Regional Assessment on Ecosystem-based Disaster Risk Reduction and Biodiversity in Oceania

A report for the Resilience through Investing in Ecosystems – knowledge, innovation and transformation of risk management (RELIEF Kit) project.

Convention on Biological Diversity

Japan Biodiversity Fund

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Abbreviations and Acronyms

BCR	Benefit Cost Ratio
BPoA	Barbados Programme of Action
C-CAP	Coastal Community Adaptation Project
CBD	Convention on Biological Diversity
CBD COP12	Convention on Biological Diversity Conference of the Parties 12
CC	Climate change
CCA	Climate change adaptation
CEPF	Critical Ecosystems and Partnership Fund
CHICCHAP	The Choiseul Integrated Climate Change Programme
COT	Crown of Thorns
CRISP	Community Resilience to Climate and Disaster Risk project
DRM NAP	Disaster Risk Management National Action Plan
DRR	Disaster risk reduction
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based disaster risk reduction
FAO	Food and Agriculture Organization of the United Nations
GEF-LDCF	Global Environment Facility – Least Developed Countries Fund
INFORM index	Index for Risk Management
ITTO	International Tropical Timber Organization
IUCN ORO	International Union for Conservation of Nature Oceania Regional Office
IWRM	Integrated Water Resources Management
LLGs	Local Level Governments
MARSH	Mangrove Rehabilitation for Sustainably-Managed Healthy Forests
MDG	Millennium Development Goals
MECCDM	Ministry of Environment, Climate Change, Disaster Management and Meteorology
MESCAL	Mangrove Ecosystems for Climate Change Adaption and Livelihoods
MPAs	Marine Protected Areas
MSI	Mauritius Strategy of Implementation
NAPA	National Adaptation Programmes of Action

NBSAP	National Biodiversity Strategy and Action Plan
NDMO	National Disaster Risk Management Office
NPV	Net Present Value
OCCD	Office of Climate Change and Development, PNG
PACC	Pacific Adaptation to Climate Change
PASAP	Australian Government's Pacific Adaptation Strategy Assistance Program
PES	Payment for Ecosystem Services
PGK	Papua New Guinean Kina
PICTs	Pacific Island Countries and Territories
PIFACC	Pacific Islands Framework for Action on Climate Change
PNG	Papua New Guinea
PNGCLMA	Papua New Guinea Centre for Locally Managed Areas
PNGFA	Papua New Guinea Forestry Authority
PWM	Partners With Melanesia
REDD+	Reducing emissions from deforestation and forest degradation
RFA	Pacific Disaster Risk Reduction and Disaster Management Framework for Action
RMI	Republic of Marshall Islands
SIDS	Small Island Developing States
SPC	Pacific Community
SPREP	The Secretariat of the Pacific Regional Environment Programme
SRDP	Strategy for Climate and Disaster Resilient Development in the Pacific
STAR	System for Transparent Allocation of Resources
TNC	The Nature Conservancy
UNCCD	The United Nations Convention to Combat Desertification
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCC	United Nations Framework Convention on Climate Change
UPNG	University of Papua New Guinea
USAID	United States Agency for International Development
WCS	Wildlife Conservation Society
WRI	World Risk Index

Executive summary

The Oceania region is very prone to natural disasters having experienced two Category 5 cyclones in as many years; Tropical Cyclone (TC) Pam struck Vanuatu on 13 March 2015 and TC Winston struck Fiji on 20 February 2016. Severe TC Winston is the strongest cyclone ever recorded in the Southern hemisphere in terms of wind strength and caused extensive destruction totalling FJD 2 billion in costs. Apart from cyclones, the region is also prone to floods, droughts and non-climatic events such as earthquakes and tsunamis that also cause widespread destruction. The Pacific Island countries are therefore very aware of the need for disaster risk reduction strategies. These strategies, however, fail to include biodiversity and ecosystems and the services that they offer in mitigating the impacts of extreme climatic events.

The following assessment is being conducted as part of the RELIEF-Kit (Resilience through Investing in Ecosystems – knowledge, innovation and transformation of risk management) project implemented by IUCN. The project aims to address knowledge gaps and capacity needs for the implementation of integrated approaches for disaster risk reduction and biodiversity conservation. The assessment mostly covers seven focal countries: Tuvalu, Vanuatu, Solomon Islands, Fiji, Papua New Guinea (PNG), Samoa and Republic of Marshall Islands. These countries were considered to be the most vulnerable to hazards. A desk-based literature review of scientific literature, national reports, project and policy documents was conducted to determine the status of ecosystem-based disaster risk reduction (Eco-DRR) in Oceania, the role of biodiversity in Eco-DRR and conversely how Eco-DRR contributes to biodiversity in the region. Regional initiatives and frameworks in Eco-DRR were also reviewed. The economic case for Eco-DRR implementation was also examined.

From the assessment, it is apparent that Eco-DRR initiatives that are identified as such are not common indicating that this field of practice is not well known and not easily recognised as such. However, while projects may not be explicitly labelled as Eco-DRR, there are several initiatives, particularly ecosystem-based adaptation projects, that are actually Eco-DRR in nature. Furthermore, several conservation projects provide co-benefits for disaster risk reduction providing a good basis for further scaling of the approach once these co-benefits are identified, understood and eventually enhanced.

For the integration of disaster risk management and conservation, it is recognised that disaster management officials need documentation on evidence to support the adoption of Eco-DRR interventions. Economic analyses such as cost-benefit analysis of natural infrastructure versus engineered options can provide a strong case for Eco-DRR. While a review of studies documenting the economic benefits of Eco-DRR in the region yielded few results, the examples available from the region, such as a case study from Lam Town in Fiji, provide good global models on the effectiveness of Eco-DRR and illustrate the methodologies that can be replicated across initiatives to build on the economic case.

The importance of implementing actions to strengthen resilience of communities in the region is highlighted in several regional policies such as the SAMOA pathway. This priority is aligned with the region's high representation of small island developing states (SIDS) that are vulnerable to climate change and coastal hazards. However, the opportunities that Eco-DRR presents as a tool to build community resilience are not fully recognised.

Given the priorities in the region to increase resilience to climate change, there is a need to increase awareness on the role of Eco-DRR approaches in supporting ecosystem-based adaptation for longer-term resilience. Following which, the entry points presented by international and regional policies for biodiversity conservation and climate change adaptation can be used to stream Eco-DRR as a cross-cutting issue.

One major challenge for the scaling up of Eco-DRR is the importance of reframing DRR concepts to ensure that ecosystem-based approaches are recognised as key constituents of disaster risk management.

For biodiversity conservation and climate change adaptation to be integrated in Eco-DRR and for greater acceptance of Eco-DRR in the region several key points and recommendations are made (Table 1).

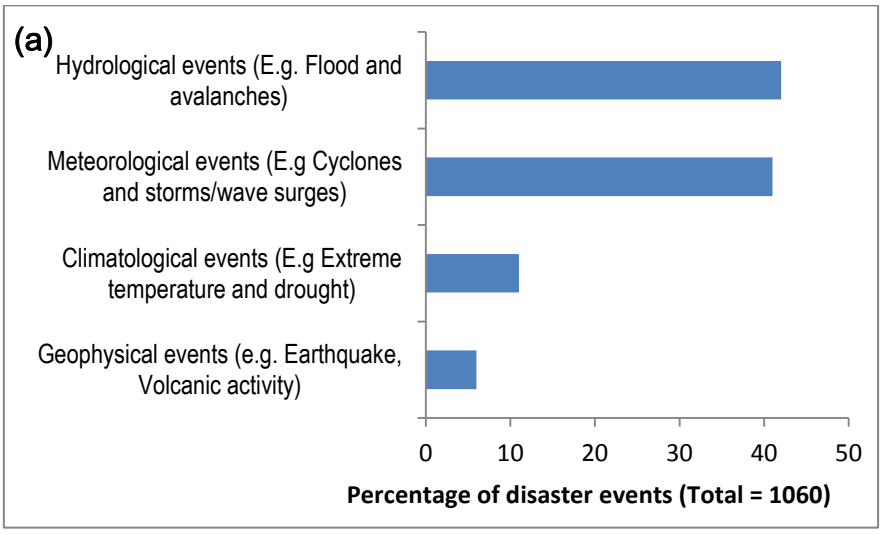
Table 1. Challenges, opportunities and recommendations for integrated approaches

Challenges	Opportunities	Recommendations
▪ The national biodiversity policies and action plans rarely mention Eco-DRR except in countries like Samoa where the Environment Department and NDMO are housed in the same Ministry	▪ There is enormous scope for integrating Eco-DRR with conservation through using and providing evidence for their role in EbA	▪ Promote inter-sectoral collaboration to improve policy implementation and translate knowledge into actions
▪ Conversely, the Disaster Management Plans and DRR policies of the focal countries do not mention biodiversity and ecosystem-based approaches	▪ With the exception of Fiji whose mangrove forests are under the custodianship of the State, the mangroves in the other Melanesian countries are owned by the traditional landowners providing opportunities for participatory Eco-DRR initiatives	▪ Raise awareness on the importance of integrated ecosystem-based approaches for CCA and DRR among governments, civil society and practitioners
▪ There is a need to ensure a solid case in favour of ecosystem-based approaches for CCA and DRR, including the need to make an economic case for decision making	▪ The Samoa Pathway and Framework for Resilient Development in the Pacific (FRDP are two key regional frameworks that provide entry points for the mainstreaming of Eco-DRR initiatives in the region	▪ Both biodiversity and Eco-DRR to be integrated into national planning for sustainable development
	▪ There is a proliferation of MPAs in the Pacific that have been set up to conserve biodiversity and their establishment and promotion are evident from action plans associated with the CBD. For these MPAs to be seen as part of Eco-DRR, they need to be incorporated into a larger seascape or ridge to reef approach to ecosystem management. Ecological connectivity is perhaps under-recognised	▪ For government buy-in, more regional and national evidence is needed to prove that Eco-DRR and the maintenance of ecosystem structure and function can provide cost-effective options for DRR. This evidence can be furnished by Cost-Benefit Analysis of the different options
	▪ The regional policy illustrates a shift from emergency response to proactive integrated approaches. The region, however, remains vulnerable and continued support needs to be provided towards the integration of efforts and its co-funding, i.e. biodiversity benefits DRR and DRR benefits biodiversity	▪ The role of people and their social systems must be recognised in Eco-DRR as traditional knowledge and practices of Pacific indigenous peoples have contributed to their coping strategies during times of natural disasters


Photo: Coral reefs in Fiji / CC0 Public Domain

1. INTRODUCTION

The past three decades have seen a rise in natural catastrophes worldwide with for example an increased incidence of climate-related disasters mostly due to floods and storms. Natural hazards (Figure 1) such as cyclones, earthquakes and tsunamis are increasingly taking a toll on human lives and causing increased property and economic losses. In the last 10 years, over 700,000 people have lost their lives, over 1.4 million have been injured and around 23 million made homeless as a result of disasters (IUCN, 2015). The year 2015 alone has seen the occurrence of 1,060 disaster events causing 23,000 fatalities and up to US$ 100 billion of economic losses worldwide (Munich Re, 2016). With the prediction that extreme weather events will increase over the long term due to climate change (IPCC, 2014), it is likely that the current trend will persist, putting more and more people at risk. People from low-income countries, communities and households face the highest risk, as they are most vulnerable and also the least resilient and last to recover from extreme events (UNISDR, 2009; Winsemius et al., 2015).



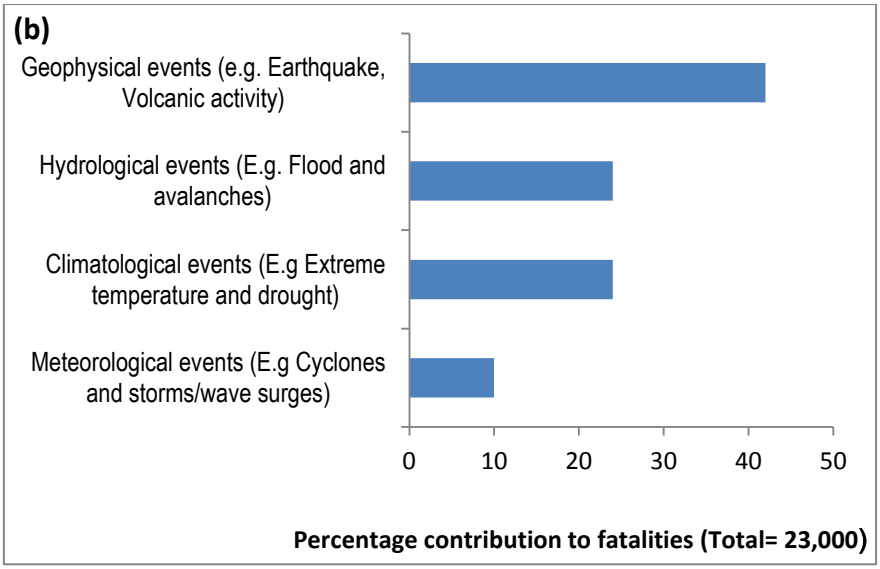


Figure 1. Categories of natural hazards and (a) their percentage contribution to disasters and (b) their contribution to fatalities worldwide in 2015 (Source: Munich Re)

In an effort to address such challenges, it is crucial to distinguish between natural hazards and disasters. While the occurrence of natural hazards cannot be prevented, disasters, defined as "serious disruptions of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources" (UNISDR, 2009), can on the other hand be prevented or at least mitigated. This requires that the anthropogenic driving forces, contributing to increased disaster risks for example bad development planning, environmental degradation, poverty and weak governance (UNISDR, 2015), be addressed. With the implementation of effective disaster risk reduction (DRR) strategies, the extent of damage and losses caused by natural hazards can be largely reduced irrespective of increase in frequency and intensity of these events.

While DRR strategies very often rely on the use of man-made structures to protect communities, nature-based approaches are also important components of DRR. Healthy and well-managed ecosystems indeed have an important role to play in cost-effective DRR strategies. For example, Sudmeier-Rieux et al. (2013) stated four reasons why ecosystems matter to disaster risk reduction:

1) Human well-being depends on ecosystems that also enable people to withstand, cope with and recover from disasters. There is a two-way relationship between poverty and disasters, with poor communities being subject to greater numbers of disasters, especially in areas where ecosystems are degraded.
2) Ecosystems, such as wetlands, forests and coastal systems, can provide cost-effective natural

buffers against hazard events and the impacts of climate change.

3) Healthy and diverse ecosystems are more resilient to extreme weather events. Intact ecosystems are less likely to be affected by, and more likely to recover from, the impacts of extreme events. However, disasters can affect ecosystems through habitat loss and species mortality. Poorly designed post-disaster clean-up efforts can also negatively impact on ecosystems, with negative consequences on progress towards achieving the objectives of the UN Convention on Biological Diversity and Millennium Development Goals.
4) Ecosystem degradation, especially of forests and peatlands, reduces the ability of natural systems to sequester carbon, increasing the incidence and impact of climate change, and climate change related disasters.

Despite its importance, environmental management is still underexplored in DRR strategies. Ecosystem-based disaster risk reduction (Eco-DRR) remains a relatively new concept to practitioners and policy makers. Lack of knowledge on such nature-based approaches, their effectiveness and implementation process, poses a serious barrier to its adoption and scaling up. Thus, there is a growing need for countries to understand what is meant by Eco-DRR and how to make this operational, so that it can become a key investment option for sustainable development. Also, there remain information gaps that need to be addressed when it comes to the implementation of Eco-DRR. Current work on Eco-DRR is focused on ecosystems but little is known on the importance of other levels of biodiversity such as species and genetic diversity. A better understanding of the contribution of the different components of biodiversity to Eco-DRR and the possible synergies with biodiversity conservation is not only critical for the field but transfer of the knowledge can also help countries to implement integrated approaches to achieve multiple goals.

Thus, the need for this assessment on Eco-DRR and biodiversity that is being implemented as part of the **Resilience through Investing in Ecosystems – knowledge, innovation and transformation of risk management** (RELIEF Kit) project. This regional assessment is being conducted simultaneously with five others, which are expected to generate regional knowledge on the importance of biodiversity and ecosystems in Eco-DRR in practice as well as identify entry points and opportunities to catalyse actions for Eco-DRR that embraces the importance of biodiversity and ecosystems.

2. METHODOLOGY

This assessment was carried out through desk research supplemented by interviews with relevant stakeholders in the Oceania region. A synthesis report on Ecosystem-based approaches to climate change adaptation and disaster risk reduction developed by the Secretariat of the Convention on Biological Diversity (Lo, 2016) was used as a basis throughout the assessment (with regards to the methodology used and sources of information) and efforts were made to ensure that the assessment does not replicate work done in the report.

A review of existing literature including project reports, scientific articles and policy documents obtained from various sources was conducted and data from different online databases were also extracted and analysed to document the following topics:

- regional overview on biodiversity and types of ecosystems, types of hazards, impacts of disasters, vulnerability to disasters
- Policy context to integrate Eco-DRR and biodiversity conservation in the region
- Biodiversity case for Eco-DRR: practical examples of how biodiversity (different species), ecosystems (different habitat types) and means of conservation (different management approaches) contribute or can contribute to Eco-DRR outcomes in the region
- Economic case for Eco-DRR: example of economic benefits of Eco-DRR in the region

A questionnaire was also developed based on IUCN's mapping analysis of ecosystem-based adaptation projects (Rizvi, 2014) to document the national experiences in Eco-DRR and map initiatives in the region.

