


Case Study

Assessing ecosystem services for informing options for ecosystem-based adaptation in small islands: the case of the Republic of Palau.

In a nutshell:

A combination of vulnerability assessment, ecosystem service assessment, participatory three-dimensional modelling and policy workshops helped Melekeok State in Palau to identify options for ecosystem-based adaptation. This case illustrates how multiple approaches can be linked for identifying vulnerabilities of local communities to climate change impacts and how a focus on ecosystem services can help identify management options and policies for adaptation. Relocating coastal communities to higher island areas is of priority as response to sea-level rise. Besides others, the results of this study informed already guidelines for "climate-smart" housing and infrastructure development.

1. Background of the ecosystem services assessment

In small-island states like the Republic of Palau, the livelihood of local communities and national economy (in particular tourism) are highly dependent on intact marine and terrestrial ecosystems. The drought occurring during the 2015-16 El Niño-Southern Oscillation (ENSO) event, has shown that watersheds play a critical role for water security and adaptation at local and national level. Given the strong dependency of island communities on ecosystems for food, water and income (Brander et al. 2018) and the dependency of Palau's national economy on nature-based tourism (IMF 2014), ecosystem-based adaptation can be a cost-effective and no-regret option for Palau.

The assessment highlights opportunities for including ecosystems into adaptation planning in Melekeok State, Republic of Palau, and it had three main goals: 1) to understand dependencies of local communities on ecosystem services provided by marine and terrestrial ecosystems, 2) to identify vulnerabilities and issues that undermine resilience to climate change, and 3) to identify management and policy options that enable ecosystem-based adaptation and sustainable development.

During 2016 and 2017 vulnerability assessments, ecosystem service assessments, participatory three-dimensional modelling (P3DM) and policy workshops were conducted. The analysis was part of the project "Building the resilience of communities and their ecosystems to climate change impacts in Micronesia and Melanesia", financed by the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).


2. Scoping the ecosystem services assessment

In a first step, **The Nature Conservancy (TNC) used The Local Early Action Planning (LEAP) Tool (Gombos et al. 2013; Wongbusarakum et al. 2015) for assessing the vulnerability of local communities to climate change impacts and to identify priorities for ecosystem-based adaptation.** The assessment was done through stakeholder consultations, workshops and using results from previous assessments (e.g. ADB 2012).

In a second step, the role of ecosystem services for local livelihoods were assessed using household surveys (Brander et al. 2018): "The questionnaires included sections on household composition; household income and wealth; use of provisioning ecosystem services; environmental threats and climate change awareness; discrete choice experiment (DCE); DCE debriefing; current adaptation practices; and attitudes to migration." The questionnaires were developed over a period of two months in consultation with The Nature Conservancy (TNC), the Ngardok Nature Reserve (NNR), the Institute for Environmental Studies at the VU University Amsterdam (IVM-VU), and Rare International. In total 70 households were surveyed.

In a third step, a participatory three-dimensional model (P3DM) was built together with the local community (a process led by TNC and Partners with Melanesians (PwM)) to identify areas that are important for the provision of ecosystem services and to define priorities for ecosystem-based adaptation (Partners with Melanesians 2016): "Many people have difficulty interpreting a 2D map (flat map) which can lead to profound confusion thereby decisions made for land use may be unrealistic and time consuming. P3DM on the other hand, provides a clear picture of the geography and key natural and human features. Planning using 3-D map diffuses the confusion and opens up a forum for opinions from local communities and other relevant stakeholders to decide how best the land can be utilized and sustained over time. […] The model was done on a scale of 1:2,500 with an estimated 2.2 vertical exaggeration."

There were two phases to completing the model. The first phase (week 1) was the construction of blank model with the youth of the local school and the second phase (week 2) was where representatives from the Government, private sector, NGOs, and Melekeok community, including elderly people and the chief, came in and populated the model with information on sites important for local livelihoods and for cultural significance (Partners with Melanesians 2016): "Having community youth take the lead role in constructing the blank model highlights the role that youth play in shaping the future of Melekeok. The punctuality and the effort put in by the participants' shows that they really care about their environment and are serious about addressing the impacts of climate change that are affecting their livelihood. The role of the youth, in combination with the elders who visit the Old Age Centre created an open forum for learning and sharing experiences. Therefore, in a way the venue helped to highlight the importance of community and how the youth are the future custodians of their environment. They will continue to protect and conserve their environment for future generations to use."

