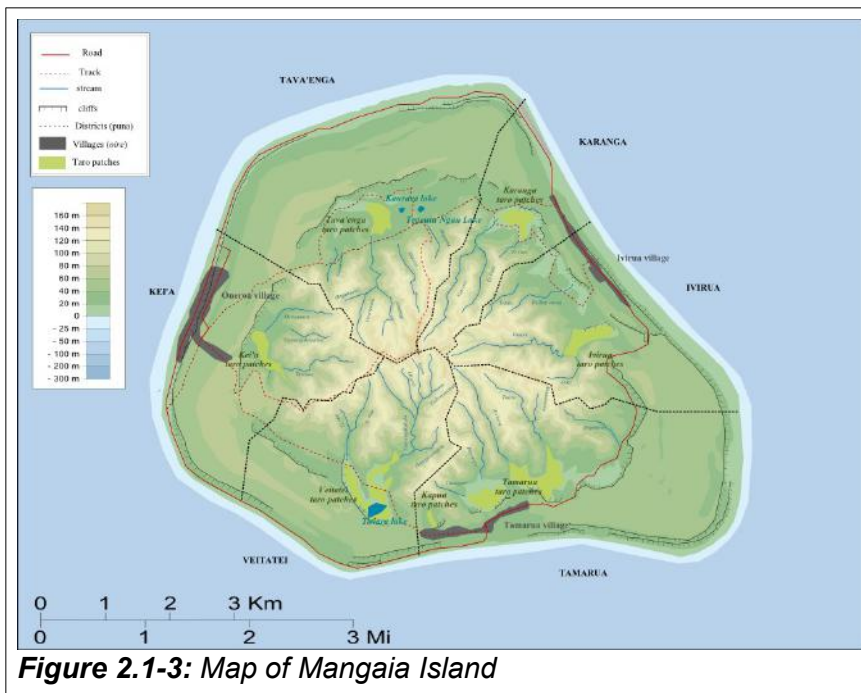
Geologists estimate the island is at least 18 million years old. It rises 4750 m above the ocean floor and has a land area of 51.8 km<sup>2</sup>. Surrounded by a fringing coral reef, like many of the southern Cook Islands, it is surrounded by a high ring of cliffs of fossil coral 60 m high. The inner rim of the makatea forms a steep cliff, surrounding swamps and a central volcanic plateau. The highest point is Rangi-motia, 169 m above sea level, near the centre of the island. Lake Tiriara is a body of fresh water in the south<sup>3</sup>.



**Figure 2.1-1:** Location of Cook Islands



**Figure 2.1-2:** Location of Mangaia Islands within the Cook Islands.



**Figure 2.1-3:** Map of Mangaia Island

### 2.2 The PACC Project

The PACC project was running from 2011 to 2014 and supported climate proofing of coastal development at the island. First concern was to increase access to Mangaia harbour with the widening and deepening of the channel.