2.1 Geographical coverage and focal countries

The first section of the report, which documents the disasters and diversity of natural resources in the region, covered all of the independent countries in the Oceania region. However, in the later chapters, regional focus is narrowed down to a set of focal countries based on their vulnerability to natural hazards. For the selection of these focal countries, vulnerability was defined as the level of risk, degree of exposure to climate change and adaptive capacity. Although Australia would have qualified as very high risk and very high

exposure to climate change, its adaptive capacity, however, is high and therefore vulnerability is low. The same would apply to New Zealand. The seven countries selected have a high risk of climatic variability, high exposure to climate change but have low adaptive capacity rendering them highly vulnerable to climate change. The final selection of countries was made after consulting with key DRR personnel in the regional agency mandated to provide technical assistance in DRR, the Pacific Community (SPC). Their extensive experience in Oceania determined the following countries as being the most vulnerable countries in the region:

1) Papua New Guinea
2) Vanuatu
3) Fiji
4) Solomon Islands,
5) Republic of Marshall Islands
6) Tuvalu
7) Samoa

2.2 Disaster risk profiles and vulnerability to disasters

Information on (1) the type of natural hazards and disasters, (2) the impact of disasters and (3) vulnerability to disasters was obtained from online databases and global indices on disaster risks (Table 2). All quantitative measures of the impacts of disasters expressed in the report were obtained from the online databases listed here.

International composite indices like the WorldRiskIndex and the INFORM index that integrate different dimensions of risks can be useful tools to indicate the likelihood that a country will experience a disaster. While not necessarily predictive, they can provide indications of which countries are most at risk.

Table 2. Indices and databases used to document hazards and disaster risks in the region.

Name	Description
Indicators	
World Risk Index	It indicates the risk of disaster as a consequence of extreme natural events and consists of four components: exposure to natural hazards, susceptibility, coping capacities and adaptation capacities
Inform Risk Index	It identifies countries at risk from humanitarian crises and disasters that could overwhelm national response capacity. It is made up of three dimensions: hazards and exposure, vulnerability and lack of coping capacity
Databases	
EM-DAT, the international disaster database	Contains essential core data on the occurrence and effects of over 18,000 mass disasters in the world from 1900 to present.
Prevention Web	Provides a disaster and risk profile for countries with information from several indicators

The WorldRiskIndex (WRI) has been developed since 2011 by researchers from the University of Stuttgart, Germany in collaboration with the United Nations University-Institute of Environment and Human Security (UNU-EHS) and the Alliance Development as a source of information for stakeholders working in the field of disaster risk reduction, spatial planning and insurance.

It calculates the relative disaster risk for 171 countries based on four components (Exposure, susceptibility, coping capacity and adaptive capacity; Figure 2) and 28 indicators. The index is expressed as a percentage with higher values indicating higher level of risk.

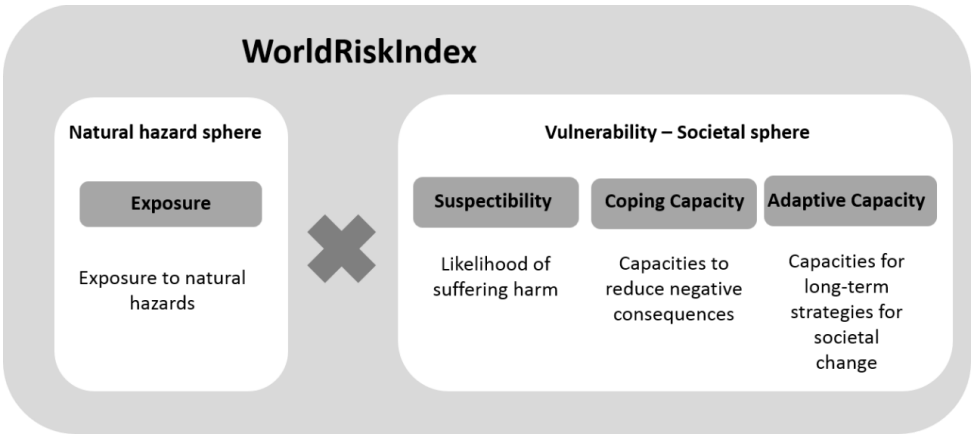


Figure 2. Dimensions of the WorldRiskIndex (Source: University of Stuttgart)

INFORM is a similar global open-sourced index that assesses the risk of both humanitarian crises and disasters. It is a collaboration between the Inter-Agency Standing Committee Task Team for Preparedness and Resilience and the European Commission and includes several partners. Calculated for 191 countries, INFORM aims to inform decision-making on crisis risk by answering the following questions: 1) Which countries are at risk of crisis that will require humanitarian assistance in response to disasters? 2) What are the underlying factors that could lead to crisis? And 3) How does the risk change with time? (Groeve et al., 2015).

The index is composed of three components expressed as a score of 1 to 10; the higher the score, the greater the risk (Source: Groeve et al., 2015):

1. **Hazard and exposure**: “reflects the probability of physical exposure associated with specific hazards”
2. **Vulnerability**: “addresses the intrinsic predispositions of an exposed population to be affected, or to be susceptible to the damaging effects of a hazard”
3. **Lack of adaptive capacity**: “measures the ability of a country to cope with disasters in terms of formal, organised activities and the effort of the country’s government as well as the existing infrastructure, which contribute to the reduction of disaster risk”.

2.3 Policy preparedness

For this section, regional and national policies and action plans on environmental management and conservation, disaster risk management, and climate change adaptation were reviewed (Table 3). To identify entry points for integrated approaches. These policy documents were sourced from the following websites and databases:

- Convention on Biological Diversity national reports database
- United Nations Framework Convention on Climate Change national reports database
- InforMEA (United Nations Information Portal on Multilateral Environmental Agreements)
- Prevention Web
- The Secretariat of the Pacific Regional Environment Programme (SPREP)
- Pacific Climate Change portal
- Pacific Disaster Net

Table 3. Summary of national reports submitted by countries on national frameworks and action plans

	Fiji	RMI	PNG	Samoa	Solomon Islands	Tuvalu	Vanuatu
National Biodiversity Strategies and Action Plans	✓	✓	✓	✓	✓	✓	✓
Fifth national report	✓	x	x	✓	✓	x	✓
Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas	✓	✓	x	✓	✓	✓	x
Ramsar convention COP 12 national report	✓	✓	x	✓	x	x	x
UNCCD: Nation action plan to combat land degradation and to militate against drought	✓	x	x	✓	x	x	x
National communication	✓	✓	✓	✓	✓	✓	✓
National climate change policy	✓	✓	✓	x	x	x	x
National Adaptation Programmes of Action (NAPA)	x	x	x	✓	✓	✓	✓
Hyogo framework of action	✓	✓	✓	✓	✓	x	✓
Disaster risk management plan	✓	✓	✓	✓	✓	✓	✓

2.4 Mapping of Eco-DRR initiatives in the region

Relevant stakeholders including government agencies (disaster risk management, environmental sector, development planning, and infrastructure) and organisations working with environmental management, conservation and DRR were identified through professional networks.

Additionally a questionnaire (Annex 1) was developed and circulated to the National Disaster Management Offices in the seven focal countries but there was no response.

2.5 Identifying Eco-DRR initiatives and activities

For documentation of Eco-DRR projects in the region, projects clearly labelled as such were identified. However, as noted in the CBD global synthesis report (Lo, 2016), Eco-DRR activities are not always explicitly labelled as such.

To identify projects that are Eco-DRR in nature and Eco-DRR activities in policy documents, a set of guidelines/ indicators was developed:

1. Any references to the use of ecosystem management tools (e.g. coastal zone management, habitat restoration) to mitigate and reduce vulnerability to the following natural hazards:
    - Cyclones, typhoons and hurricanes
    - Floods
    - Tsunamis
    - Sea level rise
    - Landslides
    - Droughts
    - Earthquakes
    - Volcanoes
    - Extreme temperatures

2. References to these activities:
    - Vulnerability/habitat assessment to understand exposure to natural hazards and disasters
    - Understanding links between environmental management and root causes of hazards
    - Understanding links between ecosystem characteristics (e.g. quality) and vulnerability
    - Assessing the risk of ecosystem collapse
    - Quantification of the role of ecosystem in risk mitigation
    - Protection and restoration of natural infrastructures/ecosystem services to reduce exposure and vulnerability to natural hazards and disasters
    - Improvement of natural resource governance with respect to disaster risk reduction

2.6 The role of biodiversity for Eco-DRR

Documentation of the role of biodiversity for Eco-DRR was conducted through literature review and call for studies. To obtain practical examples that demonstrate the role of biodiversity in disaster risk reduction, a call for case studies was made with members of the IUCN Commission on Ecosystem Management and the Species Survival Commission. The consultant also called on her own regional experience and network of practitioners to provide the case studies presented herein.

2.7 Economic case for Eco-DRR

Due to the timeframe to complete this assessment, an effective analysis of the economics of Eco-DRR was not feasible, so a review of existing information on the cost-effectiveness of Eco-DRR projects in the region was conducted.

3. REGIONAL OVERVIEW

This section examines the ecosystems, most common types of hazards and the most vulnerable countries in Oceania. The impacts of disasters in these countries are also briefly described.

3.1 Geography

The Oceania region (figure 3) covers twenty-three Pacific Island Countries and Territories (PICTs) spread over an area of ocean 30 million square kilometres in size. There are five sub-regions: Australia, New Zealand, Melanesia, Polynesia and Micronesia and these islands vary in size from continental Australia to the high volcanic islands of Melanesia to the coral atolls and sand cays of Micronesia. The islands of Melanesia in the western part of the region include Papua New Guinea, Solomon Islands, Vanuatu, New Caledonia and Fiji. Of the Pacific Island Countries and Territories (PICT), PNG is by far the largest and most populous with its land area and population exceeding that of all the other PICTs combined. To the north and east of Melanesia lie the smaller islands of Micronesia and Polynesia. The Micronesian cluster includes the Federated States of Micronesia, Commonwealth of the Northern Mariana Islands, Guam, Kiribati, Republic of Marshall Islands, Palau and Nauru. These islands are generally very small, low lying, resource-poor and scattered geographically. The sub-region of Polynesia includes American Samoa, Tuvalu, Tonga, Samoa, Cook Islands, French Polynesia, Niue, Tokelau and Wallis and Futuna. The islands of Polynesia are a mixture of raised limestone islands and atolls.

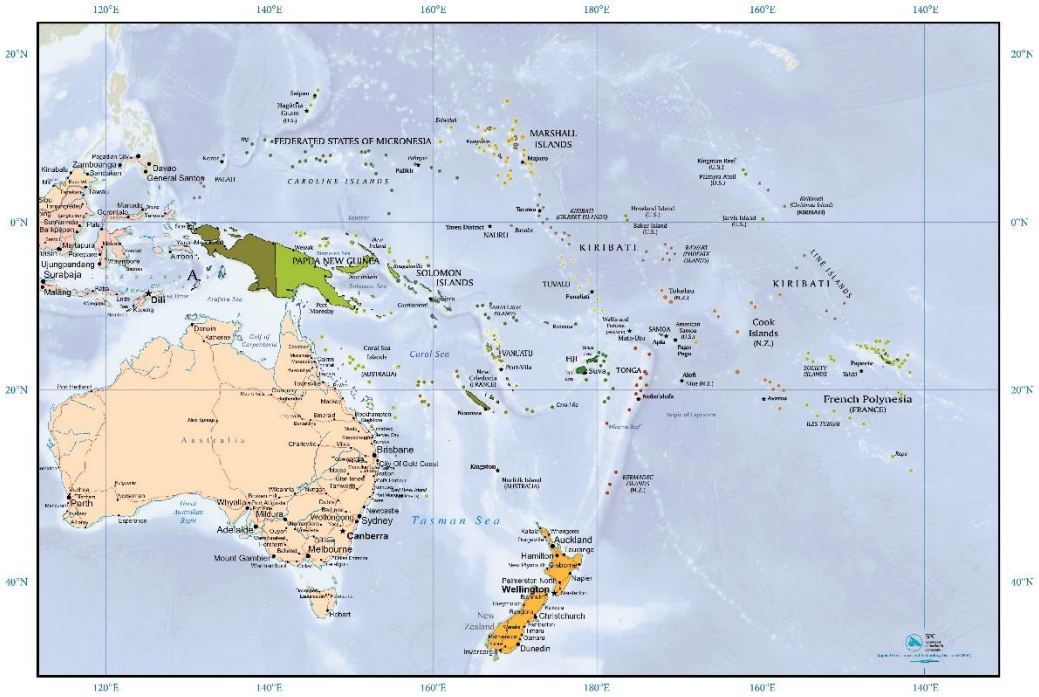


Figure 3. Map of Oceania region (Source: Pacific Community (SPC))

3.2 Ecosystems and biodiversity

While the region covers an area of approximately 30,000,000 km^2, only 2% is made up of land (SPREP, 2012). A variety of natural and cultural terrestrial, freshwater and marine ecosystems are found in the region (Table 4).

For the land based areas there are 16 broad ecological zones classifying forests, shrub lands, deserts, steppes and mountain ecosystems according to the climate (FAO, 2001). The tropical ecosystems cover small patches in northeastern Australia and the Micronesian, Melanesian and Polynesian islands (FAO, 2001). Subtropical ecosystems are located in some regions of Australia only and temperate ecosystems cover southeastern Australia and New Zealand (FAO, 2001). The arrays of ecosystems in the region have extremely high levels of biodiversity and endemism owing to their insular nature (Wardell-Johnson et al., 2011; SPREP, 2012). Some species groups have an endemism level of up to 90% (SPREP, 2012).

Table 4. Simplified classification of terrestrial, freshwater and marine ecosystems in Oceania (Source: SPREP, 2012)

TERRESTRIAL AND FRESHWATER ECOSYSTEMS	MARINE ECOSYSTEMS
Lowland Native Forest	Mangroves
Upland or Montane Rain Forest	Estuaries
Mature Fallow Forest	Intertidal Zone
Plantation Forest	Lagoons/Bays
Grassland/Woodland	Fishponds/Maricultural Areas
Scrubland/Scrub-Fern Land	Coral Reefs
Shifting Agricultural Land	Island Shelf/Reef Platform/Ocean Floor
Permanent/Semi-permanent Agricultural Land Plantations	Open Ocean
Pasture	
House Yard/Urban Gardens	
Intensive Livestock Holdings	
Ruderal Sites	
Wetlands/Swamps	
Rivers/Streams/Lakes/Ponds	
Fishponds/Aquaculture	
Coastal Strand Vegetation	
Beaches and Dunes	
Bare Rocks	
Caves	
Built/Urban	

Biodiversity hotspots are areas “featuring exceptional concentrations of endemic species and experiencing exceptional loss of habitat” (Myers et al., 2000). Conservation International has identified two main biodiversity hot spots in Oceania namely the East Melanesian Islands and Polynesia-Micronesia (CEPF, 2016). This covers the main islands in the region (Table 5).

Table 5. Overview of the endemic biodiversity and countries included in the two main Oceania biodiversity hotspots (Source: CEPF, 2016)

BIODIVERSITY HOTSPOT	OCEANIA COUNTRIES INCLUDED	NUMBER OF ENDEMIC SPECIES
East Melanesian Islands	Vanuatu	30,000 vascular plants
	Solomon Islands	41 mammals
	Papua New Guinea	148 birds
		54 reptiles
		45 amphibians
		3 freshwater species
Polynesia-Micronesia	Federated States of Micronesia	3,070 vascular plants
	Fiji	164 birds
	Kiribati	30 terrestrial reptiles
	Marshall Islands	11 mammals (all bats)
	Niue	2 amphibians
	Palau	
	Cook Islands	
	Palau	
	Samoa	
	Tonga	
	Tuvalu	
	Nauru	

3.2.1 Reefs

The islands of Oceania are estimated to have a combined reef area that constitutes 25% of the global reef area for reefs to a depth of 30 m (Chin et al., 2011). Some of the islands are also part of the coral triangle, the most diverse marine biodiversity region in the world (Veron et al., 2009) namely PNG and Solomon Islands. Coral reefs are second only to tropical rainforests in productivity and provide PICTs with coastal protection and fisheries for subsistence and small-scale commercial fisheries. There are different types of reefs: fringing, patch, barrier, shelf reefs and atolls. The reefs provide habitats for a stunning array of flora and fauna and the reefs of the southwest Pacific host high species diversity, which decreases as one progress eastwards.

The state of the reefs in the Pacific is considered stable to healthy and is in better condition than that of other regions. The longer-term outlook, however, is considered poor due to threats driven by climate change (Chin et al., 2011). There were major bleaching events in

1997, 2000-2002 due to elevated sea temperatures. Other threats include ocean acidification, cyclonic damage, eutrophication, COT outbreaks, overfishing and sedimentation from poor land use practices.