In a fourth step, **the information of step 1-3 were combined in a 3-day policy workshop bringing together key representatives of the Melekeok community, the traditional chief, NGOs and national**

government in order to make use of the assessment results for decision making. In a collaborative and interactive process, management and policy options for ecosystem-based adaptation were explored **using the approach of the Ecosystem Service Opportunity (ESO) Guide (Rode & Wittmer 2015).** The ESO Guide is a practice-oriented framework for identifying economic instruments and policies to enhance biodiversity and human livelihoods.

3. Assessment results

Vulnerability to climate change: The majority of the about 300 inhabitants (90 households) of Melekeok live along the low-lying coastal areas (Melekeok State Master and Land Use Plan 2012). The Melekeok Local Early Action Plan (2016) and an analysis by the Asian Development Bank (ADB 2012) identified infrastructure along the coast having a very high vulnerability to climate change impacts. Sea level rise, storm events with surge and wave action are leading to coastal erosion impacting houses, roads, State office building, water supply, drainage system and the waste water treatment plant. Saltwater intrusion impacts wetlands, taro patches and freshwater sources. Water security is also an issue during droughts. As immediate response, the Melekeok State Public Land Authority under the chairmanship of High Chief Reklai designated land for lease in the upland area for voluntary relocation to be administered by the Governor's office. However, over the long-term, adaptation measures are needed that maintain food and water security, buffer extreme events, provide erosion control and protect built infrastructure.

Dependencies of local communities on ecosystem services: In Melekeok State, local communities are dependent on local ecosystems for water, food and income (Brander et al. 2018). Natural products, in particular fish and agricultural products (Fig. 1), contribute about 16% to household income. Goods derived from ecosystems include fish, betelnut, taro, vegetables, sweet potato and cassava (Fig. 1). The majority (69%) of these goods are used for own consumption while a smaller share is sold on local markets (Fig. 2). Daily water use is almost exclusively derived from the local watershed, with 99% of drinking water originating from the watershed of Ngerdoch River and Lake Ngardok (Fig. 3).

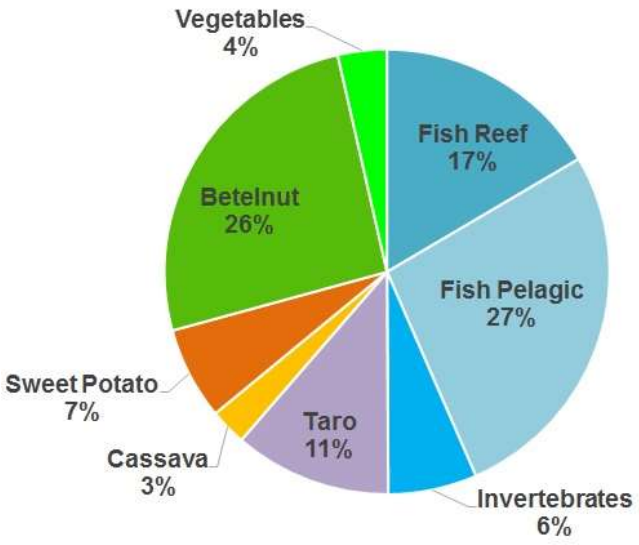

Figure 1: The share of goods derived from local ecosystems (in %) that contribute to household income in Melekeok State. Source: Brander et al. (2018) and Dijkstra (2016).

