

**ENGAGEMENT ON BIODIVERSITY
CONSERVATION AND CLIMATE
CHANGE ADAPTATION IN
PAPUA NEW GUINEA**
A FACILITATOR'S GUIDE

Engagement on Biodiversity Conservation and Climate Change Adaptation

September 2018

This handbook is a major output of the project: Engaging Communities and Government in Biodiversity Conservation and Climate Adaptation in Papua New Guinea. The project supports biodiversity conservation, through community and government engagement to enhance resilience to a changing climate and to manage local ecosystems in a way that conserves biodiversity and supports livelihoods.

Pacific American Climate Fund (PACAM), the Institute for Sustainable Futures (ISF) and the New Guinea Binatang Research Centre are working together to enhance the capacity of local communities and government to support biodiversity and adapt to a changing climate in Papua New Guinea (PNG). This handbook is based on a series of training workshops focussed on identifying locally important Ecosystem Services and how these services may be affected by climate change and development.

The workshops were held in Madang and Eastern Highlands provinces and were co-facilitated by researchers from the Institute for Sustainable Futures, based at the University of Technology Sydney, and the New Guinea Binatang Research Centre. This project is funded by USAID through the Pacific American Climate Fund (PACAM).

The workshops were designed to provide a way for communities in the focal areas to learn about how a changing climate may affect the health of their local environment, communities and livelihoods. The workshops generated rich dialogue about

ecosystem service values and potential threats, and also identified possible small-scale projects to enhance the management of ecosystems for both biodiversity conservation and protection of livelihoods.

Prepared for USAID (PACAM) by the Institute for Sustainable Futures, University of Technology Sydney, Australia

The handbook should be cited as follows:

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Contents

Introduction	1
Ecosystem Services and Biodiversity	1
How does climate change affect Ecosystem Services?	1
Papua New Guinea	1
What does the handbook do?	2
Who should use the handbook?	2
How you use the handbook?	2
Engaging community in Biodiversity & Climate Change Adaption	3
Activity 1: Storytelling about local environmental change	5
Activity 2: Identification of local Ecosystem Services (ES)	6
Activity 3: Historical and future climate trends for PNG)	8
Activity 4: Identifying ecosystem service values at risk from	9
Activity 5: Mapping the impacts of development on ES	10
Activity 6: Identifying local action projects	11
Engaging government in Biodiversity & Climate Change Adaption	12
Activity 7: Ground rules and shared ES values	12
Activity 8: Networks & Connections between Government & Communities	12
Activity 8: Networks & Connections between Government & Communities	13
Activity 9: Exploring knowledge gaps & challenges about key stakeholder groups	14
Activity 10: Presentation of findings from the community Biodiversity and Climate Change Adaptation workshops	16
Activity 11: Exploring opportunities for collective action	16
Appendix 1: Climate information for Papua New Guinea	17
Further reading	18
Appendix 2: Icons set – Ecosystem Services & Climate	19
Appendix 3: Workshop Agendas	20
Engaging communities & government in biodiversity conservation and climate adaptation in Papua New Guinea	23

1. Introduction

Ecosystem Services and Biodiversity

Ecosystem Services (ES) are the benefits people obtain from ecological systems or ecosystems. These include final products such as food; important regulating services such as the long-term storage of carbon in forests, dilution and absorption of wastes by rivers, as well as intangible benefits such as spiritual or cultural benefits. ES are critical for supporting human life and changes in these services affect human health, well-being and livelihoods. Humans, with their cultural diversity, form an integral component of many ecosystems.

Biodiversity is the variety of all living things; the variety of plants, animals and micro-organisms, the genetic information they contain and the ecosystems they form including diversity within and between species and diversity of ecosystems (MA, 2005). Biodiversity is an ES.

How does climate change affect Ecosystem Services?

Climate change alters critical climate variables, such as rainfall and temperature that can result in changes in natural climate variability and extreme events, such as floods and drought. These changes directly influence the health and function of ecosystems, which in turn influences the availability of ES. For example, heavy rainfall can wash away the top layer of soil. This layer is the most productive because it contains nutrients for plant growth. Top soil loss limits crop growth and, if washed into rivers, causes water pollution. The consequences of climate change for communities can be a permanent loss of natural resources, loss of livelihoods and flow on impacts to social cohesion.

Well-managed and healthy ecosystems can provide a buffer against natural hazards. For example, the ocean absorbs carbon emissions, but this makes the ocean more acidic. This makes it harder for coral reef ecosystems to grow, diminishing an important habitat for fish and other marine species. This in turn reduces the yield from fisheries. Coral reefs also form an important buffer for coastal communities against the impacts of big waves that cause coastal erosion (see figure 4). Poorly managed systems heighten risks of increased exposure to natural disasters e.g flooding, drought etc.

Papua New Guinea

Papua New Guinea's (PNG) mainland consists of 33 million hectares of forests representing the largest rainforest in the Asia-Pacific region, and the 3rd largest intact rainforest in the world. PNG is estimated to contain at least 7% of the world's species; 2/3 of which are unique to Papua New Guinea UNDP (2012).

A key threat to PNG's ES is from land use change from deforestation for timber and food production. In 2014, the deforestation rate was around 1.4% per annum (Vincent et al, 2014) attributed to subsistence agriculture, logging and oil palm developments. It is estimated that by 2021, 83% of the forest ecosystems that are not in designated protected areas will be cleared or degraded. Deforestation causes a loss of ES e.g. the release of carbon that has been stored in the trees. According to the Climate Change and Development Authority, PNG's carbon emissions are expected to rise by as much as 32% by 2030 of which land use change accounts for 95% of PNG's total emissions.

What does the handbook do?

The handbook aims to guide individuals and organisations who want to engage with communities to protect biodiversity, support livelihoods and adapt to a changing climate in Papua New Guinea (PNG).

Who should use the handbook?

The handbook outlines a range of activities that can be used by non-government organisations, government departments, agencies, academics and other service providers. In order to promote community dialogue, participatory decision-making to identify and plan responses that are designed with the conservation and sustainable use of biodiversity and ecosystem services as the primary goal.

How you use the handbook?

The activities outlined in the handbook use a learning-by-doing approach. The aim is to provide participants with the skills, knowledge and confidence to identify Ecosystem Services important to them, and to understand how these may be impacted by climate change and development (e.g. the availability of goods and services provided by nature).