3.2.2 Mangroves

Mangrove ecosystems are found in deltaic areas of the higher islands of Melanesia with significantly smaller areas in Micronesia and Polynesia. More than 50 mangrove species grow in the region with Australia and PNG having the greatest diversity (FAO, 2007). The two countries also possess some of the largest mangrove areas in the world with Australia having the third and PNG the eleventh largest mangrove area in the world (Spalding et al., 2010). Mangrove ecosystems have been in the spotlight in recent years because of their role in terms of both climate change mitigation and adaptation. Mangrove soils have carbon sequestration properties making them very important in climate change mitigation. The rearing of mangrove seedlings in village nurseries before transplanting them in the wild is a means of climate change adaptation because of the protection afforded by mangroves against storm surge and excessive tidal action. Mangroves are an important source of fisheries for subsistence, firewood and construction materials, traditional medicines and traditional dyes for communities in Oceania. Mangroves are generally in a healthy state, however, they are being increasingly threatened by development pressures. Tracts of mangroves are being cleared for resort infrastructure in Fiji and Vanuatu. With the exception of Fiji whose mangrove forests are under the custodianship of the State, the mangroves in the other Melanesian countries are owned by the traditional landowners. Communities are thus taking ownership of their mangrove resources by developing management plans, whilst Fiji has opted for a national mangrove management plan (MESCAL, 2013).

3.2.3 Forests

Australia, PNG and New Zealand together harbour 99% of the forest area in the Asia-Pacific region (FAO, 2011). Ecosystem benefits offered by forests include catchment protection, food, fuelwood, timber production, biodiversity conservation, medicines, cultural uses, soil and water conservation and carbon sequestration. Area of natural forest ranges from 440,000 hectares in Vanuatu (ITTO, 2011) to 37 million hectares in Papua New Guinea (PNGFA, 2015). The threats to forests include clearing by fire and deforestation for logging, agriculture and plantation development. Most forests in Melanesia are under customary ownership. The forests of PNG boast the highest number of orchid species in the world, 7.5% of the world's total number of higher plant species, thirty-five mammals and thirty birds

and ten amphibians that are listed in the IUCN Red List as critically endangered, endangered or vulnerable (ITTO, 2011). Payment for forest ecosystem services such as carbon sequestration has gained prominence with the REDD+.

3.3 Threats to ecosystems and biodiversity

Oceania region not only hosts some of the richest biodiversity but also one of the most threatened in the world (Kingsford et al., 2009). Tropical ecosystems in the region are particularly fragile and threatened by a variety of factors as summarised below (SPREP, 2012):

- Tropical rainforests: major threats are hunting, logging, mining, road construction, commercial plantation and shifting cultivation
- Tropical dry forest: major threats are fire, logging, deforestation, agricultural clearance, grazing and invasive species
- Coastal and mangrove forest: commercial plantation, habitat loss, pollution, waste dumps
- Coral reefs and other marine ecosystems: ocean acidification, mining, pollution, waste dumps

A high percentage of the species are threatened in the region with for example 21% of mammals and 60% of reptiles being at risk of extinction (SPREP, 2012). Kingsford et al. (2009) identified “six major threatening processes driving biodiversity decline in the terrestrial, freshwater, and marine environments of Oceania” namely: 1) habitat loss and degradation, 2) invasive species, 3) overexploitation, 4) pollution, 5) disease and 6) climate change.

Anthropogenic climate change particularly represents a major challenge for the protection of natural resources in Oceania with Polynesia-Micronesia being the biodiversity hotspot that is most vulnerable to global changes (Bellard et al., 2014). The consequences of climate change will exacerbate existing threats to the diversity of ecosystems and species in the region. Changes in fire regimes, sea-level rise, changes in temperature and rainfall patterns, increased prevalence of invasive species, increased storm severity and extreme events as a result of climate change are already documented to be affecting the region’s biota (Kingsford et al., 2009; Wardell-Johnson et al., 2011; Kingsford & Watson, 2011).

3.4 Natural hazards and disasters

The Oceania region is identified as a disaster risk hotspot by the WorldRiskIndex (World Risk Report, 2015). The region is not only highly exposed to natural hazards but it is also in one of the most disaster-prone regions in the world (Asia-Pacific Disaster Report, 2015).

There are eight main natural hazards that affect the region. Storms, mostly tropical cyclones, are the hazards that affect the most countries and territories (Figure 4) in the region. Extreme temperatures on the other hand affect only two countries, Australia and New Zealand. Storms are also the most common natural hazards to result in disasters in the region and impact the most countries (Figure 5).

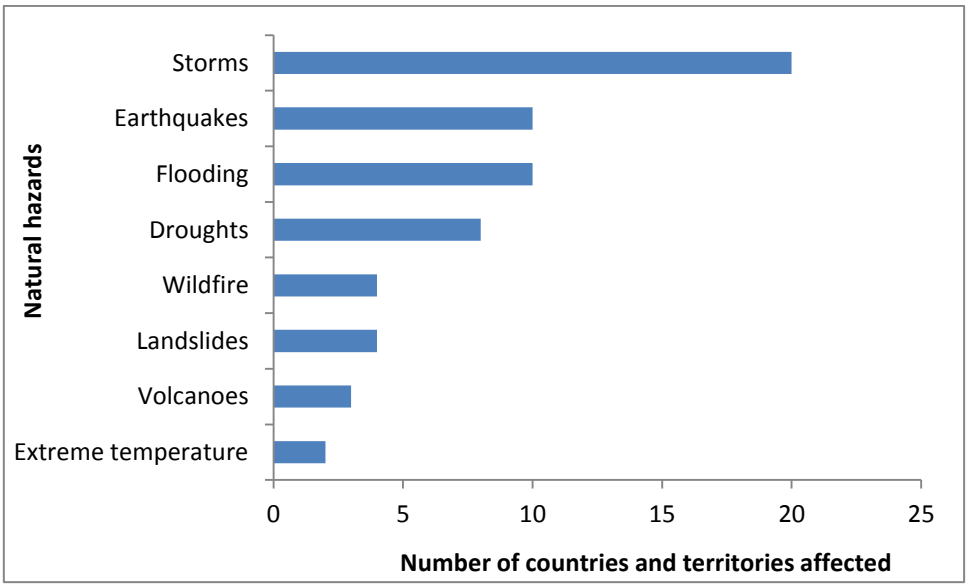


Figure 4. Number of countries and territories affected by different natural hazards from 1980-2015 (Source: EM-DAT database)

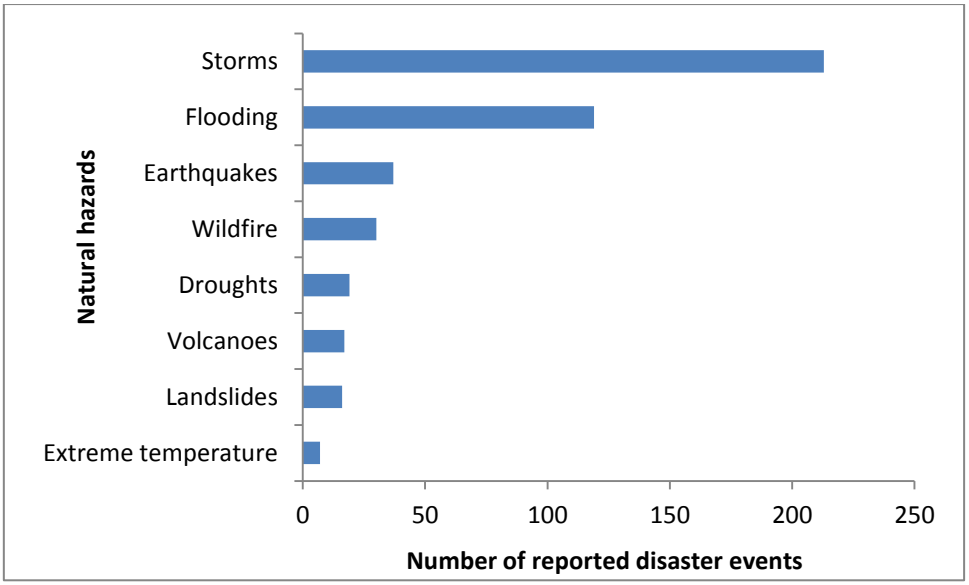


Figure 5. Reported occurrence of disasters by different natural hazards from 1980-2015 (Source: EM-DAT database)

3.5 Impact of natural hazards in the region

In the past thirty-five years, 5,549 people are reported to have been killed by disasters caused by natural hazards in the region (EM-DAT database). Furthermore, around 23 million people have been affected by such disasters. Earthquakes are the most deadly hazards in the region contributing to 51% of the reported deaths, while droughts have the most widespread impact contributing to 44% of the reported number of people affected by disasters (Figure 6).

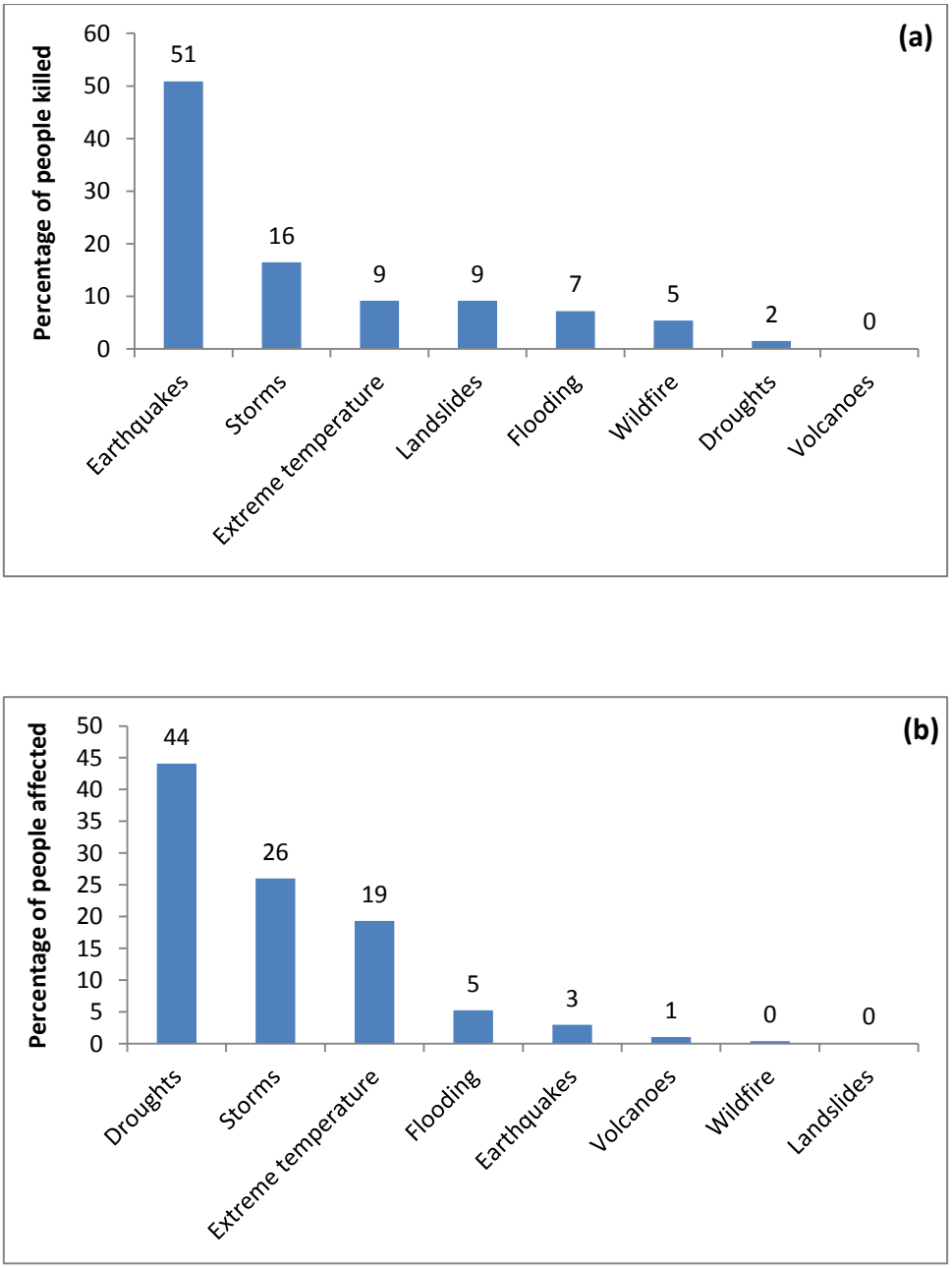


Figure 6. (a) Percentage of people killed and (b) percentage of people affected by hazard type from 1980-2016 (Source: EM-DAT database)

Disasters have also caused huge economic losses in the region. It is estimated that around US$ 75 billion of economic damages has been caused by disasters in the past 25 years mostly attributed to earthquakes and storms (Figure 7).

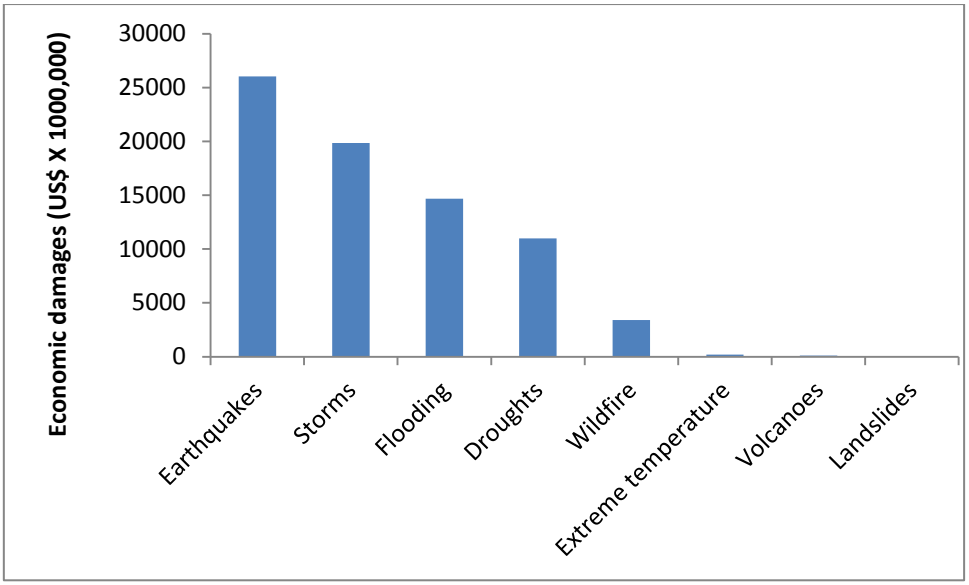


Figure 7. Estimated economic damages by hazard type from 1980-2016 (Source: EM-DAT database)

Fiji and the aftermath of TC Winston

Saturday 20 February 2016 is a day that will be indelibly etched into the collective memory of all Fijians as it was the day that Severe Tropical Cyclone Winston struck the Fiji group. TC Winston was a category five cyclone and had maximum average winds of 233 km/hour and momentary gusts of 305 km/hour making it the most severe cyclone to make landfall in the country and indeed one of the strongest ever recorded in the Southern Hemisphere. The combination of fierce winds and storm surges caused widespread destruction and the loss of 44 lives. More than 30,000 homes, 495 schools and 88 health clinics and medical facilities were either damaged or destroyed and some 40,000 people needed immediate assistance after the cyclone, such was the scale of destruction caused by TC Winston. The cyclone impacted 62% of the country's population, with the agriculture sector and the environment suffering the biggest blows. Total losses cost roughly FJD 2 billion with agricultural losses at FJD 542 million and environmental losses at FJD 630 million.

In calculating the environmental losses, the economic valuation of ecosystem services of native forests, coral reefs and mangroves in the cyclone-ravaged areas were calculated. Predictions are that it will take at least a decade for ecosystem services to be restored to pre-cyclone levels. Physical damage to reefs, fish and invertebrate mortality, fallen trees and foliage being totally stripped were widely reported in the stricken areas. This will have obvious socio-economic impacts as food security and livelihoods have been greatly affected (Fiji Govt., 2016).

3.6 Vulnerability to disasters

Oceania is particularly vulnerable to disasters and climate-related risks. Excluding Australia and New Zealand, all of the countries in the region are Small Island Developing States (SIDS), which are known to be particularly vulnerable to disasters. Sea-level rise and associated impacts such as coastal erosion and inundation pose a serious threat to the islands and coastal zones (Gero et al., 2010). Several factors contribute to the vulnerability of SIDS including their small size, isolation and limited migration capability during disasters (Pelling & Uitto, 2001). Besides geography, the socio-economic characteristics of a nation are also important determinants of its ability to reduce risks and cope with disasters.

According to the Rural Poverty Portal, "90 per cent of Oceania's population is rural and 25% of Oceania's population is believed to be living in poverty". Excluding Australia and New Zealand, which are high income countries with very high levels of human development (Table 6), the other nations are either low middle or high middle income countries (World Bank data, 2016). Low-resource countries include Kiribati, Papua New Guinea, Samoa, Solomon Islands, Vanuatu and Micronesia. Besides high levels of poverty, economic growth is also reported to be slow (MDG, 2015).