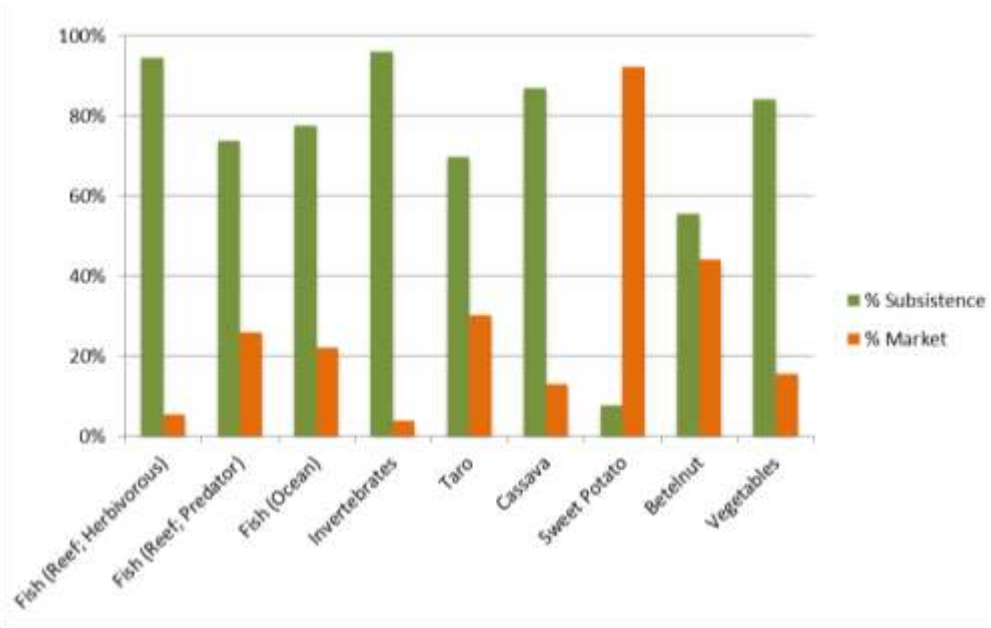

Figure 2: The share of goods derived from ecosystems that households use for subsistence (green bars) and for sale on local markets (orange bars) (in %). Source: Brander et al. (2018) and Dijkstra (2016).

The Local Early Action Plan (Melekeok State Government 2016) **identifies three adaptation priorities:** Priority 1: Ensuring that upland housing development and existing structures are environmentally friendly and climate smart. Action: Develop guidance documents for environmentally friendly development and climate resilient building, including measures for mitigating soil erosion. Priority 2: Improve water security through re-vegetation and restoration of upland watershed near water pump station. Action: Re-vegetation and restoration of upland forest. Priority 3: Improve reef health by designing rules and zones for a resilient locally managed marine protected area. Action: Community consultation for developing and passing regulations to build reef and fishery health and resilience.

Building the participatory three-dimensional model (P3DM) together with the local community helped to locate and discuss the assessment results with the local stakeholders (Fig. 4E). It also helped to facilitate discussions on adaptation options and related management options and to build local knowledge on adaptation priorities. As the model will remain in Melekeok State, the community can make use to the 3D model for future panning processes.