The handbook has 2 key sections:

- Activities to engage community-led Biodiversity conservation & Climate Change Adaption
- Activities to engage governments in Biodiversity conservation & Climate Change Adaption

The handbook provides an outline of how to:

- Identify ecosystem services related to biodiversity;
- Understand the relative values of ecosystem services and how these service may be affected by changes in climate and land use, such as intensification of agriculture, mining or logging;
- Identify threats to biodiversity and possible adaptation and preventative management strategies
- Use systems thinking approaches to identify positive solutions to address biodiversity loss and other changes

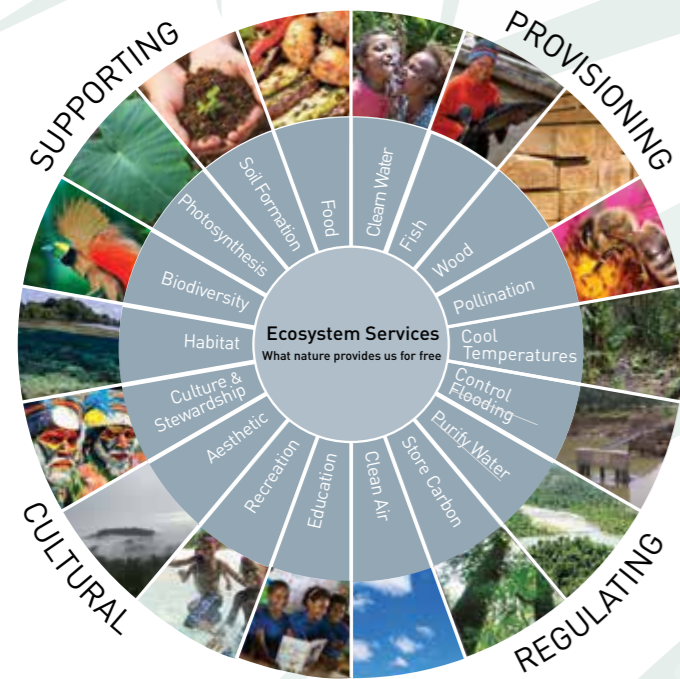
Each section provides relevant background information, the aims of the activities involved, a description of the methods, and the materials used to carry out each of the activities. The handbook provides some examples of outcomes of each activity generated through a series of training workshops on Biodiversity Conservation and Climate Adaptation conducted with four communities in Madang and Eastern Highlands provinces, PNG.

While the examples in this handbook refer to securing Ecosystem Services under a changing climate, the processes outlined are also relevant for planning adaptive management to risks in other sectors.

2. Engaging community in biodiversity & climate change adaption

Human well-being and progress toward sustainable development depend upon improving the management of ecosystems to ensure their conservation and sustainable use. Ecosystem services are grouped into four broad categories: provisioning, regulating, cultural, and supporting services (MA, 2005) (see Figure 1).

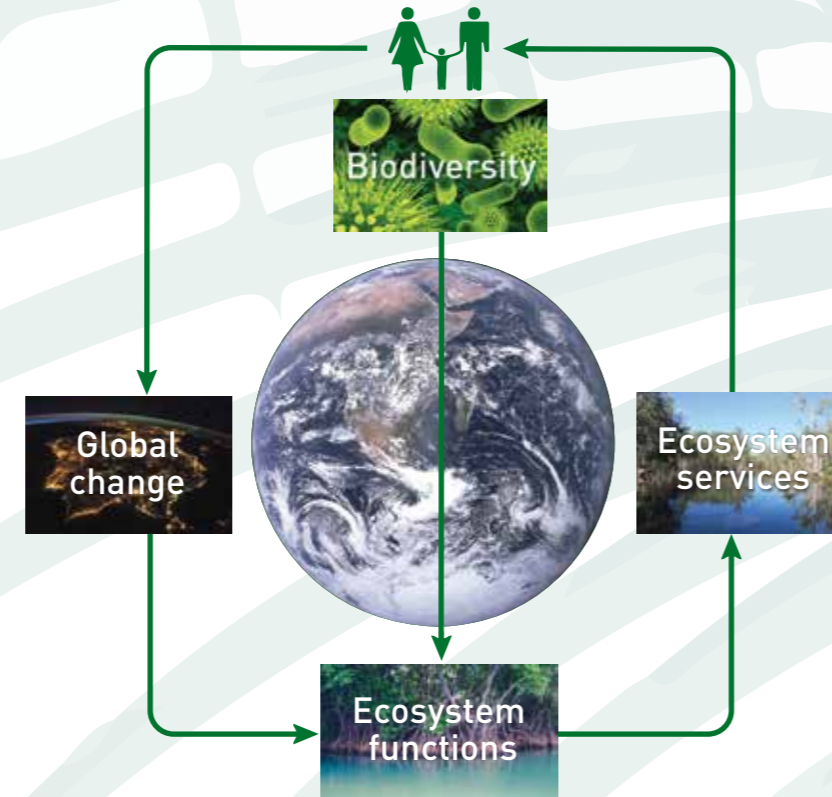
Figure 1: Diagram of the different goods and services provided by ecosystems



Source: Adapted from MA, 2005

Provisioning services involve the production of renewable resources (for example, food, wood, fresh water). Regulating services are those that lessen environment alchange (such as temperature regulation provided by forests or pest/disease control) (Cardinale et al. 2012). Cultural services include the spiritual and recreational benefits from ecosystems and supporting services, include nutrient cycles and oxygen production.

Figure 2 Humans relationship to ecosystems



Source: Cardinale et al. 2012 Biodiversity loss and its impact on humanity

The workshops activities detailed below are designed to engage community members in processes to manage local ecosystems in a way that conserves biodiversity and supports livelihoods. The community focussed workshops can be organised as a series of facilitated activities:

Activity 1: Storytelling about local environmental change

Activity 2: Identification of local Ecosystem Services (ES)

Activity 3: Historical and future climate trends for PNG

Activity 4: Identifying ecosystem service values at risk from climate change: climate impact mapping

Activity 5: Mapping the impacts of development on ES

Activity 6: Identifying local action projects

How these activities can be developed into a workshop agenda is shown in Appendix 3 of the handbook.