Table 6. Level of development and income level of countries in the region (Human Development Report, 2015; World Bank data, 2016)

Countries	Human Development Index	Level human development	Income level
Australia	0.935	very high	High income
Federated States of Micronesia	0.64	medium	Lower middle income
Fiji	0.727	high	Upper middle income
Kiribati	0.59	medium	Lower middle income
Marshall Islands	NA	NA	Upper middle income
Nauru	NA	NA	NA
New Zealand	0.913	very high	High income
Palau	0.78	high	Upper middle income
Papua New Guinea	0.505	low	Lower middle income
Samoa	0.702	high	Lower middle income
Tonga	0.717	high	Upper middle income
Tuvalu	NA	NA	Upper middle income
Vanuatu	0.594	medium	Lower middle income
Cook Islands	NA	NA	Upper middle income
Niue	NA	NA	NA
Solomon islands	0.506	low	Lower middle income

When looking at the countries that have experienced the greatest number of disasters in the past thirty-five years, Australia comes first, accounting for 42% of the disaster events in the region followed by Papua New Guinea (13%) and New Zealand (12%) (Figure 8).

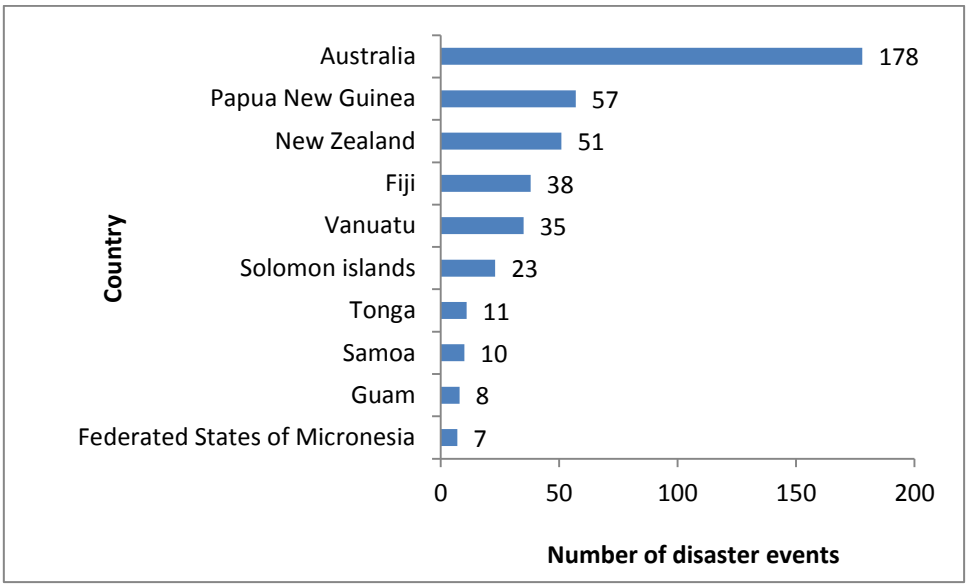


Figure 8. Top 10 countries/ territories that have experienced the greatest number of disasters from 1980-2016 (Source: EM-DAT database)

However, with regards to the impacts of these disasters on the populations, the greatest impacts are noted in the SIDS (Figure 9).

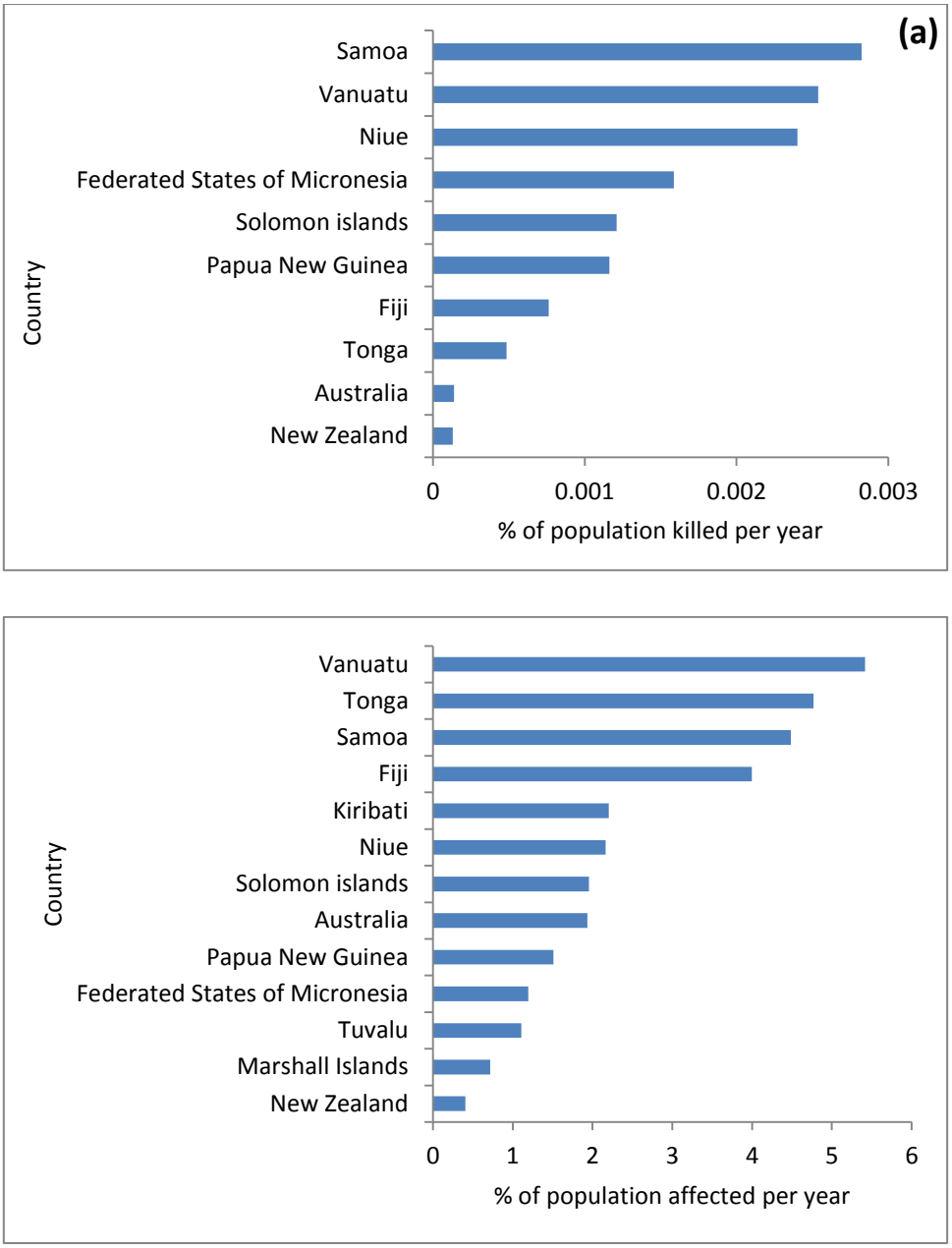


Figure 9. Top 10 countries/ territories that had (a) the greatest % of population loss (b) the greatest % of the population affected per year due to disasters from 1980-2015 (Source: EM-DAT database)

The global indices also indicate a greater vulnerability of the SIDS with Vanuatu, Solomon Islands and PNG being high on the lists for both the WRI and INFORM index. Considering that common components for these indices are exposure to natural hazards, vulnerability

and adaptive capacity, it can be assumed that the three countries share similar characteristics, i.e. high exposure and vulnerability and lower adaptive capacities.

Since the WRI index has been developed in 2011, Vanuatu has been listed as the country with the highest disaster risk (Figure 10). Three other countries in the region are also in the top 10 countries with the highest risk namely Tonga (rank 2), Solomon Islands (rank 5) and Papua New Guinea (rank 9).

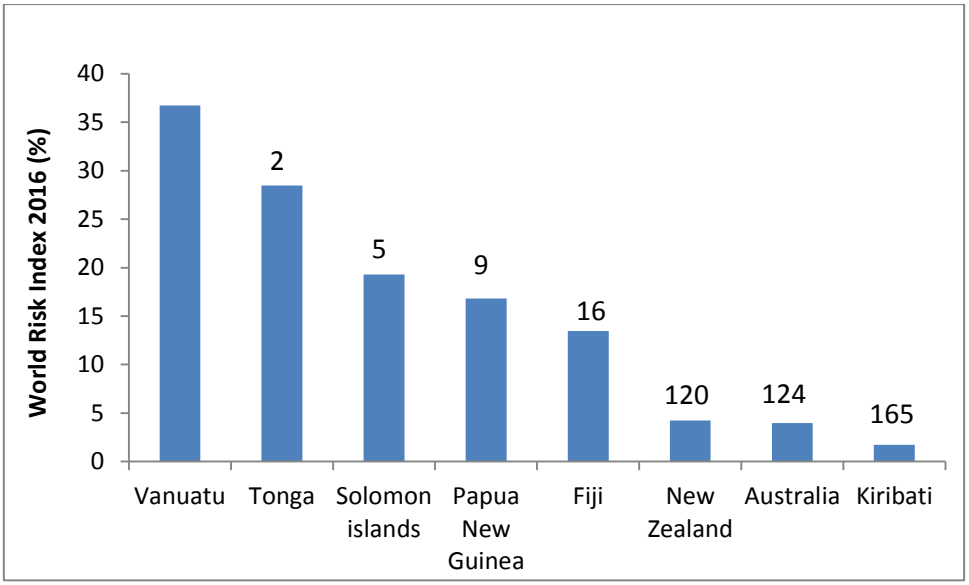


Figure 10. World Risk Index and rank per country for 2015 (Source: WRR, 2015; Information is missing for some countries)

The top three countries most at risk according to the INFORM index are Solomon Islands, Papua New Guinea and Vanuatu (Figure 11).

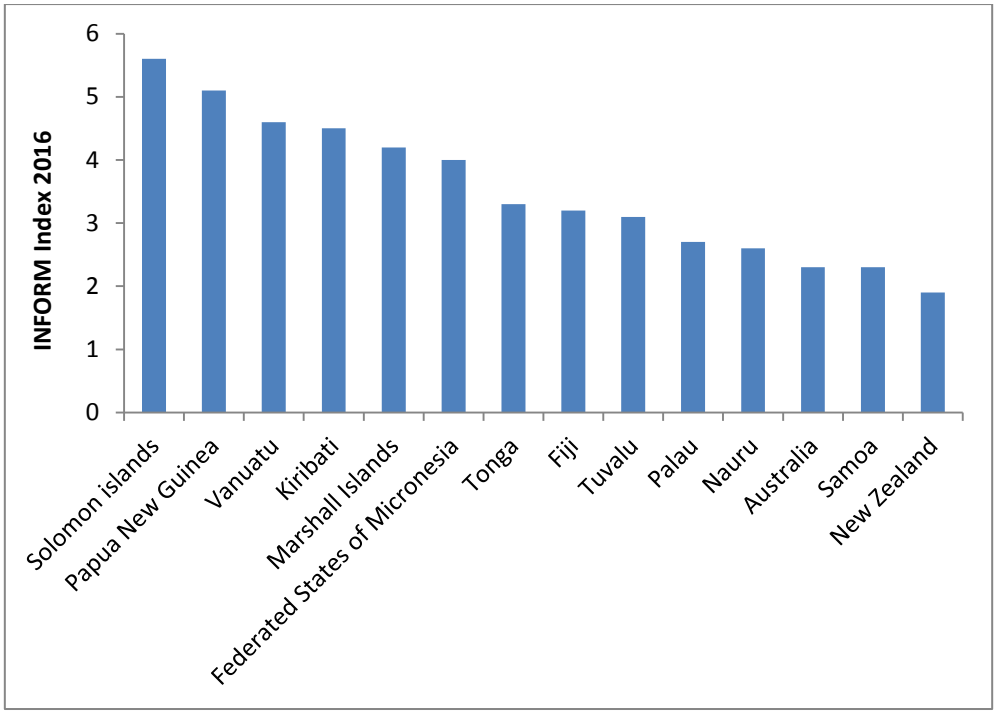
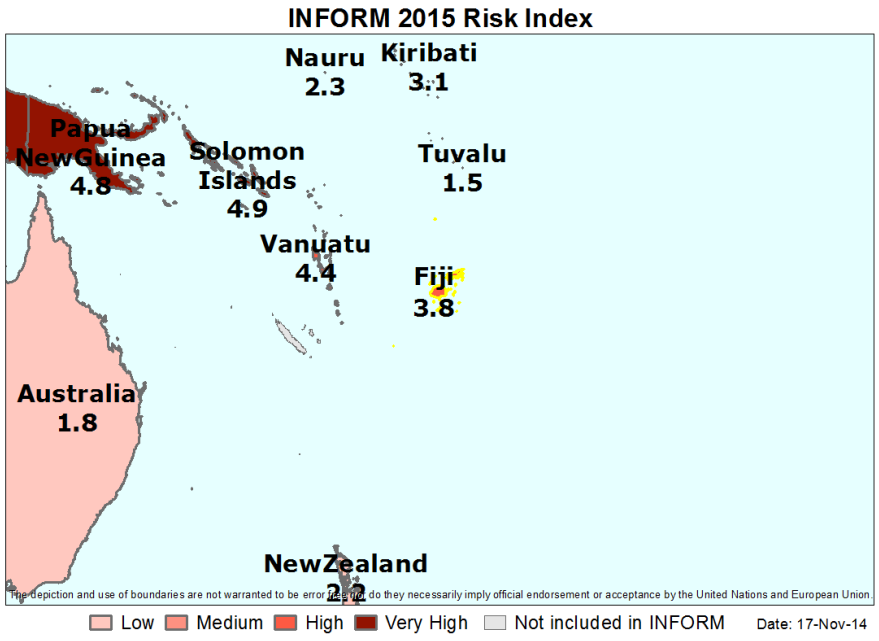


Figure 11. INFORM Index score per country for 2016 (Source: INFORM, 2016)

3.8 Country profiles of focal countries

3.8.1 Fiji



Key indicators

Land area (sq.km):
18,270

Total population:
892,145

GDP per capita (USD):
3,499

GDP growth (%):
0.2

Key economic sectors:
Tourism, sugar, textiles

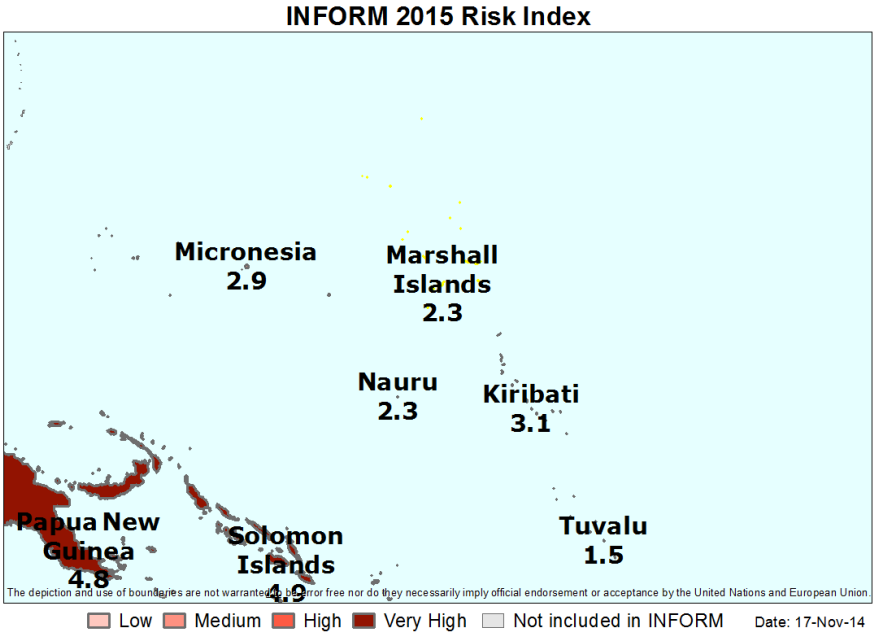
(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

Fiji is reported to have had 39 disaster events caused by natural hazards during the period 1980-2015. The top three hazards are storms, droughts and floods accounting for about 61%, 31% and 8% of disaster events caused by these hazard types in the region. In Fiji, storms have been the most common as well as the most deadly and costly hazard (Table 7).