3 Wikipedia



**Figure 2.2-1:** Satellite image of Mangaia Island recorded 23 JUL 2019. The arrow point to the harbour location.



**Figure 2.1-2:** Mangaia harbour recorded 23 JUL 2019



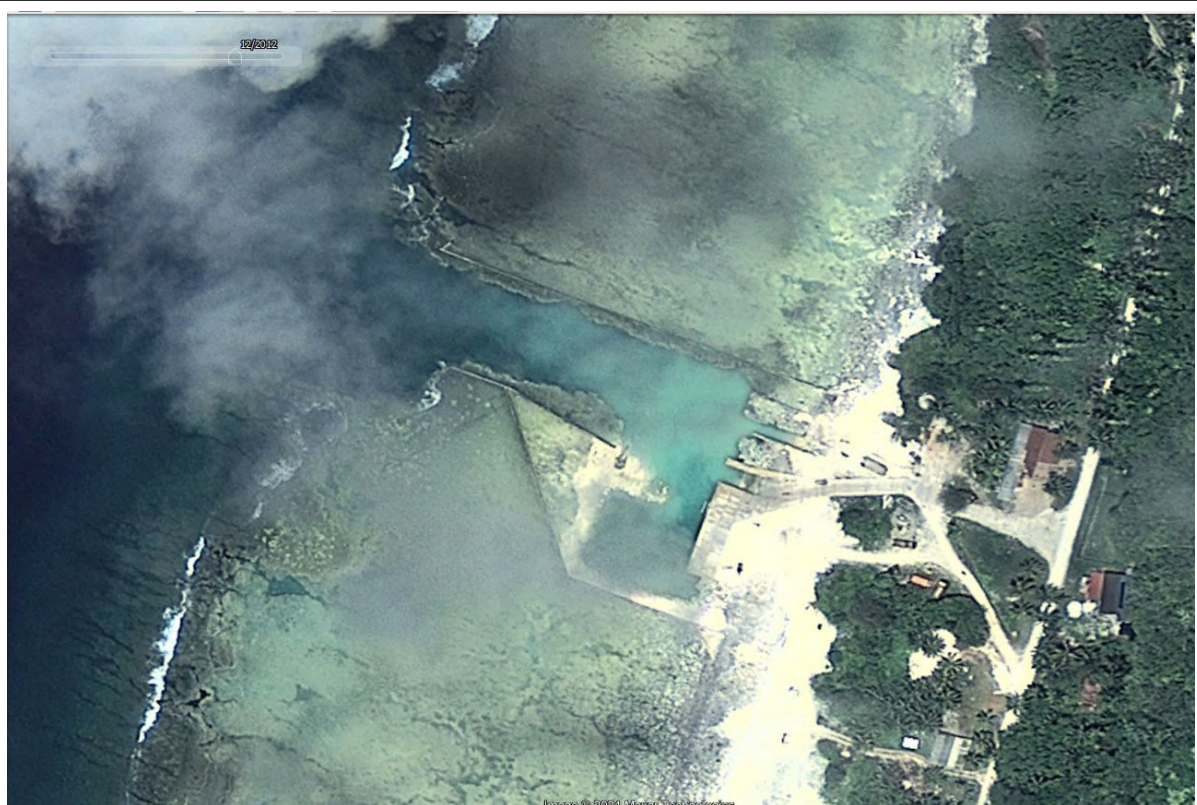
**Figure 2.2-3: -Mangaia harbour recorded 03 JUN 2016**



**Figure 2.2-4: -Mangaia harbour recorded 05 JUL 2014**



**Figure 2.2-5: -Mangaia harbour recorded 22 MAR 2013**



**Figure 2.2-6: -Mangaia harbour recorded 24 DEC 2012**





**Figure 2.2-7: Mangaia harbour recorded 21 NOV 2011**

The series of satellite image data clearly show that the main development of the harbour basin and the pier was performed between end 2011 and end 2012. Between 2016 and 2019 additional infrastructure elements like buildings were added.

The deepening of the channel is not visible with the available image data. However, it is assumed that with a visible developed pier the water must be deep enough to moor the vessels.

### 3 Increase of Economic Resilience of Pearl Farmers in Manihiki

#### 3.1 Manihiki

Manihiki is an atoll in the northern group of the Cook Islands known informally as the "Island of Pearls". It is located in the Northern Cook Island chain, approximately 1,299 kilometres north of Rarotonga, making it one of the most remote inhabitations in the Pacific Ocean. Manihiki is a roughly triangular-shaped coral atoll, consisting of approximately 43 islets surrounding a deep, nine kilometre wide lagoon, which is almost completely enclosed by the surrounding reef. The atoll is located on top of an underwater mountain rising 4,000 meters from the ocean floor. The inhabitants are divided between the two main islets of Tauhunu on the west coast (where the government administration is based) and Tukao in the north, (where Manihiki Island Airport is located). The total



**Figure 3.1-01: Location Manihiki**



**Figure 3.1-02: Google Earth display of Manihiki. image data recorded 14 December 2015.**

land area is approximately 4 square kilometres. The economy of Manihiki is dominated by the cultivation of black pearls and there are pearl farms dotted around the lagoon. Tourism provides a secondary source of income<sup>4</sup>.