Activity 1: Storytelling about local environmental change

To create a shared understanding among the workshop participants and the facilitators, participants are given the opportunity to share stories about changes they have seen in their local environment. This activity generates discussion on the 'lived experiences' of environmental change, such as loss of biodiversity and/or changes in climate.

Storytelling is an important method of communication in PNG and Melanesian societies have an oral tradition of information transmission. Storytelling is useful to gather knowledge about shared values, to build trust among the participants (particularly researchers and community members), and ensure that information gathered at each workshop is relevant and locally meaningful.

Aim:

This activity is a conversation starter as well as a resource that provides information and contextual understanding for the participants and facilitator.

Outcome:

A shared understanding of changes experienced in the local environment. This activity generated discussion on the 'lived experiences' of environmental change, such as loss of biodiversity and/or changes in climate. Examples of these experiences include:

- Increased number of hot days: This has reduced the yield of food crops and limits the time that people are able to work in the garden because it is too hot to work in the middle of the day;
- Heavy rainfall: falling in a short period of time has caused erosion of roads which makes it harder to access town. It can also wash away top soil, which makes it harder to grow crops and can affect local food security.

ACTIVITY 1: STORYTELLING ABOUT LOCAL ENVIRONMENTAL CHANGE

PREPARATION:

Identify one or two people, often community leaders (e.g. women's leaders, religious leaders and village elders), who have experienced and are willing to share their story of environmental change with the group.

PROCESS

- Allow for free discussion and sharing of past experiences.
- Topics to discuss include changes in population; natural resources (e.g. plants and animals); weather and climate; location of houses; local livelihoods, and community health and wellbeing

OUTCOME

Shared understanding of local knowledge and lived experiences of environmental change.

Depending on the number of participants, this activity could be done in smaller groups to allow more interaction among participants, leaders, religious leaders and village elders, who have experienced and are willing to share their story of environmental change with the group.

TIMING

15 mins

MATERIALS

- None
- Active listening

Activity 2: Identification of local ecosystem services (ES)

ES support peoples' capabilities, wellbeing and local or regional economies. ES may be tangible such as sources of food or fresh water or intangible such as places of cultural significance ('totem' species, or places of spiritual worship).

Aim:

A visual representation and location of the range of ES that the community depends on for survival. This can then be linked to the location of specific threats to ES in later activities.

ACTIVITY 2: IDENTIFYING LOCAL ECOSYSTEM SERVICES

PREPARATION:

- A large map (e.g. aerial image or contour map) of the local area, we recommend using at least A3 size
- You can download a map from Google Earth showing the village and surrounding environment <https://earth.google.com>
- ES icon set (see Appendix 2) to represent a range of ES in PNG relating to biodiversity.

PROCESS

- Small groups of about 6-10 participants.
- Lay the aerial maps on a large table or the ground so everyone can see
- Stick the icons on the map of your local area to build a picture of local ecosystem service and where they are located.
- Write up a list of ecosystem services

EXPECTED OUTCOMES

A place-based list of ecosystem services. Discussion about the Ecosystem Services that are valued by the local community and their contribution to local livelihoods.

TIPS AND TRICKS

We had a large workshop group of 25-30 people so we split into 3 groups, so everyone had a turn putting icons on the map. If you don't have a map you can draw the local area on paper.

TIMING

50 mins

MATERIALS

- Aerial map that shows villages and important landmarks such as rivers, mountains
- Sticky tape or blue-tac to stick the icons

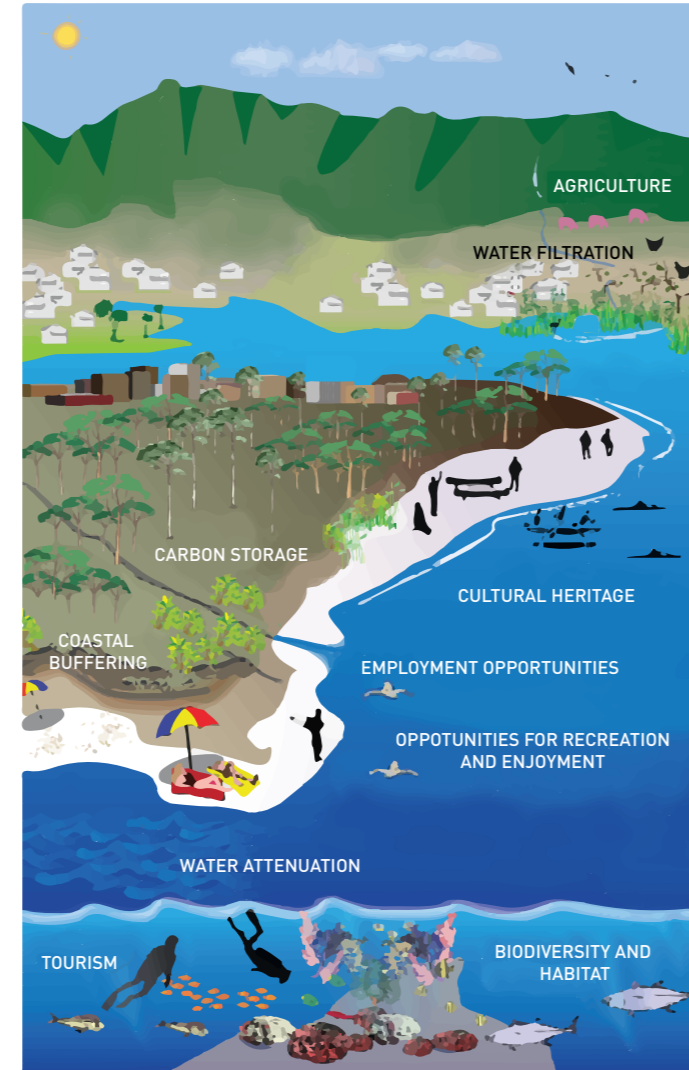
Figure 3: Local Ecosystem Services map (Coastal)



Figure 4: Local Ecosystem Services map



Figure 5: ES provided by coastal ecosystems



Adapted from the US Global Change Research project
<https://www.globalchange.gov/browse/multimedia/coastal-ecosystem-services>

Activity 3: Historical and future climate trends for PNG

In this activity the historic climate trends for temperature, rainfall, sea level rise, storms and cyclones over the past 50 years are presented. This should be followed by a presentation of the predicted changes for the next 30–50 years based on respected sources such as, the Inter-Governmental Panel on Climate Change (IPCC) emissions scenarios. Appendix 1 contains summarised information about the historical and projected changes in climate for PNG sourced from the Pacific Climate Change Science Program. Climate change is an amplifier of existing vulnerabilities in social-ecological systems. Therefore, the presentation can be followed by discussion of how a changing climate is being experienced at the local level drawing on the community stories from Activity 1.