Table 7. Reported disaster events in Fiji from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Flood	3	-	361,455	30,000
Drought	12	71	250,194	210,147
Storm	24	210	985,954	886,986

3.8.2 Marshall Islands



Key indicators

Land area (sq.km):
180

Total population:
52,993

GDP per capita (USD):
2,851

GDP growth (%):
1.2

Key economic sectors:
Copra, fisheries, tourism

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

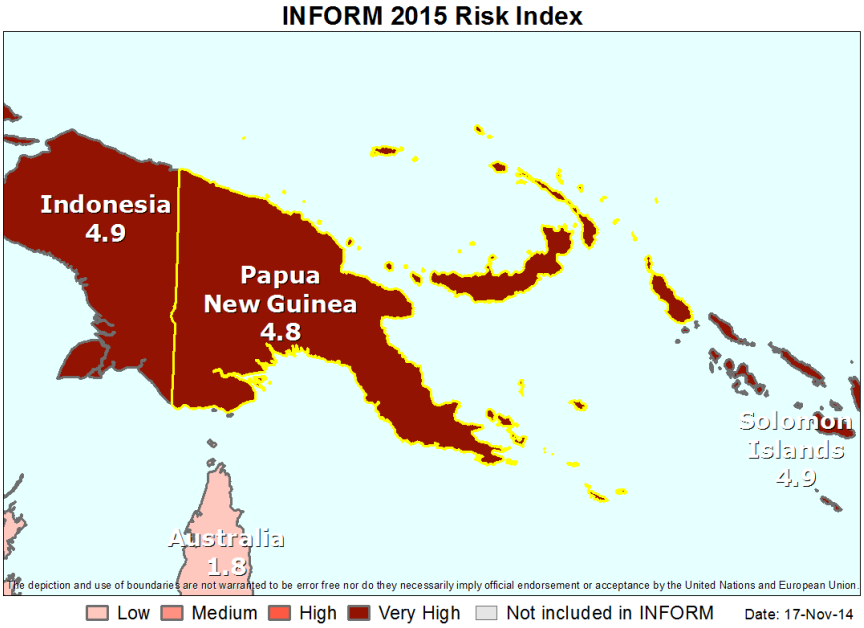
Marshall Islands is reported to have had four disaster events caused by natural hazards during the period 1980-2015. These were caused by floods, droughts and storms accounting

for about 2%, 5% and 1% respectively of disaster events caused by these hazard types in the region. Droughts were the most deadly hazards in the country while volcanic activities were the most costly hazards (Table 8).

Table 8. Reported disaster events in Marshall Islands from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Flood	1	0	6,384	-
Drought	2	0	960	-
Storm	1	0	6,000	-

3.8.3 Papua New Guinea



Key indicators

Land area (sq.km): 462,840

Total population: 7,619,321

GDP per capita (USD): 897

GDP growth (%): 7

Key economic sectors: Agriculture, petroleum, mining, forestry, fisheries, copra, palm oil

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

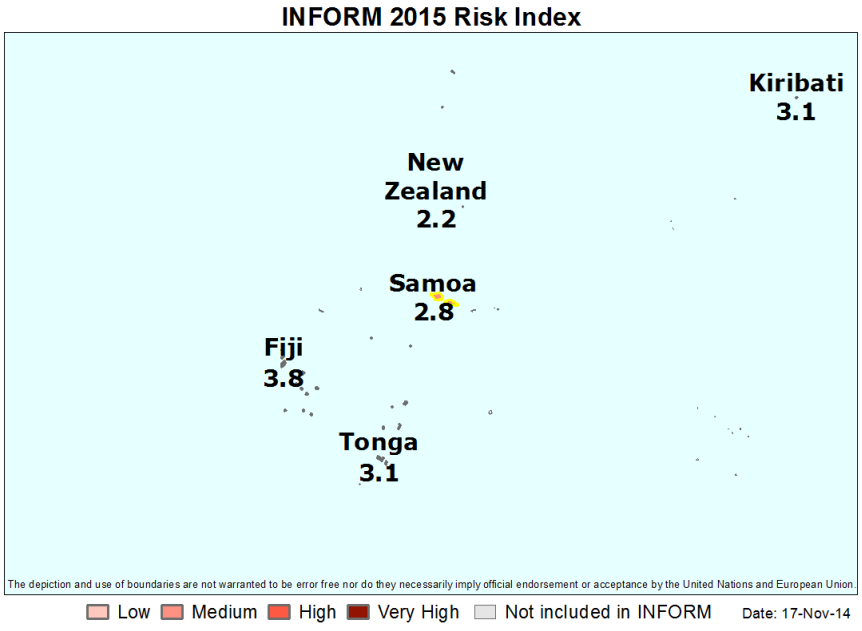
PNG is reported to have experienced 57 disaster events caused by natural hazards during the period 1980-2015. The top three most common hazards were volcanoes, earthquakes and floods accounting for about 65%, 32% and 13% respectively of disaster events caused

by these hazard types in the region. Storms had the greatest impact on the population (Table 9).

Table 9. Reported disaster events in Papua New Guinea from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Drought	3	2940000	60,000	-
Earthquake	12	2,254	45,938	9,125
Flood	15	75	577,193	84,628
Landslides	10	457	17,103	-
Storm	5	219	222,026	1,500
Volcanic activity	11	9	221,110	110,000
Wildfire	1	0	8,000	-

3.8.4 Samoa



Key indicators

Land area (sq.km): 2,840

Total population: 193,228

GDP per capita (USD): 2,672

GDP growth (%): 4.5

Key economic sectors: Fisheries, tourism, textiles, automotive parts

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

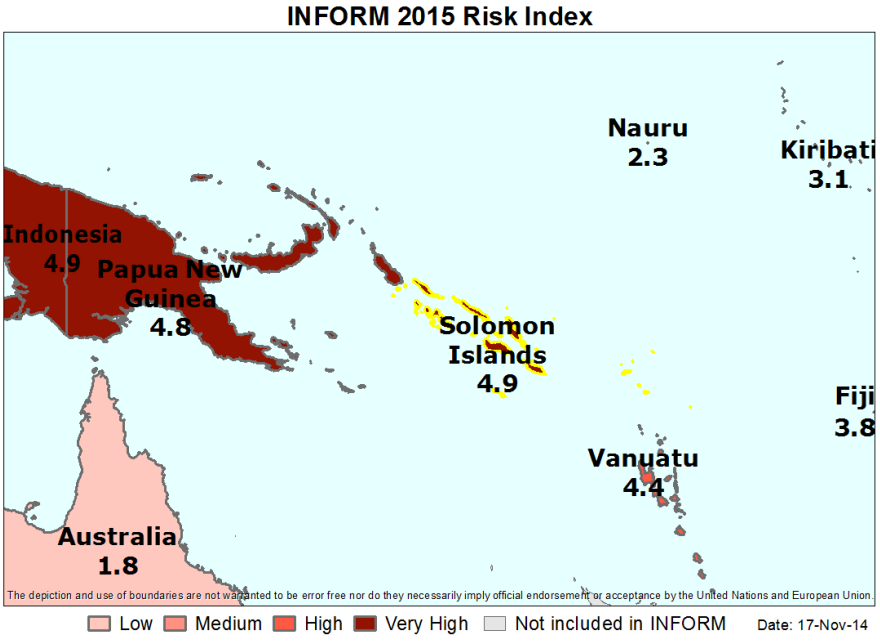
Samoa is reported to have had 10 disaster events caused by natural hazards during the period 1980-2015. These were caused by wildfires, earthquakes, storms and floods

accounting for about 3%, 3%, 3% and 1% respectively of disaster events caused by these hazard types in the region. Earthquakes were the most deadly hazards in the country while storms were the most costly hazards (Table 10).

Table 10. Reported disaster events in Samoa from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Earthquake	1	148	5,584	124,040
Flood	1	0	0	1,500
Storm	7	43	296,703	658,100
Wildfire	1	0	1,000	31,650

3.8.5 Solomon Islands



Key indicators

Land area (sq.km): 28,900

Total population: 583,591

GDP per capita (USD): 1,014

GDP growth (%): 7.3

Key economic sectors: Forestry, fisheries, copra, mining

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

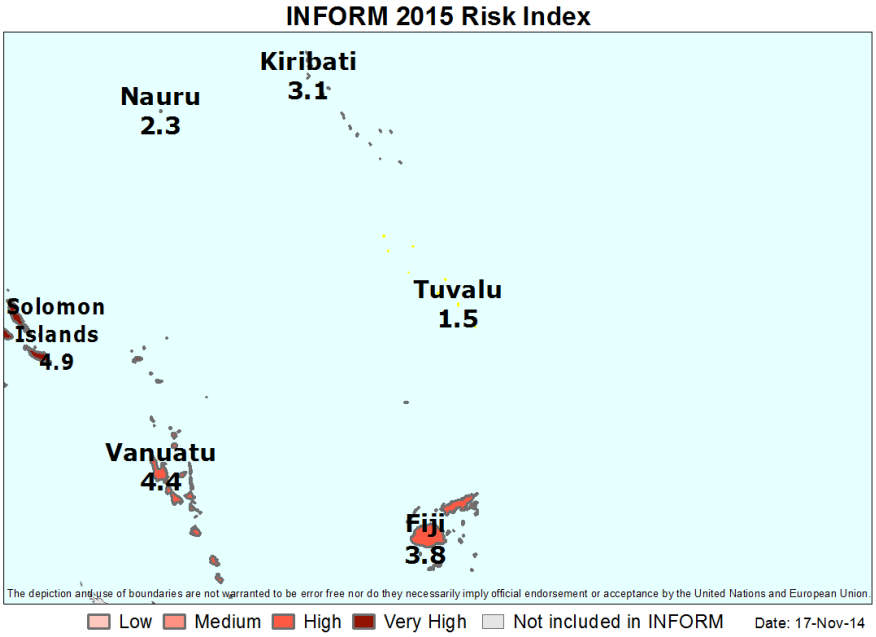
Solomon Islands is reported to have had 23 disaster events caused by natural hazards during the period 1980-2015. These were caused by droughts, earthquakes, storms and floods accounting for about 16%, 11%, 5% and 4% respectively of disaster events caused by

these hazard types in the region. Earthquakes were the most deadly hazards in the country while floods were the most costly hazards (Table 11).

Table 11. Reported disaster events in Solomon Islands from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Drought	3	0	380	-
Earthquake	4	62	7,339	-
Flood	5	70	90,080	24,000
Storm	11	114	301,675	20,000

3.8.6 Tuvalu



Key indicators

Land area (sq.km):
30

Total population:
9,916

GDP per capita (USD):
1,831

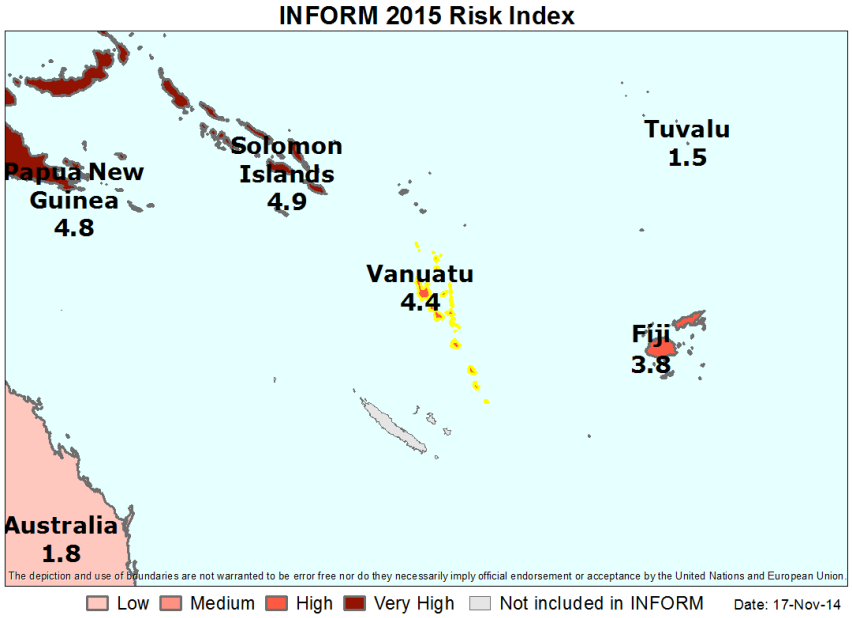
GDP growth (%):
2.5

Key economic sectors:
Fisheries, copra

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

Tuvalu is reported to have had four disaster events caused by natural hazards during the period 1980-2015 caused by storms causing four casualties and affecting 5,463 people.

3.8.7 Vanuatu



Key indicators

Land area (sq.km): 12,190

Total population: 264,652

GDP per capita (USD): 2,218

GDP growth (%): 6.6

Key economic sectors: Tourism, agriculture, fisheries, forestry

(Data and map source: preventionweb.net, World Development Indicators 2016; GEF R2R ProDoc, 2013)

Vanuatu is reported to have had 35 disaster events caused by natural hazards during the period 1980-2015. The top three most common hazards were volcanoes, earthquakes and storms accounting for about 29%, 24% and 8% respectively of the disaster events caused by these hazard types in the region. Earthquakes and storms were the most deadly hazards in the country with storms causing the greatest economic losses (Table 12).

Table 12. Reported disaster events in Vanuatu from 1980-2015 and their impacts

Disaster type	Number of events	Total deaths	Total people affected	Total economic damages ('000 US$)
Earthquake	9	112	15,105	-
Flood	2	0	3,951	-
Landslide	1	1	3,000	-
Storm	18	122	460,579	654,400
Volcanic activity	5	0	18,900	-

4. POLICY PREPAREDNESS FOR ECO-DRR

This section reviews several environmental frameworks and policies as well as disaster risk reduction frameworks of the focal countries to determine entry points to implement Eco-DRR at national and/or regional level.

Ecosystem-based approaches to disaster risk reduction are being recognised more and more, however, as briefly mentioned in section 1, they are still underdeveloped in practice, sometimes being implemented as pilot projects. Policy mechanisms that facilitate Eco-DRR are key catalysts to promote the adoption and implementation of the approach at much larger scales.

There is a combination of international and regional frameworks and conventions that influences and provides provisions for Eco-DRR globally as well as in the Oceania region. The past two years have particularly seen the adoption of major global agreements that recognise the importance of ecosystems in disaster risk reduction as well as provide entry points to upscale such approaches, for example:

- At the CBD COP12 in 2014, a decision XII/20 titled “Biodiversity and Climate Change and Disaster Risk Reduction” was adopted. The decision encourages Parties to promote and implement ecosystem-based approaches to climate change and disaster risk reduction.
- In March 2015, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted as the successor to the Hyogo Framework for Action 2005–2015. This new framework places a stronger emphasis on the importance of ecosystems and biodiversity, and proposes a more rigorous monitoring framework, which strongly advocates for capacity development and knowledge transfers for risk management.
- In June 2015, the Ramsar Convention Decision XXII.13 was adopted, which recognised the role of wetlands in disaster risk reduction.
- In September 2015, the UN General Assembly adopted the Sustainable Development Goals (SDGs).
- In December 2015, the Paris Agreement was adopted by 195 countries.

Two recent publications highlight how most of the above policy agreements provide national-level mechanisms to implement Eco-DRR, i.e. briefing by the Partnership for Environment and Disaster Risk Reduction (PEDRR, 2016) and Renaud et al. (2016)

Of particular importance are the SDGs and the Sendai Framework as countries are yet to prepare action plans to implement these. PEDRR highlight SDG Goals 2, 6, 11, 14 and 15 in particular as providing instruments to integrate ecosystem management, climate change and DRR (PEDRR, 2016)

As for the implementation of the Sendai Framework, PEDRR also provides some practical guidelines under each of the priority actions that need to be taken into account for implementation (Table 13).

Table 13. Some recommended steps to implement the Sendai Framework at National level (Source: PEDRR, 2016)

Priority Actions	Some recommended steps
1: Understanding disaster risk	Incorporate ecosystems in risk assessments at the appropriate levels and timescales
2: Strengthening disaster risk governance to manage disaster risk	Strengthen multi-stakeholder processes for planning and implementation of Eco-DRR/CCA interventions
	Create an enabling public and private policy environment for Eco-DRR/CCA
	Developing Eco-DRR/CCA indicators to support monitoring of the SFDRR implementation
3: Investing in disaster risk reduction for resilience	Include ecosystem-based approaches in risk-informed, land-use planning
	Develop national and local capacities for Eco-DRR/CCA
	Identify Eco-DRR/CCA ambassadors
4: Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction	Consider the environmental impacts of disasters and incorporate ecosystem rehabilitation as part of recovery and reconstruction plans
	Ensure disaster response, recovery and reconstruction activities do not have adverse environmental impacts

4.1 International Frameworks and Conventions

4.1.1 UNESCO World Heritage Convention

The UNESCO World Heritage Convention (Paris, 1972) is not always showcased as a potential mechanism to implement Eco-DRR. However, recent developments and discussions are emerging on the role of World Heritage Sites in disaster risk reduction and vice-versa.

Upon the adoption of the convention in 1972, a World Heritage Committee was established within UNESCO. In 2004, the committee invited relevant parties to prepare a risk-preparedness strategy. Following a first presentation at the 30th session to the World Heritage Committee in 2006, the strategy entitled, “Strategy for Risk Reduction at World Heritage Properties” was approved with the following key objectives:

1) Strengthen support within relevant global, regional, national and local institutions for reducing risks at World Heritage properties;
2) Use knowledge, innovation and education to build a culture of disaster prevention at World Heritage properties;
3) Identify, assess and monitor disaster risks at World Heritage properties;
4) Reduce underlying risk factors at World Heritage properties;
5) Strengthen disaster preparedness at World Heritage properties for effective response at all levels

In 2010, a resource manual for disaster risk management was published and it recognises that disaster risk management for heritage is also concerned with the role of ecosystems in buffering hazards and that natural heritage can play a significant role in providing such protection.

The opportunity to integrate Eco-DRR in the management plan of World Heritage sites is particularly relevant for the natural sites that have the greatest potential role in risk reduction.