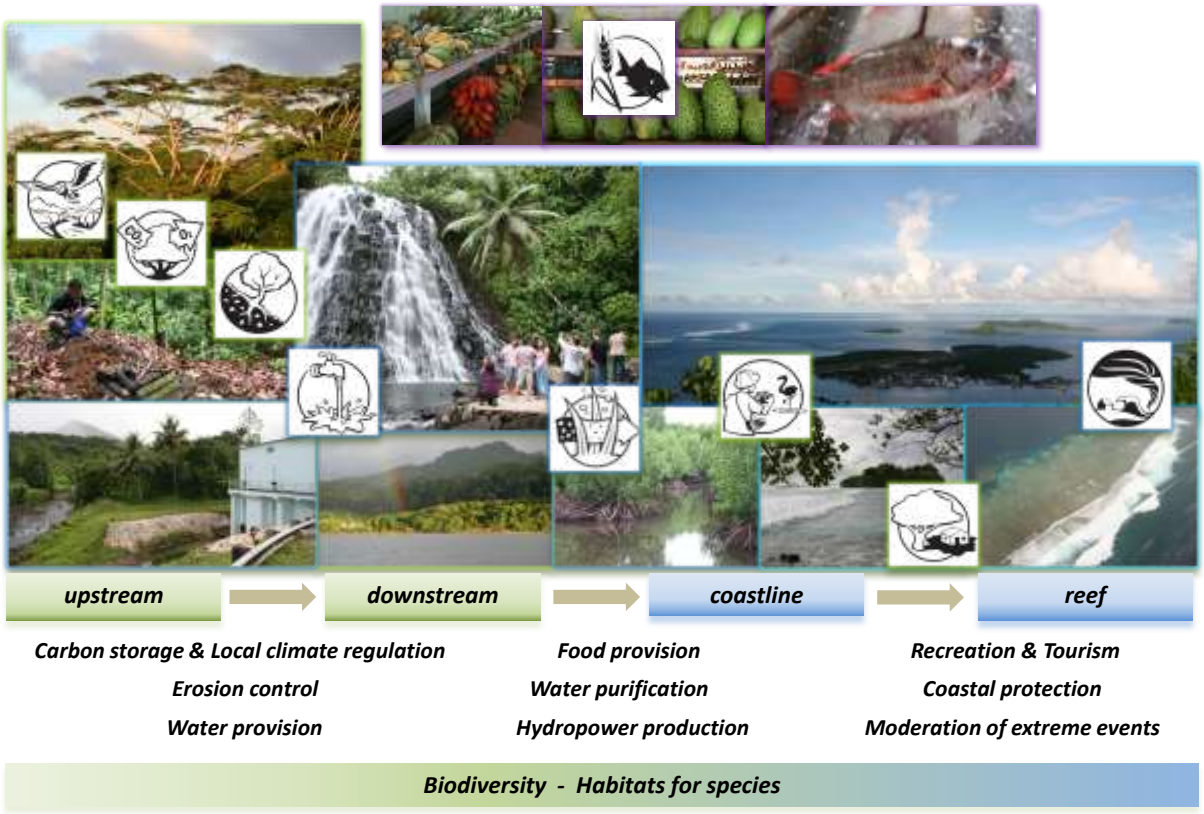

Figure 3: Ecosystem services along a ridge-to-reef transect (based on Förster et al. *accepted*). Photo credit: Johannes Förster 2015.