Aim:

To understand trends in climate variables and how these may change in the future based on climate modelling.

ACTIVITY 2: UNDERSTANDING PAST AND FUTURE CHANGES IN THE CLIMATE

PREPARATION:

Prepare a brief presentation of the available information on historical and projected climate trends for the region. Print images or icons that represent a change in relevant climate variables, e.g. changing rainfall patterns, temperature, sea level rise and extreme weather such as fire, cyclones, drought and storms (see Appendix 2)

PROCESS

- Present the historical and projected climate information for the region.

- Work in small groups of about 6-10 participants.
- Each participant is given 3 dots to vote on the climate variables they are most concerned about (e.g more intense storms, changing rainfall, drought, increasing temp etc.). More dots means more votes and greater importance of the climate variable/s.
- Count the dots for each climate variable.
- Facilitators order the climate variables from most important or concerning (most dots) to the least concern (least dots).
- Report back and confirm with the group the prioritised climate variables.
- Lead a brief group discussion about why this climate variable is of concern to the community or ask the participants to share their experiences of its impact on ecosystems.

TIMING
40 mins

- MATERIALS**
- PowerPoint presentation or printed climate fact sheets
 - Half of an A4 piece of paper displaying the climate icon for each variable
 - Sticky dots

EXPECTED OUTCOMES

A common understanding of the historical climate trends and the projected climate changes for the area under discussion.

A list of the priority climate variable/s and why they are of concern to the community

Activity 4: Identifying ecosystem service values at risk from climate change: climate impact mapping

Variability in the climate such as changes in rainfall patterns, and extreme events such as cyclones, directly affect ES which has flow on effects for the community's health and livelihoods. Understanding how and where these impacts will affect local communities is important when planning and implementing adaptation responses. The information can inform an assessment of local sensitivity to climate hazards. For example, during a cyclone, low-lying coastal areas may become inundated due to heavy rainfall and/or storm-surge.

An impact map provides a way to see the changes in local systems, the interconnections between changes and how impacts cascade through the community and local area. The direct impacts are the first set of effects that occur immediately after an event at the beginning of the chain. These affects are initially experienced locally. Indirect impacts occur at the end of the impact chain as an event escalates in scale and scope . By considering the broad consequences of an impact, flow-on affects related to a change in the situation are revealed.

Aim:

This process provides a way to understand the direct and indirect impacts on local biodiversity and livelihoods following a specific climatic event.

ACTIVITY 4: MAPPING THE IMPACTS OF CLIMATE CHANGE ON ES

PREPARATION:

In Activity 3 participants prioritised the climate impact/s. Select the 2 or 3 climate impacts as a starting point for an impact map

PROCESS

- In small groups consider chain of impacts on the community, environment and livelihoods triggered by specific climate-related event e.g. a flood.
- Start with the immediate impact of the climate event, e.g. a flood may cause houses close to a river to be damaged.
- Facilitators ask questions such as "what's the first thing that happens during the climate event?", "what does that cause?" and "what happens next?" to encourage participants to think of the next logical impact until they arrive at critical impacts for biodiversity, human health or well-being.
- Each group then reports back to the whole workshop on their impact map.

TIMING
40 mins

MATERIALS
• Large flip-chart paper

OUTCOME

A map of the likely chains of events (linked by arrows) caused by each climate impact (see Figure 5 on page 15)

TIPS AND TRICKS

Position a facilitator on each table to assist and prompt the participants to consider each link in the chain of impacts rather than jump too quickly to the ends of the impact chain.

Activity 5: Mapping the impacts of development on Ecosystem Services

As the human population grows so does the demand for ES such as building materials, food and clean water. Yet human actions have altered these ecosystems through direct and indirect means. For example, harvesting timber from a forest may provide benefits such as building materials and money, but it can also degrade the capability of ecosystems to provide other goods and services such as clean air and temperate regulation. The growing demand placed on increasingly degraded ecosystems limits the achievement of sustainable development. Human well-being is affected by the gap between ES supply and demand and also by the effects of changing climate and other drivers of environmental change.

Change in the availability of ES that are valued by communities will depend upon a range of factors such as proximity to new and existing developments, the scale of the development and the ability of the ecosystem to recover from disturbance.

Aim:

Increased awareness of the ES and local livelihoods at risk from developments.

ACTIVITY 5: MAPPING THE IMPACTS OF DEVELOPMENT ON ES

PREPARATION:

- Refer Ecosystem Services aerial map developed in Activity 2.

PROCESS

- In small groups consider chain of impacts on the local community, environment and livelihoods that are triggered by a development (new or current).

- Map two chains of impacts from the development considering 1) the benefits and 2) problems caused by the development.

- Facilitators ask questions such as "what's the first thing that occurred due to the development" and "what happens next?" to encourage participants to think of the next logical impact to identify the critical impacts for biodiversity, human health or wellbeing.

- Consider the short and long-term impacts of this development.

- Each group then reports back to whole workshop on their impact map.

OUTCOMES

A map of the likely chains of events (linked by arrows) caused by each development impact (see Figure 6 on page 15)

TIPS AND TRICKS

Facilitators could prepare for this activity by asking district and provincial government officers about any proposed developments for the region.

Use the ES maps from Activity 2 to see how the location of the development may affect ES supply and how loss of ES would be replaced.

TIMING
40 mins

MATERIALS

- Large aerial map
- A4 paper
- blue tack (or sticky tape)
- pens information handout

Activity 6: Identifying local action projects

In this session participants will identify and begin to plan projects on practical actions to manage the negative impacts and capture the benefits of socio-ecological change. The projects are intended to increase preparedness and resilience to change and empower the community to develop and lead their own local solutions.

ACTIVITY 6: LOCAL ACTION TO CONSERVE ES

PREPARATION:

Prepare a large flip chart paper with 5 headings: project name, project description, steps to implement, stakeholders involved and resources needed.