In the Oceania region, there are 16 natural heritage sites found in four countries: Australia (12), New Zealand (2), Kiribati (1) and Solomon islands (1). The region also possesses six mixed natural and cultural heritage sites. Out of the 16 natural heritage sites, one of them, East Rennell found in Solomon Islands is described as being in danger. East Rennell is found on Rennell Island in the Solomon Island group in the western Pacific. The island is the largest raised coral atoll in the world and is home to a dense cover of native forest and a

biodiversity of global value. East Rennell is, however, threatened by logging activities and invasive species on the island, and climate change also poses another challenge to its integrity.

Several tools are currently in development and new data are being generated in the field, for example, the Earth Sciences and Geohazard Risk Reduction Section of UNESCO is currently compiling data and mapping the exposure of UNESCO designated natural sites around the globe. These provide good scope for more integrated strategies under this convention in conjunction with the implementation of other frameworks, such as the Sendai Framework, for example, by considering UNESCO natural sites as some of the ecosystems that need to be taken into account in disaster risk management under priority action 1.

4.1.2 SIDS frameworks

As mentioned earlier most of the countries in the region are SIDS; as part of the 39 SIDS they are all low-lying developing countries with similar vulnerabilities and characteristics. Facing common challenges with regards to sustainable development, three frameworks have been developed for SIDS since 1994 to guide actions for sustainability and these are meant to complement each other. These provide important specific entry points for islands in the Oceania region, particularly the latest SAMOA Pathway

Barbados Programme of Action for Sustainable Development

The Barbados Programme of Action (BPoA) was the first SIDs-focused framework to be adopted in May 1994. The framework recognises that SIDs are vulnerable to disasters and that there is limited capacity to respond and recover from these. There were also concerns for climate change and the threats posed by sea-level rise. However, actions, policies and measures proposed to address disasters and climate change did not cover the use of ecosystem-based approaches.

Actions proposed to address land use challenges covered some Eco-DRR elements as it was proposed to “Prepare and/or review land-use plans in conjunction with agricultural, forestry, mining, tourism, traditional land-use practices and other land-use policies, with a view to formulating comprehensive land-use plans and zoning so as to protect land resources, ensure sustainable and productive land-use and guard against land degradation,

pollution and support appropriate afforestation and reforestation programmes, with appropriate emphasis on natural regeneration and the participation of land owners, in order to ensure watershed and coastal protection and reduce land degradation exceeding island carrying capacity".

Mauritius Strategy

The Mauritius Strategy of Implementation (MSI) was a review of the Barbados Programme of Action and was adopted in 2005, which remained the blueprint to address sustainable development in SIDS. Specific reference to ecosystem-based approaches in proposed actions to address challenges of climate change and disasters were not included in the declaration. Eco-DRR elements were covered in section 6 on land resources where it is proposed that "Small Island developing States should fully utilise available Global Environment Facility resources to develop and implement projects to address land degradation through sustainable land management. In this regard, every effort must be made to ensure the full implementation of the Convention" with reference to the United Nations Convention to Combat Desertification.

However it must also be noted that there are possible synergies when it comes to addressing challenges in some of the identified key areas, namely (1) Climate change and sea-level rise, (2) Natural and environmental disasters, (3) Coastal and marine resources, (4) Freshwater resources, (5) Biodiversity resources and (6) Land resources, a possible entry point for Eco-DRR as an integrative approach.

SAMOA Pathway

The resolution of the SAMOA pathway was adopted by the general assembly at the third International Conference on Small Island Developing States in November 2014 in Samoa and it aims to contribute to implementation of the other two action plans. It covers different themes of relevance for Eco-DRR with the section on DRR recognising that "there is a critical need to build resilience, strengthen monitoring and prevention, reduce vulnerability, raise awareness and increase preparedness to respond to and recover from disasters." Also similarly to the other two frameworks, Eco-DRR elements are covered in the section on desertification, land degradation and drought where it is recognised that "addressing desertification, land degradation and drought challenges will be critical for the achievement

by small island developing States of food security and nutrition, their adaptation to climate change, the protection of their biodiversity and the development of resilience to natural disasters." This particular reference is the first one in the three SIDS frameworks together that highlights the importance of ecosystem management to achieve multiple goals (climate change adaptation, disaster risk reduction and biodiversity conservation) and provide an entry point for integration of approaches.

4.2 Regional partnerships and frameworks of relevance for Eco-DRR

There are two major regional agencies in the Pacific that will be covered here through their action plans and regional frameworks that they support.

Secretariat of the Pacific Regional Environment Programme

The Secretariat of the Pacific Regional Environment Programme (SPREP) is an intergovernmental agency that works towards the protection and sustainable development of the region's environment. SPREP's members include 21 Pacific Island countries and territories and five developed countries that include France, the United Kingdom and the United States of America. All of the countries in Oceania are members of the Secretariat. SPREP's activities are based on its Strategic Action Plan that focuses on four priorities: Climate change, biodiversity and ecosystem management, waste management and pollution control and environmental monitoring and governance. SPREP strategies to address climate change are linked to disaster risk reduction and also recognising the use of ecosystem-based measures. This is reflected in goal CC1.1: "Climate change adaptation, including ecosystem-based approaches, is mainstreamed in national and sectoral polices, strategies and plans, and implemented through coordinated institutional arrangements supported by enabling environments at all levels and sectors; adaptation and mitigation activities are integrated to prevent any contrary ('perverse') impacts on ecosystems" and goal CC2.1: "Strengthened adaptation and risk-reduction capacity and decision-making processes and sustained integrated system-based actions implemented; based on improved understanding of climate change and extreme events trends, projections, and impacts".

Secretariat of the Pacific Community

The Pacific Community (SPC) is the principal scientific and technical organisation in the Pacific region. It works towards Sustainable Pacific development through science, knowledge and innovation and focuses on key issues including climate change and disaster risk management. The organisation has 26 members including 22 Pacific Island countries and territories. The Pacific community strategic plan aims to contribute to the following development goals: 1) Pacific people benefit from sustainable economic development; 2) Pacific communities are empowered and resilient and 3) Pacific people reach their potential and live long and healthy lives. The first two goals include Eco-DRR elements with objectives to "strengthen sustainable management of natural resources (fisheries, forestry, land use, agriculture, minerals, and water)" under Goal 1 and to "Improve multi-sectoral responses to climate change and disasters" under Goal 2. More specifically SPC will "support water resource management strategies… with a particular focus on water resources in climatic extremes (such as droughts and flooding)" and provide support to plan climate change and disaster risk management as well as promote integrated approaches.

Pacific Climate Change Roundtable and Pacific Islands Framework for Action on Climate Change

SPREP and SPC together with other partners are also part of the steering committee of the Pacific Climate Change Roundtable (PCCR). The roundtable is the bi-annual premium climate change coordination mechanism for the Pacific. PCCR supports regional climate change dialogue and networking and also supports monitoring and reporting on progress made in the Pacific Islands Framework for Action on Climate Change (PIFACC). The PIFACC was endorsed in 2005 by Pacific Leaders and was set to be implemented from 2006-2015. The purpose of the Framework is to strengthen climate change action in the region as well as promote links with other sectors including disaster risk management and ecosystem management. One of the targeted outcomes was to "Enhanced resilience to the adverse effects of climate change through the implementation of best practice adaptation and risk reduction measures".

Strategy for Climate and Disaster Resilient Development in the Pacific (SRDP) and Framework for Resilient Development in the Pacific (FRDP)

The Strategy for Climate and Disaster Resilient Development in the Pacific (SRDP) was created to succeed existing regional separate frameworks on disaster risk management and climate change including the Pacific Islands Framework for Action on Climate Change (PIFACC) and the Pacific Disaster Risk Reduction and Disaster Management Framework for Action (RFA). The SRDP was intended to be formally endorsed by the Pacific leaders at the Leaders meeting in 2015, however, this did not happen. The leaders instead extended the life of the RFA and PIFACC by another year and asked SPC and SPREP to undertake more national consultation to submit a revised SRDP for endorsement in 2016. In September 2016, the SRDP now known as the Framework for Resilient Development in the Pacific (FRDP) was endorsed by Pacific Leaders. The framework aims to build resilience to climate change and disasters in the Pacific Islands and advocates for the adoption of integrated approaches which position the Pacific as "the first region in the world to fully integrate climate change and disaster risk management into a single overarching regional policy framework". The three strategic goals are: 1) Strengthened integrated adaptation and risk reduction to enhance resilience to climate change and disasters, 2) low-carbon development and 3) strengthened disaster preparedness, response and recovery. The framework recognises the importance of ecosystems for community resilience and has set one of its 10 guiding principles for implementation to be as follows: "incorporate ecosystem-based services and functions in resilience building".

4.3 Environmental frameworks and action plans

While Eco-DRR is generally not clearly mentioned in policies, several environmental frameworks provide provisions for the implementation of Eco-DRR particularly where ecosystem approaches are promoted (Table 14) (See annex 2 for more details).

Table 14. Provisions for Eco-DRR in environmental frameworks and action plans

Convention/ framework	Reports reviewed	Ecosystems are recognised as providing protection from hazards or increasing resilience	Environmental degradation recognised as contributing to vulnerability to disasters	Specific Eco-DRR activities proposed
Fiji				
Convention on Biological Diversity	NBSAP, Fifth National Report, CBD Programme of Work on Protected Areas	Yes	Yes	Yes
United Nations Convention to Combat Desertification	Nation action plan	No	Yes	Yes
United Nations Framework Convention on Climate Change	National communication, National climate change policy	Yes	No	Yes
Marshall Islands				
Convention on Biological Diversity	NBSAP, CBD Programme of Work on Protected Areas	No	No	No
United Nations Framework Convention on Climate Change	National communication, National climate change policy	No	No	Yes
Papua New Guinea				
Convention on Biological Diversity	NBSAP	Yes	No	Yes
United Nations Framework Convention on Climate Change	National communication, National climate change policy	No	No	Yes
Samoa				
Convention on Biological Diversity	NBSAP, Fifth National Report, CBD Programme of Work on Protected Areas	Yes	No	Yes
United Nations Convention to Combat Desertification	Nation action plan	No	Yes	Yes

United Nations Framework Convention on Climate Change	National communication, NAPA	No	No	Yes
Solomon Islands				
Convention on Biological Diversity	NBSAP, Fifth National Report, CBD Programme of Work on Protected Areas	No	No	Yes
United Nations Framework Convention on Climate Change	National communication, NAPA	Yes	Yes	Yes
Tuvalu				
Convention on Biological Diversity	NBSAP, CBD Programme of Work on Protected Areas	Yes	No	Yes
United Nations Convention to Combat Desertification	Nation action plan	No	Yes	Yes
United Nations Framework Convention on Climate Change	National communication, NAPA	No	Yes	Yes
Vanuatu				
Convention on Biological Diversity	NBSAP, Fifth National Report	Yes	No	Yes
United Nations Framework Convention on Climate Change	National communication, NAPA	Yes	No	Yes

Despite no clear mention of Eco-DRR in environmental policies, several of the priorities, challenges and solutions proposed are directly or indirectly linked to Eco-DRR. The latter approach can be implemented through several ecosystem management tools that are proposed as activities in several NBSAPs for example:

- Integrated Coastal Zone Management
- Integrated Water Resource Management
- Forest conservation and restoration
- Wetland conservation and restoration

While these activities are often proposed in the context of conservation or sustainable development, there is a need for greater awareness on the potential contribution of these

approaches to disaster risk reduction including through building community resilience. Similarly some ecosystems are clearly recognised as important in providing protection against hazards particularly mangroves, coral reefs and forests indicating that conservation and restoration of these habitats could also be valued and recognised for their DRR co-benefits.

4.4 Disaster management plans

Most of the disaster management plans makes references to institutional arrangements and structure and stakeholders involved. There is no specific mention of the use of the ecosystem approach to reduce risk except for Marshall Islands. In the latter's plan, one key outcome is identified as the reduction of vulnerability to coastal hazards and proposed actions to address this include the mapping of high risk coastal areas, vulnerability assessments, the development of integrated coastal area plans and the provision of training in coastal ecosystem monitoring.

It must be noted that while Eco-DRR is notably absent as a proposed measure for DRR in most national plans, several activities, particularly vulnerability assessments, implemented to design adequate disaster management plans can provide an important basis for Eco-DRR. These can help to pin point the priority risks as well as guide the identification of ecosystem management tools that can contribute to reduce these risks. These vulnerability assessments can also integrate ecological assessments as part of the process to understand underlying risks by documenting the state of the ecosystems and risks of collapse and loss of ecosystem services due to degradation.

5. ECO-DRR INITATIVES IN THE REGION

This section showcases the type of projects being implemented in the region that contribute either directly or indirectly to DRR. They are largely to do with increasing the resilience of Pacific Island communities to the impacts of climate change, which include hazards such as tropical cyclones, flooding, landslides and droughts.

5.1Solomon Islands

Roviana Case study

The Australian Government's Pacific Adaptation Strategy Assistance Program (PASAP) assisted the communities of Roviana in the Western Province who are experiencing the impacts of climate change through coastal flooding, low crop yields, erratic rainfall, mangrove degradation and high aerial temperatures. Through a combination of traditional knowledge and science, communities are working with Australian scientists in finding solutions that include ecosystem restoration. A simple method has been devised to allow the villagers to determine areas that will be flooded by sea-level rise, which then allows the villagers to plan accordingly. Villagers are now engaged in mangrove replanting and coral planting. Marine Protected Areas are being redesigned to allow greater connectivity between coastal and offshore areas to facilitate replenishment of fish stocks.

Temotu case study

Temotu was struck by an earthquake and tsunami in 2013 but cyclones and droughts were also regular hazards that the village of Nanngu in Temotu had to contend with. Water security was a major concern with women having to walk several kilometres to fetch water or to paddle in dugout canoes to adjacent islands for water. This was even at the expense of spending time in their plantations. During drier months, school would close early to allow the

children to assist their parents in collecting water. The life of the community revolved around the quest for potable water. The World Bank funded Community Resilience to Climate and Disaster Risk project (CRISP) assisted the village of Nanngu, Temotu by making water from the catchment available through a piped water supply system and giving the villagers access to running water. According to the villagers, it has totally transformed their lives and made them more resilient to natural hazards.

Lauru Ridge to Reef Protected Areas Network (Lauru PAN)

TNC worked very closely with the community to address biodiversity conservation in the face of climate change impacts. This was achieved by combining local and scientific knowledge in improved planning of the implementation of MPAs. Stocks of key resource species have recovered and alternative source of livelihoods, e.g. ecotourism is a new source of income for the communities, which has enabled them to negotiate with mining interests.

Maramasike Passage, Malaita

The Mangrove Ecosystems for Climate Change Adaptation and Livelihoods (MESCAL) project was implemented by IUCN with the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECCDM), the relevant Government Ministry that includes the Environment Department and Worldfish. The project highlighted the importance of the mangrove ecosystem in enabling communities to increase their resilience to the impacts of climate change. There were mangrove floral and faunal inventories compiled, a mangrove policy brief prepared, a mangrove co-management plan developed with the communities and an excellent DVD in Pidgin highlighting the importance of mangroves to the livelihoods of communities. The project linked healthy mangroves with disaster risk reduction.

5.2 Vanuatu

Vanuatu Coastal Adaptation Project

The project is working with coastal communities to increase their resilience to climate change through improved infrastructure, increased food production and sustained livelihoods. The hazard being faced by the communities is sea-level rise. One of the main

components of the project includes the rehabilitation of coastal ecosystems including mangroves, coral reefs, and the stabilisation of coastal areas through revegetation. The project also aims to improve information and early warning systems on coastal hazards. Climate proofing of physical infrastructure such as pedestrian bridges and coastal footpaths and the establishment of agro-forestry nurseries will improve food and water security.

Eratap and Amal Crab Bay, Vanuatu

The Mangrove Ecosystems for Climate Change Adaptation & Livelihoods (MESCAL) project promoted the conservation of mangrove ecosystems as a means of increasing the resilience of communities to the impacts of climate change. There were extensive studies done on the biodiversity supported by the mangroves, above ground carbon stock analysis, the first ever economic valuation of mangrove ecosystem services in Vanuatu and the mangrove taboo area in Amal Crab Bay was legally registered. The registration of the taboo area means that the landowners can legally enforce their management plan and prosecute offenders. The economic valuation is a decision support tool for government when considering development proposals in mangrove areas.

5.3 Fiji

Rewa Province, Fiji

The MESCAL project produced a revised national Mangrove Management Plan, a mangrove taxonomy field guide, the first study ever done in Fiji on carbon emissions at different stages of mangrove conversion and the most comprehensive survey of the country's largest mangrove forest looking at biodiversity, socio-economic and cultural aspects was conducted. The project succeeded in increasing the profile of mangroves and in promoting the importance of Fiji's mangrove resources as a means of increasing coastal protection from storm surges and king tides while ensuring food security. The national Mangrove Management Plan is awaiting formal endorsement by Cabinet and will be used by the authorities as a decision support tool when considering development proposals.

GEF STAR Ridge-to-Reef National project for Fiji

This project will focus on enhancing integrated management of six forested watersheds to protect land, water, forest and biodiversity resources, maintain carbon stocks and protect coastal mangrove and coral reef MPAs. The project is yet to commence.