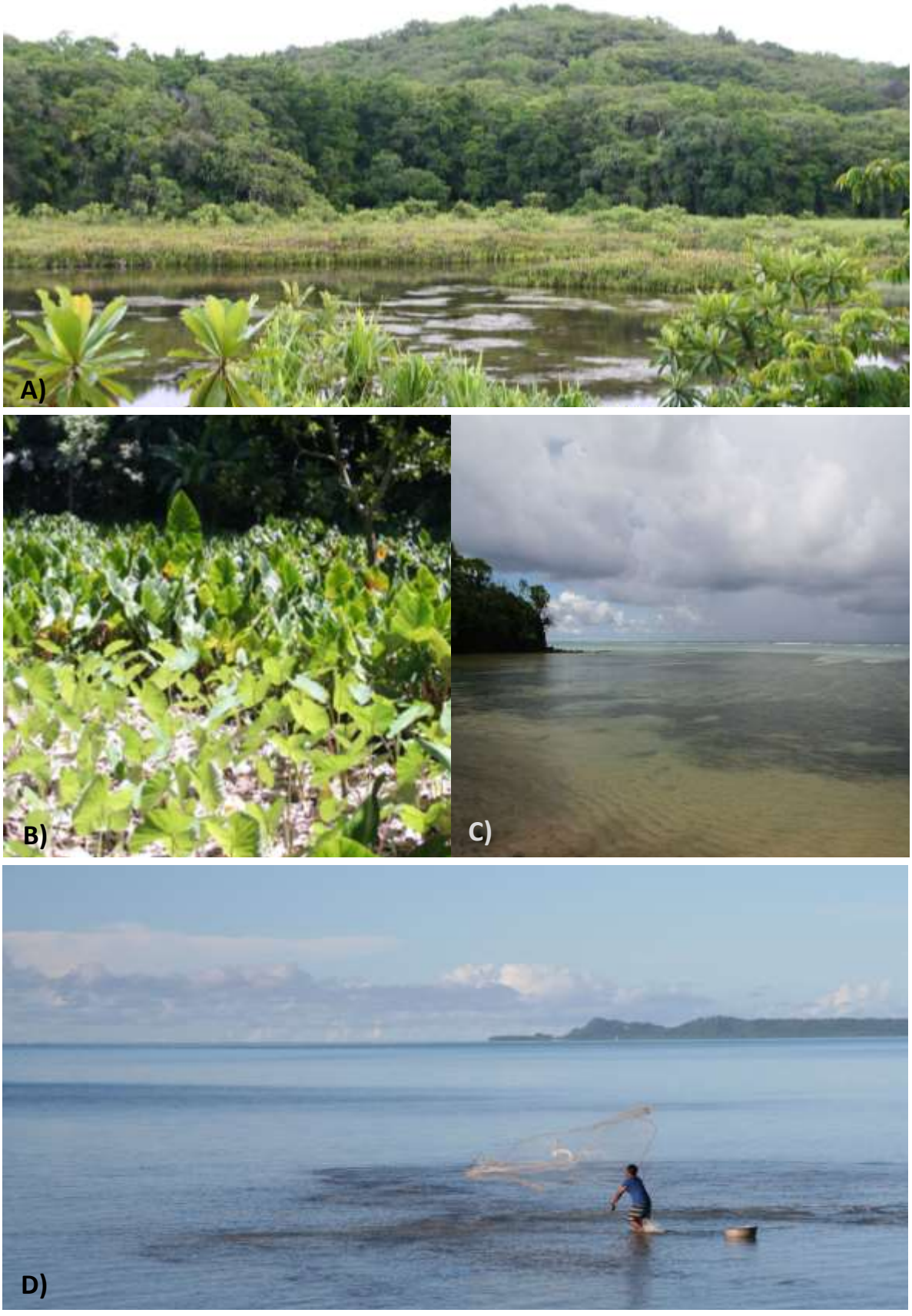

Figure 3: A) Ngardok Nature Reserve with Lake Ngardok is the main tributary to the watershed of Ngerdoch River, providing 99% of water supply to Melekeok State. **B)** Traditional taro patches contribute 11% to food derived from local ecosystems (Brander et al. 2018; Dijkstra 2016). **C)** Reef flat and outer reef provide coastal protection by reducing wave energy on average by 97% (Ferrario et al. 2014). **D)** Fishing contributes 43% to food sources derived from local ecosystems (Brander et al.2018). Photo credit: J. Förster, 2017.

Figure 4: in a participatory process, issues related to water security **(A and B)** and needs for improving watershed management **(C - F)** were identified for Melekeok State. Photo credit: Johannes Förster, 2017.

A) Erosion in watershed causes sediments being washed into Ngerdoch River and causes a decline in water quality.

B) Point for water withdrawal for supplying Melekeok State with drinking water. Erosion causes poor water quality and sedimentation of dam.

C) Ngardok Nature Reserve protects forests and wetlands in the upper watershed including Lake Ngardok, the largest freshwater lake of Micronesia.

D) Ngardok Nature Reserve restores forests on degraded land within and outside the protected area, providing benefits to the entire watershed.

E) Participatory three-dimensional modelling (P3DM) was used to identify priorities for ecosystem-based adaptation using a ridge-to-reef approach. The white area on the left side indicates the upland area designated for voluntary relocation of Melekeok State coastal residents.

F) Upland area designated for voluntary relocation of coastal communities. The sloping of the area requires measures for erosion control when establishing new housing development in order to mitigate negative impacts on the watershed.


4. Making use of results

Based on the assessment results, management options and policy instruments were identified (Förster 2018) using the Ecosystem Service Opportunity (ESO) Guide (Rode & Wittmer 2015) (Summary Table 1).

Summary Table 1: Representatives of the local community and Melekeok State Government identified policy options for ecosystem-based adaptation (adapted from workshop report by Franco et al. (2017)).