PROCESS

- In small groups participants focus on a damaging impact to ES from either a development or climate change and brainstorm some practical solutions.
- Facilitator leads discussion among participants to fill in the project template
- Each group then reports on their project

TIMING

45-60 mins per project

MATERIALS

- Large flip-chart paper
- Pens or marke

OUTCOME

Range of projects that will improve the management of impacts on ES and/or local livelihoods.

TIPS AND TRICKS

Fill out the template with as much detail as possible as this could be used to plan a new community initiative or attract funding from government or NGOs.

Aim:

Identify a range of potential community projects that can conserve ES and/or support community health and wellbeing.

Projects that were developed during the 4 community workshops included: making legume compost and mulching to improve soil health; reducing the risk of bushfire; enhancing food security through the planting of legume trees, reforestation to improve habitat connectivity, and mangrove restoration to provide habitat for marine species, materials and a buffer against the impact of storms and coastal erosion. Other projects centred on decreasing health issues and deaths associated with climate change, for example limiting the spread of malaria via mosquitos through community action such as reducing standing water to limit mosquito breeding grounds.

These projects can be considered as ecosystem-based adaptations (EBA). These adaptations have:

- Multiple co-benefits from adaptation actions e.g. tree planting can stabilise a coastline and provide shade to reduce heat;
- 'No-regrets' approaches – even if the climate impacts do not occur as projected, the action can still have positive outcomes through risk reduction and the protection of ES.

2. Engaging government in biodiversity & climate change adaption

Government decision makers from around the world are beginning to recognize the need for more sustainable and effective management of ecosystems. Identifying how local communities value and utilise ES is a necessary step for improved management of scarce and rapidly depleting natural resources.

This part of the handbook focuses on activities to engage government representatives in biodiversity conservation and climate change adaptation. The processes outlined in Activities 1 to 6 are the first steps toward gathering the data needed to make informed policy decisions relating to local conservation of Ecosystem Services (ES).

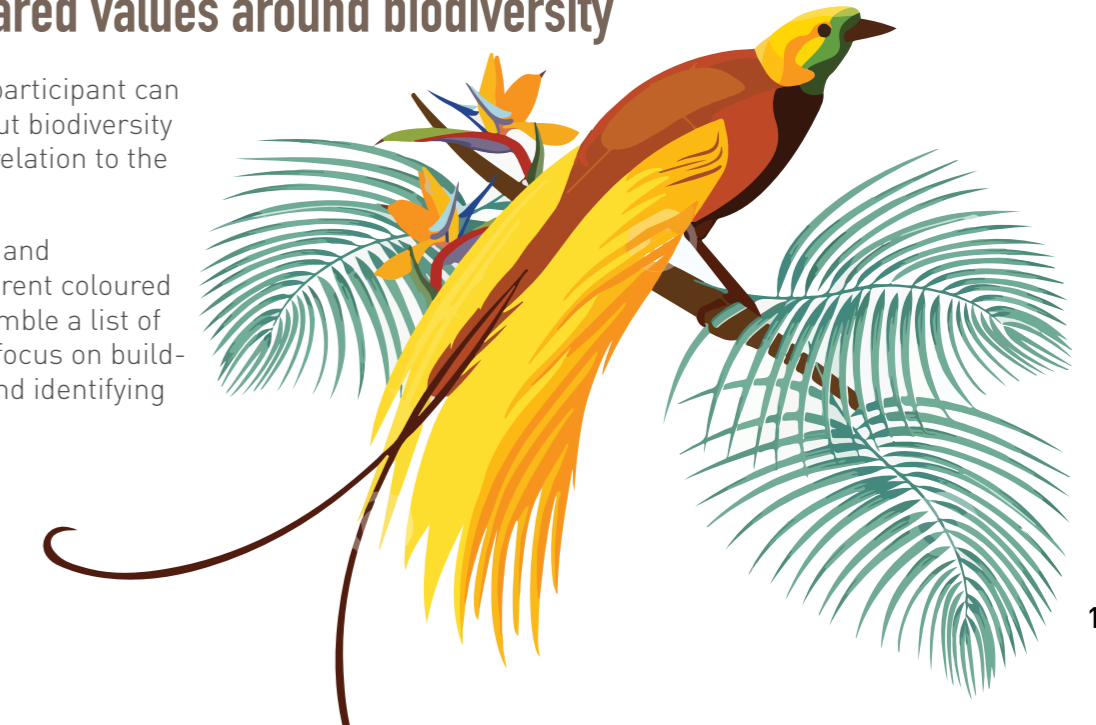
The workshop can be organised as a series of facilitated activities as shown in Appendix 3, and it includes the following activities:

- Activity 7:** Ground rules and shared values around biodiversity
- Activity 8:** Networks and connections between government and communities
- Activity 9:** Exploring knowledge gaps and challenges about key stakeholder groups
- Activity 10:** Presentation of findings from the community biodiversity and climate change adaptation workshops

Activity 7: Ground rules and shared values around biodiversity

At the start of the workshop to build trust each participant can introduce themselves and say why they care about biodiversity and what are they are most concerned about in relation to the loss of biodiversity.

The facilitators can write answers relating to ES and Biodiversity concerns on a white board. Use different coloured pens for different stakeholder groups, then assemble a list of common concerns for the group. Activities 7-11 focus on building trust between government and community and identifying ways to implement community lead projects.



Activity 8: Networks and connections between government and communities

Networks and connections are formed in many different ways. For example, one of your neighbours could be a representative in the district government. This activity looks for the connections between people that know each other socially or professionally or that may have friends in common.

Aim:

To reveal and explore existing links between Government and community representatives.

ACTIVITY 8: NETWORKS & CONNECTIONS BETWEEN GOVERNMENT AND COMMUNITIES

PROCESS

- Assemble the Government representatives in one line and Communities representatives in another line. Use string or ribbons to show the links between people or, print out all the participants names and stick on a board or wall and draw a line between people that have a connection.
- Look around to see who has a high number of connections. These people are described as hubs in which information can flow to and from.