5.4 Samoa

Safata District, Samoa

The Mangrove Ecosystems for Climate Change Adaptation & Livelihoods (MESCAL) project mapped the mangrove resource of Samoa and identified 26 new mangrove forest areas that had previously gone undocumented. The link between healthy mangroves and disaster risk reduction was stressed through awareness-raising activities that included mangrove replanting in areas that had become degraded. There was also the first economic valuation of mangrove ecosystem services ever conducted in Samoa.

Pacific Adaptation to Climate Change (PACC)

The PACC project in Samoa focused on Community based Integrated Coastal Protection and included activities like the re-vegetation of coastal areas and watershed management and rehabilitation. These activities were to address coastal erosion and flooding.

5.5 Papua New Guinea

National Capital District, Central, West New Britain, New Ireland and Manus

The USAID-funded Mangrove Rehabilitation for Sustainably-Managed Healthy Forests was implemented by IUCN, TNC, WCS, UPNG, PNG Assembly of Disabled People, PNGCLMA and PWM. Biodiversity surveys, mangrove rehabilitation through community nurseries, below ground carbon assessments, and mangrove management plans were some of the activities conducted in the five provinces by the partners. There was much awareness raising and a mangrove-planting handbook designed for communities was developed and printed in both English and Tok Pisin. A total of 13,186 seedlings were planted in 40 villages in 11 Local level Governments in five provinces over a space of three years. This was done to rehabilitate mangrove forests and thus provide coastal protection while also strengthening people’s livelihoods.

5.6 Regional Initiatives

Ridge to Reef: Testing the integration of water, land, forest and coastal management to preserve ecosystem services, store carbon, improve climate resilience and sustain livelihoods in Pacific Island countries

This International Waters project will be implemented in 14 Pacific Island countries to complement the national STAR Ridge to Reef projects. The objective is to test the mainstreaming of ridge-to-reef climate resilient approaches to the integration of land, water, forest and coastal management in the Pacific Island countries through strategic planning, capacity building and pilot projects to sustain livelihoods and maintain ecosystem services. **The STAR Ridge-to-Reef National Projects for Kiribati, Federated States of Micronesia, Niue and PNG** will look at strengthening their protected area network and improving ridge-to-reef connectivity. They also aim to improve sustainable land management practices and water management and feasibility of Payment for Ecosystem Services (PES) schemes.

USAID Coastal Community Adaptation Project (C-CAP)

This was implemented in 12 Pacific Island countries and it aimed to build community resilience to climate change by strengthening disaster preparedness and prevention, risk identification, infrastructure adaptation and land use planning.

6. ECO-DRR AND CONSERVATION BENEFITS

One important aspect of Eco-DRR is that it first involves the use of an ecosystem approach to achieve risk reduction. Examples of these ecosystem-based and environmental management approaches include (Source: Doswald and Estrella, 2015):

- Land use planning and zoning
- Sustainable (natural resource) management within forestry, agriculture and pastureland
- Integrated water resource management (IWRM)
- Integrated coastal zone management (ICZM)
- Integrated watershed or river basin management (IWM)
- Integrated land management (ILM)
- Protected Areas Management
- Drylands management
- Community-based action
- Stewardship systems

While they may differ in goals, Eco-DRR and biodiversity conservation implement similar environmental measures. So that even if Eco-DRR is focused on addressing a societal challenge namely disaster risk, the approach used to achieve this goal can provide co-benefits for conservation. This co-benefit can be further enhanced through strategic spatial planning by protecting areas for both their conservation value and their DRR benefits.

While Eco-DRR can directly contribute to conservation, it also has the potential to be an important incentive strategy for the protection of natural habitat and resources that are still unprotected. Conservation of natural resources and biodiversity becomes a greater challenge in the absence of incentives. Influencing human behaviour and practices is no doubt a sine qua non when it comes to biodiversity conservation but to achieve this, a case

must be made on the social benefits of the field. Application of the ecosystem services concept to justify biodiversity conservation often focuses on the benefits of ecosystems for climate change mitigation and targets market-based incentive strategies. Yet Eco-DRR as an interdisciplinary approach that aims to protect society also has the potential to contribute to the valuation of ecosystems and combined with evidence of its effectiveness in helping communities to cope with disasters, it can be used as an incentive argument for conservation.

The best documentation on the role of Eco-DRR initiatives in contributing to biodiversity conservation in the region comes from the MESCAL project. The MESCAL project stated as its overarching goal to increase the resilience of Pacific Island communities to the potential impacts of climate change by the adaptive co-management of mangroves in Samoa, Tonga, Vanuatu, Fiji and Solomon Islands. It thus contributed to Eco-DRR outcomes. The project promoted and raised the profile of mangrove ecosystems as a means of climate change adaptation and mitigation and involved the compilation of floral and faunal inventories in the demonstration sites. This resulted in the discovery of previously unrecorded floral species for Solomon Islands and Vanuatu. Mangrove mapping was also conducted in Samoa and Vanuatu, which led to 26 new mangrove sites being recorded in Samoa. The mangroves on Malekula in Vanuatu are the country's largest mangrove area and the most diverse. The mangrove *tabu* site established by the communities in Amal/Crab Bay on Malekula was legally registered so that communities could legally enforce the mangrove management plan that they had developed for the site thus serving to protect the biodiversity (IUCN, 2014).

- The MARSH project implemented in PNG had as its overarching goal to empower communities and build capacities of national institutions in the rehabilitation and management of mangrove forests to increase resilience to the impacts of climate change. Like MESCAL, it too involved floral inventories and a mangrove taxonomy guide was prepared in draft form. The communities were taught basic mangrove taxonomy and a booklet was prepared on community-based mangrove replanting and rehabilitation. A household use survey of mangrove goods and services, conducted among 1,268 households in 52 villages in 12 LLGs in three provinces, showed a very high dependence on mangroves. The results of the survey spurred communities to include mangrove management in their community resource plans. The value of the mud clam, *Polymesoda erosa*, or *kina* fishery, was determined for the first time through market surveys and is estimated to be worth between PGK 300,000 – 1 million per year depending on whether the market is in Port Moresby or

in a provincial town. It is thus a very important source of revenue for the resource owners. Over 13,000 mangrove seedlings were planted in degraded mangrove areas in 45 villages in 11 LLGs in five provinces of PNG. Mangrove and coral planting are means of biodiversity conservation whilst also providing coastal protection. Carbon accounting was also done at two mangrove sites to calculate carbon stocks at undisturbed sites thus proving their ability to sequester carbon and mitigate climate change (IUCN, 2016).

- Catchment rehabilitation in Fiji and Samoa has included the removal of invasive species like *Merremia peltata* and the planting of native vegetation to prevent soil erosion and allow water retention. It has also involved the planting of vetiver grass and native fruit trees in the riparian zone to prevent riverbank erosion. The native fruit trees also provide food and a means of livelihood. Catchment rehabilitation in Nakasaleka district, Kadavu and in Nadi included sourcing seedlings of native trees from the wild and rearing them in community nurseries before planting them in upland areas. Catchment management plans also involved baseline surveys, which led to the discovery of a plant new to science, *Medinilla sp*., in Kadavu, Fiji, thus illustrating the role of biodiversity in water resource management.
- Atolls are experiencing the full brunt of sea-level rise, and coastal erosion and saltwater intrusion in domestic plantations are major issues. Reforestation of coastal areas with native vegetation is serving two purposes in the prevention of coastal erosion and conservation of native species.
- The Choiseul Integrated Climate Change Programme (CHICCHAP) was a novel approach proposed by the Solomon Islands Government to have an integrated “whole of island” and ridge to reef approach to climate change adaptation and mitigation. It brought together government agencies, development partners and NGOs to work on a multi-sectoral approach to increase the resilience of the communities in Choiseul province to the impacts of climate change. It allowed for better coordination, complementarity, collaboration and created an enabling environment for monitoring and evaluation and lessons learnt for sustainable development. Training was provided on food security, CCA, EbA and cost benefit analysis.

7. ROLE OF BIODIVERSITY IN DRR

The health of ecosystems and their ability to provide ecosystem services like protection against natural hazards is linked to their biodiversity with an increasing documentation on the subject. Diversity of species and functional group of species contribute to the complexity of ecosystems and are critical for resilience and consequently the provision of ecosystem services (Folke et al., 2004). Recent studies further illustrate the importance of biodiversity in contributing to the resistance of ecosystem productivity to climate extremes (Isbell et al., 2015) and long-term resilience of ecosystem functions and services (Oliver et al., 2015). Biodiversity can not only contribute to risk reduction by maintaining resilient ecosystems but diversity of species is also equivalent to variation in characteristics, traits, structures and genetic diversity that provide a pool of resources for DRR strategies.

Mangroves and Disaster Risk Reduction

The mangrove ecosystems in Oceania are recognised for the important role that they play in both climate change mitigation and adaptation. The mangrove soil has the ability to sequester large volumes of carbon and the extensive root system of mangrove trees affords protection against storm surges, coastal erosion and coastal flooding. In areas where mangroves have been degraded and where there have been large tracts cleared, mangrove rehabilitation or restoration is gaining momentum in countries including Fiji, PNG and Samoa. Nurseries are being established by coastal communities where seedlings are reared before being transplanted in the wild. Others engage in direct planting of propagules or seedlings without prior potting. The mangrove forests of the islands of Oceania are typically zoned with *Rhizophora sp.* trees dominating the seaward fringe where the substrate is muddy and waterlogged. The extensive stilt roots of *Rhizophora* trees allow them to live in the most waterlogged and oxygen deficient soils at the seaward edge. The middle zone of a typical mangrove forest is dominated by *Bruguiera sp.* (orange mangroves) and *Sonneratia*

sp. The bottom substrate has greater sand content and is less waterlogged. Rather than the extensive stilt roots in the seaward zone, these trees have stocky buttresses and “knees” for anchorage and respiration in the soil of the mid-intertidal area. The landward edge or back of the mangrove forest is dominated by *Xylocarpus* (puzzle nut mangroves) and *Avicennia* (grey mangroves) species where the substrate is sandy loam. The tree morphologies in the different zones would certainly assist in the amelioration of wave action, and community mangrove planting has been accompanied by training in which species to plant in a certain location (OCCD, 2013). The Mangrove Rehabilitation for Sustainably Managed Healthy Forests (MARSH) project implemented in PNG by IUCN ORO from 2012-2015 saw 13,186 seedlings planted in 40 villages in five provinces as a climate change adaptation measure for these coastal communities (IUCN, 2016).

Climate resilient crop varieties

The Pacific Adaptation to Climate Change (PACC) demonstration project for Fiji was entitled *Building resilience to climate change in lowland farming communities in Fiji* and was implemented in the deltaic areas of the Rewa and Navua Rivers, areas prone to flooding after extreme rainfall and salt-water intrusion from sea-level rise. The project trialled varieties of taro, cassava and sweet potato to assess their growth in waterlogged and saline soils and whether such varieties could provide food security during times of natural disasters. Sweet potato is traditionally planted immediately after natural disasters such as cyclones and flooding because it only takes 3-5 months to mature and be ready for consumption. It was not a crop commonly grown in the study areas. In the trials that followed, two taro varieties showed the greatest yield with the least tuber rot whilst sweet potato varieties were least suited for the waterlogged and saline soils (PACC, 2015).

Reforestation in Fiji

Upland afforestation has been implemented to protect water catchments and to reduce flooding. Nadi catchment is an area prone to flooding and experienced two major floods in 2009 and 2012 that caused widespread destruction that cost the country up to FJD 50 million in losses to the agriculture and tourism sectors and physical infrastructure. In the upper Nadi catchment, Fiji, the Integrated Water Resources Management (IWRM) project established village nurseries where seeds of trees were sourced from the wild for rearing

and afforestation of 60 hectares of *talasiga* grasslands (IWRM Fiji, 2013). Tree species included native fruit trees, breadfruit and coconut trees.

In the Lomani Gau project implemented in Gau Island, Fiji, 16 villages, one settlement and the Gau Secondary School each planted 3,000 trees as part of the reforestation of coastal areas to prevent coastal erosion and to provide a source of income and construction materials for the islanders. A total of over 180,000 trees were planted, and included mangroves for coastal protection, pandanus, coconut and breadfruit trees for food security and improving livelihoods (SPC, 2015).

Coral reef diversity

Coral reefs protect coastlines from heavy swell generated by cyclones and hurricanes. Reefs, however, are being degraded by anthropogenic influences and bleaching events due to prolonged periods of elevated sea surface temperatures. Attempts have been made to restore reefs by the rearing of coral fragments in cages set on the reef. Species selected for rearing include the fast growing Acropora species that normally dominate the back reef and the more robust but slower growing Porites species that are found on the forereef and which form micro atolls on the backreef. Coral reef restoration by the transplanting of coral fragments reared in cages has been successfully implemented on the Coral Coast, Fiji but on small patch reefs.

There is a proliferation of MPAs in the region that have been set up largely for biodiversity conservation. If managed properly, however, they can provide Eco-DRR outcomes indirectly. MPAs provide the best opportunity for reefs to recover after a natural disaster through provision of seed. They can be opened and assist in the provision of relief food supplies when cyclones strike. The presence of herbivores in MPAs will assist in keeping algal growth in check, post-cyclone, when there is an increased volume of rubble and algal colonisation. Restoration of reef health is critical for protection from excessive wave action and storm surge.

8. ECONOMIC CASE FOR ECO-DRR

This section seeks to document the economic case for Eco-DRR in Oceania by looking at available cost-benefit analyses of ecosystem-based approaches versus man-made engineering options. There are three good case studies from the region that show the cost-effectiveness of ecosystem-based approaches thus providing good illustrative arguments to promote the adoption and scaling up of nature-based solutions in the region. However, these studies used the terminology EbA – and at first glance make a case for EbA – but they are also Eco-DRR in nature as most of the problematic hazards in the region are climate-related. The cost-benefit analyses also cover only two countries, namely Fiji and Vanuatu, and freshwater and coastal ecosystems. Additional studies from other countries in the region and covering different ecosystems such as forests would contribute to build the case for Eco-DRR in the region.

Case study 1: CBA for Ba and Penang River catchments for DRR

A study by Brown et al., (2014) in the Ba and Penang River catchments did a cost-benefit analysis for disaster risk reduction due to flooding looking at different EbA options versus engineered options. The EbA options they considered included the planting of riparian buffers, afforestation of the upper catchment and the planting of floodplain vegetation. Engineered options considered included reinforcing riverbanks, dredging and raising houses on stilts. They also evaluated an integrated approach that combined both EbA and engineered options. Although cyclones were the most common natural hazards, risks due to flooding were considered the single most significant challenge facing the communities. The cost-benefit analysis calculated the Net Present Value (NPV) of each management option and the Benefit Cost Ratio (BCR) which quantified the relative efficiency of each management option. Their analysis for both the Ba River catchment and the Penang River catchment found the following to be true:

- Riparian buffers yielded positive NPV and BCR values for every scenario. Although it is not the most effective in providing the highest level of protection from flooding, the costs of implementation and the ecosystem services provided by the riparian vegetation make it a viable option.
- Upland afforestation also yielded very high NPV and BCR values for all scenarios but the high cost of planting was prohibitive without community buy-in.
- Planting native vegetation in the floodplains was considered as the option best suited as part of a mixed intervention.
- Of the engineered options, reinforcing river banks yielded the least net economic benefits for most of the scenarios but was found to reduce damage from flooding by as much as 80% relative to “business as usual”.
- River dredging was found to be economically feasible but the cost of dredging is high relative to benefits accrued in the lower catchment.
- Both dredging and raising houses were considered options best used as part of a mixed intervention.
- The mixed approach was considered the most viable option when the biophysical characteristics and flood risks faced by specific communities in both the Ba and Penang River catchments were considered.

Case Study 2: Economic valuation of mangroves in Vanuatu

An economic valuation of ecosystem goods and services of two mangrove areas in Vanuatu was conducted as part of the MESCAL project. The study used a combination of literature review, expert opinion and surveys to determine an economic value for each of the nine ecosystem services that included coastal protection. The total economic value for the nine ecosystem services in Crab Bay (mangrove area of 136.5 ha) was USD $586,000 of which the value for coastal protection was in the range USD $4,156 – $7,133.

The total economic value for the nine ecosystem services in Eratap (mangrove area of 31.2 ha) was USD $266,000 of which the value for coastal protection was USD $34,833 - $59,722. The site at Eratap is more exposed than the Crab Bay site which has a barrier reef, providing added protection (MESCAL, 2015). The value of mangroves in providing coastal protection was calculated to assist decision-makers when considering applications for mangrove conversion by developers.

Case Study 3: Climate Change Vulnerability Analysis/Cost Benefit Analysis for ecosystem-based adaptation and engineering options for Lami town, Fiji (Rao et al., 2013)

A Cost benefit Analysis was conducted for ecosystem-based adaptation versus engineered options to address the town's vulnerability to flooding from heavy rainfall and storm surges associated with cyclones. Ecosystem-based options included coastal revegetation including mangrove replanting, reducing upland logging and conservation of coastal ecosystems through monitoring and surveillance. Engineered options included bridge improvements, reinforcing river bank through the use of gabion baskets and river dredging. A benefit-to-cost analysis was done on four scenarios:

Scenario 1: Focus on ecosystem-based options
Scenario 2: Emphasis on ecosystem-based options but with some engineering options
Scenario 3: Emphasis on engineering options but with some ecosystem-based options
Scenario 4: Focus on engineering options

Benefit-to-cost ratio for each scenario of adaptive options with assumed percentage of damage avoidance is presented in the table below (Chin *et al.,* 2015):

Scenario	**Benefit-to-cost ratio (FJD)**	**Assumed damage avoidance**
Ecosystem-based options	$19.50	10–25%
Emphasis on ecosystem-based options	$15.00	25%
Emphasis on engineering options	$8.00	25%
Engineering options	$9.00	25–50%

The findings recommended a combined approach of engineered options with some EbA options for the protection of higher value priority infrastructure.