Issue	Desirable change	Current barriers for implementation/enforcement	Policy options & economic instruments
Erosion, sedimentation, fire causing decline in water quality and quantity	• Revert to traditional agricultural practices (e.g. traditional taro patches). • Restoration of sites with bare soil. • Conservation of natural vegetation.	• Lack of funding • Lack of knowledge / awareness • Shift in traditional livelihood to cash economy	• Develop site specific guidelines with focus on erosion control and water security • Revive traditional conservation measures and investigate modern soil conservation measures. • In spatial planning, recognize areas of natural vegetation as "green infrastructure" that reduces erosion and supports water supply.
Water security	• Water use efficiency • Sediment control • Erosion control • Water harvesting improvement	• Developers have no obligation for water saving. • High water demand during drought • Lack of water diversion system (e.g. natural barriers as strip buffers) near Compact road causes runoff from paved surface and erosion • Lack of erosion mitigation guidelines for new developments and road construction activities	• Water fee for securing funds for watershed management, conservation and restoration activities • Develop progressive water tariffs that encourages large and commercial water users to invest in water use efficiency • Develop site specific guidelines for mitigating erosion for new developments • Reduce fees for water users implementing water saving, energy efficiency and erosion control
Pollution **i) Upland**	• Upgrade dump site to a landfill	• Community embracing regulations on recycling, segregation, reuse and composting of waste • Lack of waste management plan with targets and indicators • Need for awareness and education campaign	• Capitol need to be held accountable for implementing waste management plan • Potential to embed the costs of landfill maintenance in importers tax • Assess options to cover State costs for waste management
ii) Aquaculture	• Reduce contamination of coastal waters	• Lack of rules and regulations for water quality management	• Embed monitoring costs in business operation costs • Build capacity of State Office for monitoring • Define measurable indicators and pollution targets

During the three-day policy workshop, three priority areas were selected as pilot projects for promoting the implementation of measures for ecosystem-based adaptation including:

Pilot project 1: Erosion control and enhancing water quality
Pilot project 2: Developing guidelines for climate-smart housing (already completed)
Pilot project 3: Waste management for pollution control

Pilot project 2 has the goal to decrease the impact of droughts and typhoons by ensuring that new housing developments and existing structures are environmentally friendly and climate smart, hence supporting adaptation to climate change. As a result of the assessments, guidelines have been produced by the Melekeok State Government for promoting more “climate-smart” development (Figure 5).