The GCCA PSIS (2013-2015) increased economic resilience of pearl farmers in Manihiki though increased ability to reduce the negative impacts of climate variability on their pearl shells. Project activities included the training of pearl farmers in water quality monitoring and set up of monitoring equipment to provide real time data of extreme conditions at Manihiki lagoon for the pearl farmers<sup>5</sup>.

4 Wikipedia

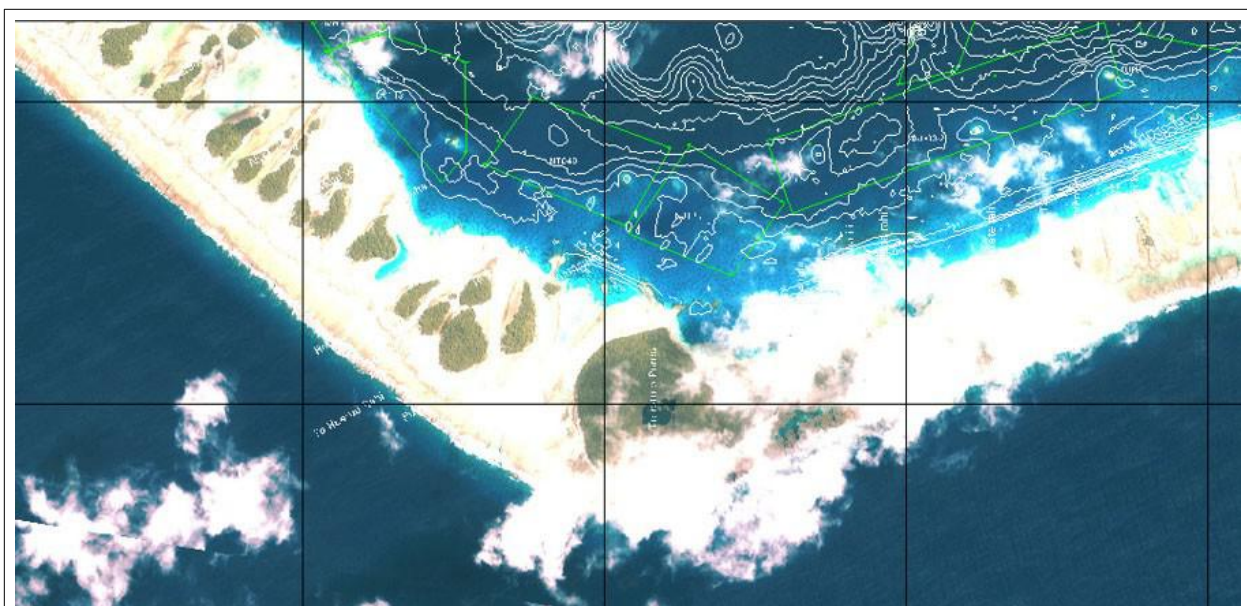
5 Copied from SPREP Service Agreement

The situation in Manihiki with a high number of pearl farms in the atoll is not new. Already 20 years ago disease outbreaks happened through possible overpopulation of farms during low water circulation conditions. Remote sensing methods can recognise changes of water colour, however, that stage would be far too late to solve the problem.

Spatial data can help the farm management if following data is incorporated which was done 20 years ago:

- Farm boundaries through DGPS survey,
- Bathymetry mapping with subsequent water circulation modelling,
- High resolution image data,
- Tabular data of pearl farm stock and harvest per farm.

Weather forecast, pearl shell stocking and water quality measurements can predict outbreaks and avoid them. Important was a central management of all pearl farm in the lagoon.



**Figure 3.1-03:** Pearl farm map, SOPAC 2002. Visible are the farm boundaries in green, the bathymetry as white contour lines and very high resolution image data further visualising the bathymetry.

All elements such as stock per farm, harvest per farm, water quality measurements can be included in “living” thematic maps. These maps updates whenever new measurements are reported and can highlight critical areas in a central location.

## 4 Tamarua Water Supply on Mangaia Island

For the location and description of Mangaia island see chapter 2.