TIMING

30 mins

MATERIALS

- String to show the connections

OUTCOME

An understanding of how connected or disconnected the community is from government representatives. Existing connections between people can form the basis of new relationships around shared values (Activity 7)

TIPS AND TRICKS

Try to uncover 'third party' connections. Connections may not be immediately obvious to participants but may be created through joint membership of groups, attendance at the same schools, and support for the same sports team or shared experiences.

Activity 9: Exploring knowledge gaps and challenges about key stakeholder groups

Different stakeholders' i.e. government and communities face a range of challenges and resource limitations (financial, skills, knowledge etc.) in responding to climate change and protecting biodiversity.

Aim:

To explore the range of assumptions that different stakeholder groups have about each other and to discuss openly the issues each group faces in trying to perform their roles in government or community. These issues are then shared. This activity aims to build better relations between different stakeholder groups by fostering transparency and trust.

Trust can enhance the efficacy and resilience of any sustainability initiative, collaborate effort or natural resource management up to a point.

ACTIVITY 9: EXPLORING KNOWLEDGE GAPS AND CHALLENGES FACED BY DIFFERENT STAKEHOLDER GROUPS

PREPARATION:

Remind participants of the ground rules before you begin. Everyone has a valid point to make based on their role and experiences. We need to be respectful of others' opinions, even though we may not understand or agree with their point of view.

PROCESS

- Split participants into small groups
- Each group writes down the major constraints that they face in their role in protecting ES and dealing with climate change. List what makes it hard for them to do their job – maybe the things that are outside of their control.
- Facilitators report back to remain neutral as sensitive information could arise.
- Discuss the similarities and differences in assumptions.

TIMING

45 mins

MATERIALS

- Large flip chart paper
- Pens or markers in different colours

OUTCOME

This activity aims to build better relations between different stakeholder groups by fostering transparency and trust.

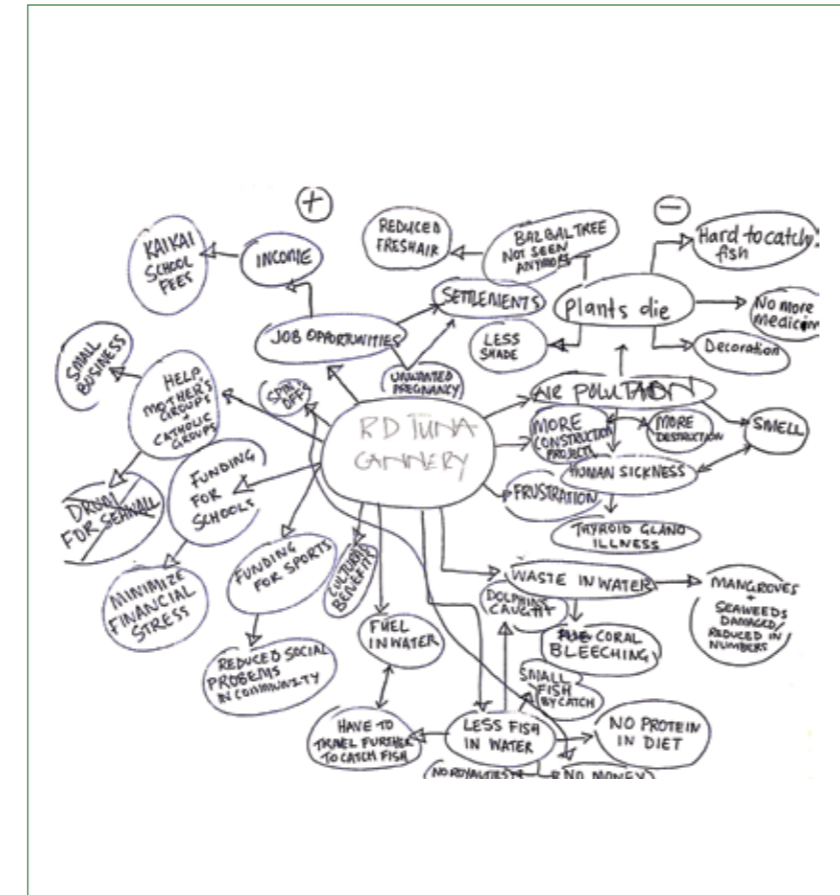
TIPS AND TRICKS

Don't assume that stakeholders have knowledge about each and why their tasks are difficult even though they may be trying their best to achieve similar outcomes.

Figure 6: Example of climate impact map relating to hot days



Figure 7: Example of an impact map relating to development



Activity 10: Presentation of findings from the community biodiversity and climate change adaptation workshops

This activity presents the outcomes from the community workshops to Provincial Government representatives. Topics covered include:

- 1) Valued Ecosystem Services: The list of ES valued by the local community;
- 2) Socio-ecological vulnerability to climate change: Climate impact maps and community concerns (from the voting) from A4;
- 3) Development impacts and why they are of concern to the community A5;
- 4) Community projects A6;

Activity 11: Exploring opportunities for collective action

This last activity of the workshop explores opportunities for collaboration among stakeholders to implement community projects developed during A6. The steps are:

- How do the community projects and plans align with government policy and/or guidelines?
- What could be a way forwards to foster these new connections and on-going dialogue in the future?
- How can projects be implemented through sharing of resources, knowledge etc?
- Can shared commitments on action among the stakeholder groups be identified?

ACTIVITY 11: IMPLEMENTING PROJECT PLANS

PREPARATION

Pre-printed project descriptions from community workshops

PROCESS

- Each project description (e.g. a project to reduce landslides or protect the shoreline) is on a table with a community project champion.
- Participants (government and community) provide input into the project details or implementation.
- After 30 minutes participants can go to another table to discuss another project but one community project champion must remain on the table to present the project.
- Record ideas/opportunities for stakeholder collective action
- The community project champion reports back on 'additions to the project.'

TIMING
1 hr + 30mins

MATERIALS
• Butchers paper and different coloured pens

OUTCOME

This activity aims to take steps so that important community projects can be implemented to protect biodiversity and reduce vulnerability to climate change

TIPS AND TRICKS

Try not to focus only on financial resources, there are many ways to achieve progress on projects through sharing of information, ideas and connections that do not rely on funding and may be more beneficial in the long term.

Appendix 1: Climate information

Background information for Papua New Guinea

Papua New Guinea (PNG) is located in the southwestern Pacific Ocean and is the largest country of the Pacific region.