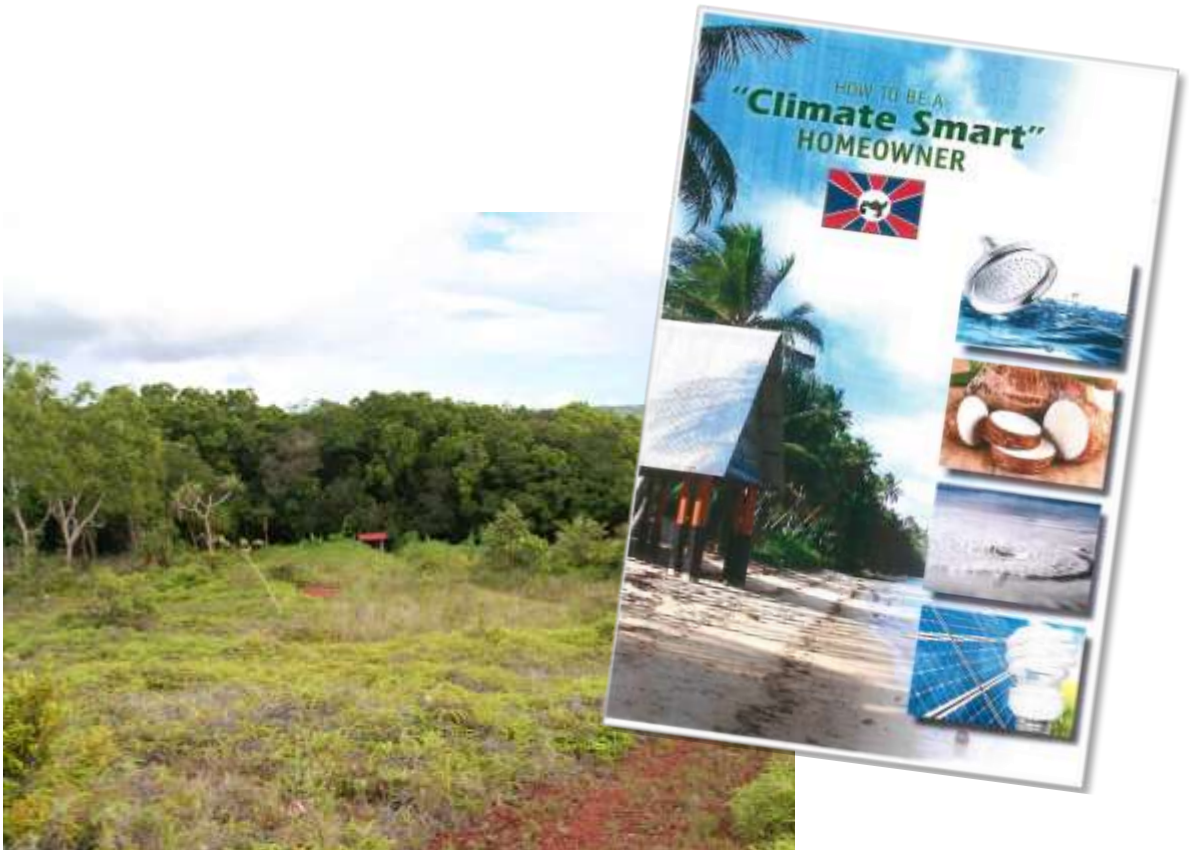

Figure 5: Area designated for voluntary relocation of coastal communities to upland area in Melekeok State. In 2018, the Melekeok State Government published guidance for “climate smart” homeowners (right side) in order to mitigate environmental impacts by new housing developments and for building resilience to climate change. (Photo credit: Johannes Förster 2017).

References

ADB, 2012. Strengthening the Capacity of Developing Member Countries to Respond to Climate Change Final National Report – Palau.

Brander, L.M., Franco, C., van Beukering, P.J.H., Dijkstra, H.M. Hagedoorn L.C., Hughes, L. and Gilders, I (2018). The contribution of provisioning ecosystem services to food security and livelihoods: A comparative study of Pacific island communities. Report for The Nature Conservancy (TNC) and the German Federal Ministry for Environment, Nature Conservation and Nuclear Safety (BMU).

Dijkstra, H., 2016. Tackling Climate Change as an Island Community: An application of the integrated climate change adaptation framework in Melekeok State, Palau. Vrije University Amsterdam.

Förster, J., 2018. Assessment of policy options for ecosystem-based adaptation in Melekeok State, Republic of Palau. An assessment from a perspective of The Economics of Ecosystems and Biodiversity (TEEB), Leipzig.

Franco, C., Förster, J. & Bruton-Adams, M., 2017. Workshop Report: Watershed management for enhancing the resilience of island communities to the impacts of climate change in Melekeok State, Republic of Palau.

Gombos, M., Atkinson, S. & Wongbusarakum, S., 2013. Adapting to a Changing Climate: Guide to Local Early Action Planning (LEAP) and Management Planning, Pohnpei, Federated States of Micronesia.

Melekeok State Government, 2016. Melekeok Local Early Action Plan Republic of Palau. FINAL Draft. December 2016

Partners with Melanesians, 2016. Participatory 3Dimensional Model for Melekeok State, Republic of Palau.

Rode, J. & Wittmer, H., 2015. Acting on Ecosystem Service Opportunities Guidelines for identifying, selecting and planning economic instruments to conserve ecosystems and enhance local livelihoods, Leipzig, Germany. URL: www.ufz.de/index.php?de=34602

Wongbusarakum, S. et al., 2015. The Local Early Action Planning (LEAP) Tool: Enhancing Community-Based Planning for a Changing Climate. Coastal Management, 43(4), pp.383–393.

Further reading:

Local Early Action Planning (LEAP) and Management Planning: https://www.weadapt.org/knowledge-base/climate-adaptation-training/adapting-to-a-changing-climate-guide-to-local-early-action-planning-leap-and-management-planning

Partners with Melanesians Participatory 3 Dimensional Modelling (P3DM):
http://www.pwmpng.org.pg/participatory-3-d-model-mapping/

Acting on Ecosystem Service Opportunities (ESO) Guidelines: www.es-opportunities.net

Compiled by: Johannes Förster (UFZ) 2018.

Reviewed by: Chiara Franco (TNC), Mae M. Bruton Adams (TNC), Patrick Vuet (Partners with Melanesians Inc.)

Contact: info@aboutvalues.net

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