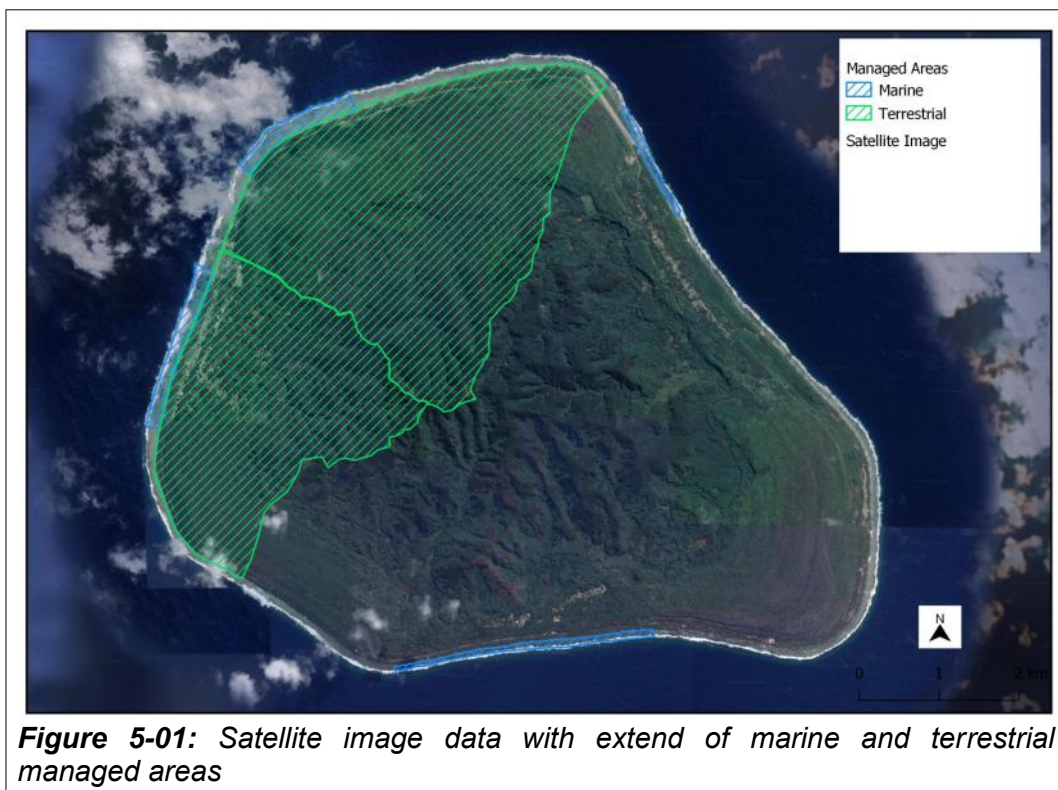
Two activities are mentioned in the Pacific Australia Climate Change Science Adaptation Planning:

1. Set-up of an intake system and water weir to an off-stream filtration and sedimentation tank before delivering the water by gravity to a pumping station located 200m downstream.
2. The water is then pumped to an elevated water storage tank located approximately 1km at the village lookout point for final reticulation by gravity into the Tepauru and Kiriapi sections of the wider Tamarua village.

A report of the Ministry of Infrastructure<sup>6</sup> shows that the project was successfully completed. However, it is currently unclear if a GIS layer shows the location and dimensions of these infrastructure elements.

## 5 Mangaia Island Ra’ui Marine protected Areas

A survey of the protected areas took place in March 2018 which indicates that the area must be mapped<sup>7</sup>. However, corresponded GIS data was not submitted yet, but an IMG file indicating the terrestrial and marine managed areas.



**Figure 5-01:** Satellite image data with extend of marine and terrestrial managed areas

6 <https://ici.gov.ck/featured/manihiki/#:~:text=Funding%20in%20the%202017%2F2018%20financial%20year%20was%20appropriated,gravity%20to%20a%20pumping%20station%20located%20200m%20downstream.>

7 See [Mangaia-Booklet-FINAL-2018.pdf](#)