Natural resources remain central to the PNG economy, which is dominated by two sectors: the agricultural, forestry and fishing sector and the minerals and energy extraction sector (World Bank, 2017). While these sectors are important sources of economic development, they also contribute to environmental degradation through over-exploitation of natural resources, unsustainable land use, fishing practices, habitat destruction, pollution and poor environmental governance (UNDP, 2012).

Papua New Guinea's climate varies from year to year due to the El Niño-Southern Oscillation. This is a natural climate pattern that occurs across the tropical Pacific Ocean and affects weather around the world. There are two extreme phases of the El Niño-Southern Oscillation: El Niño and La Niña and also a neutral phase. In Papua New Guinea, El Niño years are usually drier than normal associated with droughts, while La Niña events are usually wetter associated with prolonged rainfall leading to flooding and landslides.

Key climate projections are: 1) temperatures will continue to increase; 2) incidence of very hot days will increase; 3) rainfall patterns will change; 4) incidence of extreme rainfall days will increase; and, 5) tropical cyclones will become less frequent but more intense (PCCSP, 2011, p.6).

Historical and projected climate trends for PNG

The Pacific Climate Change Science Program (PCCSP) identified 18 best fit Global Climate Change models (GCM's) to represent the climate of PNG (PCCSP, 2011). These models were used to develop PNG climate projections to 2090 with keys forecasts on changes to: cyclones; rising temperatures; rainfall; sea level rise; ocean acidification; and food security.

Table 2: Future climate projections for PNG

	2030	2055
Rainfall	Increase in average annual rainfall and seasonal rainfall	Increase in average annual rainfall and seasonal rainfall
Average annual temperature	Increase of between 0.4-1.2°C Increase in number of hot days	Increase of between 1-2°C Further increase in hot days
Sea Level Rise	Increase of between 5-14cms	Increase by between 9-30 cms

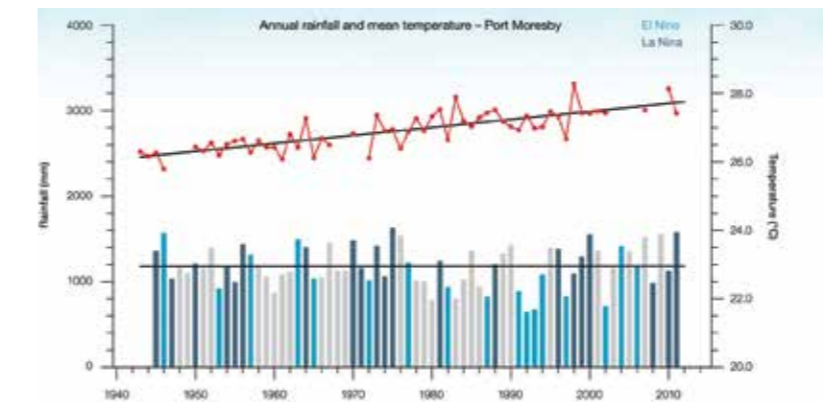
Based on the IPCC medium emissions scenario A1B

Temperature: In PNG's capital of Port Moresby, minimum recorded temperatures have increased by 0.3 oC per decade from 1940 to 2010, while maximum temperatures have increased by 0.13oC per decade (PCCSP). This will result in more hot days and warm nights, especially in the Highlands Region.

Rainfall: Annual rainfall is highly variable throughout PNG depending on El Nino and La Nina events. Rainfall is projected to increase over this century with more extreme rainfall events particularly in the traditionally wet seasons (PCCSP, 2011).

Figure 7: Average rainfall and temperatures for PNG (1940-2012)

Source: PCCSP (2011)



Storms: are expected to be less frequent but more intense with an increase in average maximum wind speed and increase in rainfall intensity. Increased rainfall during storms will heighten risk of soil erosion, nutrient loss, landslides and floods and require the increased maintenance of major roads, such as the Highlands Highway.

Ocean acidification: Carbon emissions increase the risk of ocean acidification which damages coral reef ecosystems. Coral reef fisheries could decrease by a further 20% by 2050. Coral reefs form an important buffer against the impacts on big waves for coastal communities.

Further reading

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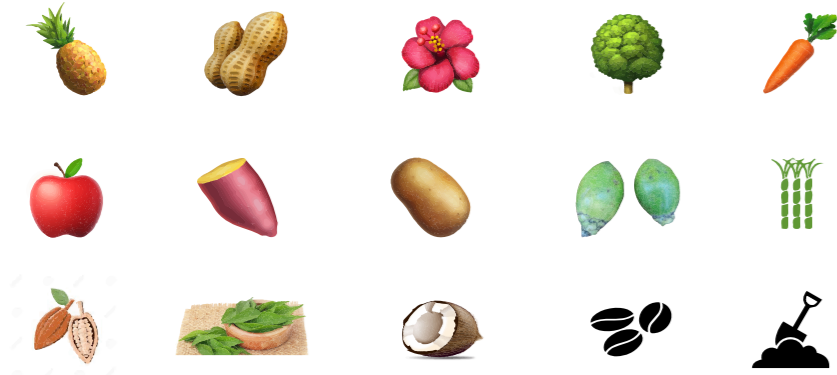
UNDP. (2012). About Papua New Guinea. http://www.pg.undp.org/content/papua_new_guinea/en/home/countryinfo.html

Vincent, J.B., Henning, B., Saulei, S., Sosanika, G. & Weiblen, G.D. (2014). Forest carbon in lowland Papua New Guinea: Local variation and the importance of small trees. Austral Ecology, 40(2), pp.151-59.

Appendix 2: Icons set – ecosystem services & climate

This icon set can be photocopied and used for Activities 2: Identification local Ecosystem Services and Activity 3: Historical and future climate trends for PNG

Plant & vegetable products



Animal and animal products



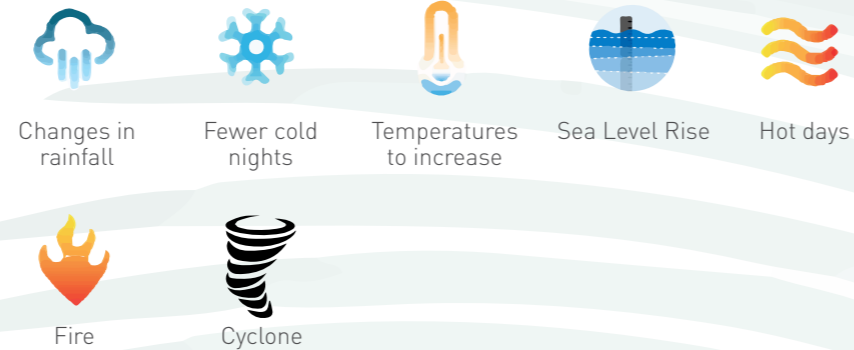
Coastal



Recreation & culture



Climate



Landmarks



Appendix 3: Workshop Agendas

Suggested outline of community biodiversity & climate change adaptation two-day workshop

There is a lot of information and a number of new concepts to cover in the workshop. Therefore it is important to give the participants enough time to grasp the concepts and work through the exercises over a day and a half. The following table provides guidance about how to structure the workshop activities and roughly how much time will be needed for each activity. However, the pace of your training should match that of the needs of the participants, and their domestic obligations.

DAY 1 WORKSHOP ACTIVITIES

Time	Activity
9:00-9:30am	Welcome and introductions
9:30-10:00am	Activity 1: Plenary session: Shared values around biodiversity
10:00-10:30am	Activity 2: Plenary session: Networks & connections between Government to Communities
10:30-11:15am	Activity 3: Exploring knowledge gaps & challenges about key stakeholder groups
11:10-11:45pm	Presentation on climate impacts for the region & voting on climate impacts of concern
11:45-12:45pm	Lunch break
12:45-1:45pm	Activity 3: Visualizing the impacts of environmental change (Impact mapping)

1:45-3:00pm	Activity 4: Identifying ecosystem service values at risk from climate change
3:00- 3:15pm	Wrap up, evaluation, next steps, certificate of participation

DAY 2 WORKSHOP ACTIVITIES

Time	Activity
8:30-9.30am	Activity 5: Identifying ecosystem service values at risk from development
9.30-12.30pm	Activity 6: Community lead ideas to conserve ES
12.30-1.15pm	Lunch
1.15-1.30pm	Wrap up, evaluation, next steps, certificate of participation

See page over for: Suggested outline of government biodiversity & climate change adaptation one-day workshop

Glossary of terms

Suggested outline of government biodiversity & climate change adaptation one-day workshop

ONE-DAY WORKSHOP ACTIVITIES	
Time	Activity
8:30-9:30am	Welcome and introductions
9:30-9:50am	Activity 1: Storytelling around peoples' experience with change in their local environment.
9:50-10:30am	Activity 2: Identification of local Ecosystem service values
10:30-11:15am	Activity 3: Exploring knowledge gaps & challenges about key stakeholder groups
11.15am	Morning tea break
11:30-12:15am	Activity 4: Summary of findings from the community workshops on Biodiversity and Climate Change Adaptation
12.15-1:00pm	Lunch
1:00-1:40pm	Activity 5: National and Provincial Government plans and policies regarding Climate Change Adaptation and Biodiversity conservation
1:40-3:20pm	Activity 6: The way forward making new connections between Provincial Govt. and the communities
3:20-3:45pm	Wrap up, next steps and workshop evaluation

Biodiversity	The variety of all living things; the variety of plants, animals and micro-organisms, the genetic information they contain and the ecosystems they form. Biodiversity is usually explored at three levels - genetic diversity, species diversity and ecosystem diversity.
Capacity	Competence to address challenges including an individual's skills, knowledge and confidence to act on their own or as part of a group.
Climate Change	A significant change in the average weather conditions or a change in the distribution of weather events. Likely to happen over an extended period (typically decades or longer). For example, it includes incremental changes in average temperatures and extreme events such as heat waves.
Climate Change Adaptation	Adaptation is a process of continual change in response to climate and non-climate drivers. For climate change, it includes action taken to avoid actual or likely climate impacts. Actions include planned response to managing climate change risks as well as taking advantage of the opportunities a changing climate could provide.
Ecosystem	Ecosystem functions are ecological processes that control the fluxes of energy, nutrients and organic matter through an environment. Examples include: primary production, which is the process by which plants use sunlight to convert inorganic matter into new biological tissue;

Ecosystem Services	The benefits people obtain from ecosystems which can be classified as provisioning, regulating, supporting, and cultural services. Ecosystem services include products such as food and clean water (provisioning); climate regulation and disease control (regulating); and nonmaterial benefits such as spiritual or cultural benefits. Changes in these services have multiple affects on human well-being.
Exposure	The degree to which a system or sector is exposed to climate related impacts, including the duration, frequency, and magnitude of changes in average climate and extremes.
Impacts (climate)	Consequences of climate change on natural and human systems.
Natural resource security	Equitable access to an adequate supply of resources from the natural environment including fresh water, timber, soil fertility and biodiversity.
Response	Planned or unplanned actions in response to climate related impacts.

Sensitivity	The degree to which a system could be damaged by change.
System	A collection of parts that are organized for a common purpose, or principles or procedures that define how something is done.
Storm surge	A rise above the normal water level along a shore resulting from strong onshore winds from storms or tropical cyclones
Vulnerability	The degree to which something could be adversely affected by climate change. Vulnerability can be thought of as the combination of exposure, sensitivity and the capacity to adapt.
Well-being	Human well-being includes basic material for a good life, freedom of choice and action, health, good social relations, and security as experienced and perceived by people, differently reflecting local geography, culture, and ecology.

Engaging communities and government in biodiversity conservation and climate adaptation in Papua New Guinea

The project is funded by USAID through the Pacific American Climate Fund (PACAM) and is a collaboration between the Institute for Sustainable Futures (ISF) and in-country partner, the New Guinea Binitang Research Centre.

Engaging Communities and Government in Biodiversity Conservation and Climate Adaptation in Papua New Guinea

The project supports biodiversity conservation, through community and government engagement to enhance resiliency to a changing climate and to manage local ecosystems in a way that conserves biodiversity and supports livelihoods.



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The project has three primary objectives:

1. Identify ecosystem services (ES) valued by the communities
2. Provide communities with locally relevant tools to gather information, report on impacts of climate change & other threats to biodiversity and livelihoods;
3. Inform Provincial-level Government policy and planning on biodiversity conservation & climate change adaptation

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