Mangrove foreshore forests and avoiding the clearance of vegetation from high risk erosion areas were two options recommended as a minimum for any EbA or CCA programme. Lami Town Council established a mangrove nursery which has provided revenue for the Council and mangrove restoration involving community planting days (SPC 2015).

9. CONCLUSION

The review of policies relating to biodiversity and Eco-DRR for the seven focal countries revealed the following gaps:

The biodiversity policies and action plans rarely mention Eco-DRR except in countries like Samoa where the Environment Department and NDMO are housed in the same Ministry. Conversely, the Disaster Management Plans and DRR policies of the focal countries do not mention biodiversity and Ecosystem-based Approaches. The DRM plans are by and large instructions regarding agencies and responsibilities and coordination mechanisms during disaster preparedness, response and rehabilitation phases. For many of the small Pacific Island countries, the only link between the environment and climatic events is made when discussing climate change adaptation interventions. Therefore, Eco-DRR in Oceania is essentially the same as EbA, which inherently includes CCA interventions such as mangrove and coral reef restoration, reforestation in upland areas and watershed rehabilitation.

The policy review highlighted the challenge that many countries in the region have in submitting reports as part of their obligations under the different multilateral environmental agreements. The largest country in the region in terms of area, population, ecosystems and biodiversity, Papua New Guinea, had submitted the least reports of all seven focal countries. This is a reflection of the lack of capacity in-country to implement, monitor and report on progress and PNG is by no means alone in this regard. This is where a multi-sectoral approach in-country would work best for Pacific Island countries where the lack of technical expertise and financial resources are major constraints. Countries often mention the paucity of data in their reports to the Conference of Parties for the different conventions, and thus research is also a major challenge.

The Samoa Pathway and the FRDP are two regional frameworks that provide entry points for the mainstreaming of Eco-DRR initiatives in the region. The region will be setting the pace for the rest of the world when the SRDP is endorsed by the Pacific leaders in 2016, as it will then be the first regional framework to fully integrate climate change and disaster risk management.

For many countries in the Pacific, the land tenure system and local governance systems can present challenges to the implementation of such activities.

There is a proliferation of MPAs in the Pacific that have been set up to conserve biodiversity and their establishment and promotion is evident from action plans associated with the CBD. For these MPAs to be seen as part of Eco-DRR, they need to be incorporated into a larger seascape or ridge to reef approach to ecosystem management. Ecological connectivity is perhaps under-recognised.

The financial instruments available for addressing disaster risks require technical expertise that the small Pacific Island countries do not possess. The dearth of reports from some of the focal countries is a reminder of how under-resourced many Environment Departments and NDMOs are, both financially and technically. It, therefore, does not create an environment where innovative concepts can be catered for, as there is neither the headspace nor the capacity to implement. To continue with business as usual is probably considered the easiest option.

The regional policy illustrates a shift from emergency response to proactive integrated approaches. The region, however, remains vulnerable and continued support needs to be provided towards the integration of efforts and its co-funding, i.e. biodiversity benefits DRR and DRR benefits biodiversity.

Key next steps to scale-up Eco-DRR in the region includes:

- Integration of biodiversity conservation and Eco-DRR into national planning for sustainable development and DRR strategies
- For Eco-DRR to be recognised by government personnel, evidence is needed that it can be more sustainable and cost-effective option and this is best done by a Cost Benefit Analysis of EbA options versus the engineered options for disaster risk reduction.
- Actively promote the ridge to reef concept by means of case studies where there is integration of water, forest, land and coastal ecosystems for disaster risk reduction.
- Provide capacity building in Eco-DRR concepts to government personnel from different sectors including national planning, NDMOs, finance and infrastructure.
- A multi-sectoral approach needs to be adopted by governments in the region for Eco-DRR initiatives to be mainstreamed in government policies.
- It is incumbent on biodiversity conservation organisations to recognise the role of people and their social systems in the promotion of Eco-DRR. Traditional knowledge and practices have enabled the peoples of Oceania to survive hazards for centuries. Their knowledge of the utility of different species and methods of preservation during

times of disasters has ensured food and water security in the rehabilitation phase of disasters.

- Greater collaboration between government, NGO and academia could address the knowledge gaps highlighted by countries in their national reports. The development of a research strategy for DRR could be a first step.

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Annex 1

Draft Questionnaire for stakeholders

Purpose: To document and map national experiences and initiatives in ecosystem-based disaster risk reduction (Eco-DRR) in FOCAL COUNTRY

Key terms:

Natural hazards: events such as cyclones, earthquakes, tsunamis that occur in the physical environment and can potentially cause harm to people

Disasters: UNISDR defines a disaster as "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources

Disaster risk reduction (DRR): DRR refers to "reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events" (UNISDR, 2009)

Eco-DRR: The Partnership for Environment and Disaster Risk Reduction (PEDRR) defines it as "Sustainable management, conservation and restoration of ecosystems to provide services that reduce disaster risk by mitigating hazards and by increasing livelihood resilience."

Name of your institution	
Your name	
Your function	
Your contact details ***(phone, email)***	

1. **What is your institution's core objective/mission?**
   A. Disaster risk management and reduction
   B. Development
   C. Environmental Conservation/ Natural Resource Management

2. **What are your institution's activities in disaster management, risk reduction and/or environmental (ecosystem) management and/or climate change adaptation?**

   a) Early Warning System
   b) Disaster preparedness
   c) Disaster/ Emergency response
   d) Post-disaster recovery and/or reconstruction a) shelter; b) water and sanitation; c) livelihoods?
   e) Environmental management
   f) Ecosystem management
   g) Protected area management

h) Water resource management
i) Biodiversity/ Wildlife conservation
j) Community-based climate change adaptation
k) Ecosystem-based adaptation

3. Does your institution currently implement or plan to implement Eco-DRR projects as per the definition given above?

A. Yes
B. No

If yes, go to question 4

If no, go to question 5

4. Can you fill the following table to describe the Eco-DRR project (s) implemented by your institution? (Please copy the table as required for multiple projects)

Project title	
Duration	
Geographical coverage/location if national	
Ecosystems involved	
Partners	
Main objectives/results	
Summary of main activities	
Is the project contributing to biodiversity conservation? If yes, How?	
What Knowledge products are available? (please provide links to project website or communication materials)	
Additional comments	
Project focal points (name and email)	

5. Why has your institution not included Eco-DRR in their work?

6. **What is your institution's capacity development needs with regards to ecosystem-based disaster risk reduction?**

Annex 2

Details of policy review

1. **Fiji**

National Biodiversity Strategies and Action Plans (NBSAPs)

References to Eco-DRR elements in Fiji's Biodiversity Strategies and Action Plans include the following:

- Ecosystems are recognized as providing protection from natural hazards
- Coral reefs and mangrove forests are reported to regulate disturbance likes ocean waves and surging tides
- Tropical forests are reported to absorb water and prevent floods as well as preventing water scarcity by storing rainfall
- Mangrove and tropical forests are reported to resist erosions
- Biodiversity is also recognized as contributing to ecosystem stability and that they promotes ecosystem health and associated services
- Action 26 under focus 1 (Community support-awareness, involvement and ownership) state that low-fire land uses should be encouraged in degraded grasslands to mitigate wildfires.

Fifth national report

References to Eco-DRR elements in Fiji's Biodiversity Strategies and Action Plans include the following:

- It is recognized that biodiversity contributes to many aspects of human well-being but there is also emphasis on the impact that biodiversity loss has on ecosystem services
- Loss of mangroves and coral reefs and freshwater aquatic habitat deterioration is linked to less protection from winds, floods and storms with increased impact on communities
- Degraded watersheds are reported to retain less sediment, contribute to flooding and providing less resilience to high rainfall and cyclones.
- Management recommendation to protect inland watersheds include "Ecosystem management utilizing traditional community based catchment management", "Maintaining and restoring forest cover" and "prohibiting the introduction of exotic aquatic species into pristine riverine systems".

Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas

The action plan does not include specific Eco-DRR elements but promote the integration of protected areas with Ecosystem-based approaches to climate change adaptation. Some of the priority activities identified to fully implement the Programme of Work on Protected Areas that can be relevant to integrate or inform Eco-DRR activities include the following:

- Integrated Costal Management (ICM) planning, integrated terrestrial management
- Agro biodiversity/local/ traditional variety management, assessing ecological effectiveness of different management types
- Appropriate incentives in place for institution

- Develop Protected Area legislations and regulations including best practices and standards
- Develop economic valuation for protected areas for each category

Green Growth Framework

The Green Growth Framework (Fiji Govt, 2014) is an economic tool devised by the Fiji Government in 2014 to promote climate resilient sustainable development while fostering economic growth and protection of the environment. Its ten thematic areas include the following three:

- Building resilience to climate change and disasters
- Sustainable island and ocean resources and
- Freshwater resources and sanitation management

The framework promotes an integrated approach to risk management and to achieve this it recommends a national Strategic Plan for Climate and Disaster Resilience. Such a plan will assist to mainstream climate change and disaster risk within national and subnational development planning and resource allocation processes. Although the Government has already made some progress with building resilience by the planting of native trees and root crops to minimise soil erosion and the planting of mangroves to reduce coastal erosion and coastal flooding, there are still key challenges to be met. One such challenge is to strengthen the role of local governments in building resilience. To address this challenge it is proposed that town plan regulations are reviewed to facilitate enforcement of zoning and buffer zones of coastal areas, river banks, high risk areas and mangrove areas by end 2016.

Ramsar convention COP 12 national report

The report does not cover Eco-DRR elements but some information has been identified as being relevant for streaming Eco-DRR into the implementation of the convention:

- It is reported that that the condition of the Ramsar sites have not changed but that wetlands in general has deteriorated in the country. This was associated with the lack of legislation that is solely dedicated to protecting wetlands
- Under strategy 1.4, the country has to promote recognition of wetland services. It is reported that an assessment of the ecosystem services provided by the Ramsar sites has been done in 2006 and that it need to be updated.
- Under strategy 1.11 on incentive measures, it is reported that the promotion of incentive measures have not been implemented but is planned

UNCCD: Nation action plan to combat land degradation and to militate against drought

Implementation of the UNCCD generally requires Eco-DRR approaches as the goal is to address a natural hazard that is linked to ecosystem degradation. In Fiji, deforestation, inappropriate land use in the watershed and coastal margins are listed as direct drivers of land degradation and drought. Ecosystem management such as sustainable forestry management and protection of natural resources are listed as key activities in the national action program framework.

Second National communication (2014)

Fiji's national communication for the UNFCC puts a large emphasis on the importance of natural resources for reduction of vulnerability to disasters and climate risks for example forest resources is recognized as being important for flood mitigation. Several adaptation measures are suggested to address climate risks for different sectors and ecosystem-

based approaches are very imminent. For example soil restoration and watershed management are listed as practices that can contribute to adaptation in the agricultural sector. Reforestation, protection of wetlands and soil conservation are other examples of practices suggested as solutions to climate risks.

National climate change policy

Fiji's national Climate Change Policy has eight objectives which include:

- Mainstreaming
- Data collection, storage and sharing
- Awareness raising
- Education and training
- Adaptation
- Mitigation
- Financing and
- International and Pacific region participation

Under the objective of adaptation, one of the key strategies is to "support the ecosystem based approach throughout Fiji, recognizing that ecosystem services, such as food security, natural hazard mitigation and physical coastal buffer zones, increase resilience". Another strategy promotes the inclusion of "vulnerability assessments and climate change impact projections into resource management planning such as integrated coastal and watershed management plans"

Disaster risk management action plans

Hyogo framework of action

The progress report for 2013-2015 has as Strategic goal area 2 "the development and strengthening of institutions, mechanisms and capacities at all levels, in particular at the community level, that can systematically contribute to building resilience to hazards." Resilience to be strengthened through different means including reforestation and conservation through marine (NBSAP) and forestry (REDD+) protected areas. Acknowledgement is made of the many donor-funded CCA projects that inherently include Eco-DRR elements but better coordination between donors, Government and implementing agencies is recommended.

Disaster risk management plan

Fiji's National Disaster Management Plan (1995) makes no reference to Eco-DRR. It simply outlines the agencies, roles, processes and coordination mechanisms during times of disaster preparedness, relief and rehabilitation.

2. Republic of Marshall Islands

National Biodiversity Strategies and Action Plans (NBSAPs)

One of the six strategic themes is Conservation of Biodiversity and Biological Resources of which one of the sub-themes was people taking the initiative to plant trees and crops. This was suggested to engage communities, NGOs, church groups, women's groups to restore the vegetation on the atolls and to replenish their food crops. Other priorities include the establishment of "mo" or conservation sites, the strengthening of traditional knowledge and practices of natural resource management and biosecurity.

Biodiversity considered of scientific and cultural diversity include:

- Ecosystems like the northern atoll of Bikar
- Species of traditional importance e.g. Micronesian pidgeon
- Biological resources considered traditionally important e.g. cultivars of pandanus and
- Traditional conservation practices e.g. mo

Threats to biodiversity include invasive species, breakdown of traditional governance systems and loss of traditional knowledge. There is a need to monitor the status of biodiversity at community, local government and national government levels.

Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas

The Reimaanlok is the National Conservation Area Plan for RMI. It is an overarching framework for conservation area planning that was developed for the Marshallese people by Marshallese resource management personnel in both Government and NGO agencies. It contains guiding principles, processes and guidelines for the establishment of conservation areas that are fully owned and led by local communities based on their needs and traditions.

Ramsar convention COP 12 national report

There has been active awareness raising on the importance of mangrove conservation and distribution and replanting of seedlings in outer islands and atolls has been implemented.

National communication

The Report on Intended Nationally Determined Contribution (2015) has a small section on adaptation although the focus is largely on mitigation. It proposes rehabilitation of mangrove and agriculture which will also enhance carbon stocks.

Disaster risk management action plans

Hyogo framework of action

The report (2011-2013) attributes the lack of progress with priority actions and core indicators to the lack of human and financial resources, the remote nature of the outer islands and the inherent transport and communication problems. The link between DRM and CC and the impact on water resources is being increasingly recognised and where most efforts are focussed.

The National Action Plan for DRM (2008-2018)

One of the key goals is the sustainable development of coastal areas with the key outcome being reduced vulnerability to coastal hazards. Sea level rise and coastal erosion are the main CC-related issues impacting the atolls. Proposed actions include the mapping of high risk coastal areas, vulnerability assessments, the development of integrated coastal area plans and the provision of training in coastal ecosystem monitoring. Public awareness raising on the link between coastal degradation and disaster vulnerability is also proposed. Ensuring water security through institutional strengthening and improved infrastructure, is a key element of the DRM NAP, which is inevitable given that drought is the primary natural hazard that RMI has to contend with.

3. Papua New Guinea

National Biodiversity Strategies and Action Plans (NBSAPs)

The NBSAP for 2008-2013 has no Eco-DRR content. Under the Program on Research and Information on Biodiversity, objectives include vulnerability due to climate variability and climate change, adaptation strategies for biodiversity, sustainable land-use strategies and prevention of desertification. One of the suggested activities is to implement the Sustainable Land Use Management Strategy to control/prevent desertification. Under the Program on In situ and Ex situ Biodiversity Conservation, one of the key objectives is to support the implementation of an Integrated Coastal Zone Management Plan for the entire coastline of PNG.

National communication

In the First National Communication, coastal flooding and sea level rise is listed first of the nine natural hazards prevalent in PNG. There is no mention, however, of Eco-DRR.

National Climate Change Policy

The policy (OCCD, 2014) has adaptation and mitigation strategies that include conducting national and sub-national vulnerability assessments of human, environmental and socio-economic systems. Interventions include evaluating the feasibility of adaptation measures like community-based mangrove planting.

Disaster risk management action plans

Hyogo framework of action

Disaster risk management plans are being promoted at national, provincial and district levels. Hazard risk analysis is a great need in the country.

Disaster risk management plan

The DRM Plan (2012) provides in detail the agencies, committees/subcommittees, responsibilities, and coordination mechanisms during disaster preparedness, relief and recovery phases and response measures for each type of disaster.

4. Samoa

National Biodiversity Strategies and Action Plans (NBSAPs)

Under the theme of ecosystem management, two of the proposed actions include establishing conservation areas in underrepresented ecosystems e.g. Mangrove areas and the development and implementation of programs to restore degraded ecosystems like mangrove and watershed areas. The development and implementation of integrated coastal management programs is also proposed.

Fifth national report

In response to how changes in biodiversity have impacted on ecosystem services, the threat of climate change has put environmental sustainability at the top of the national development agenda. Solutions being promoted include utilising forests, reefs, dunes and mangroves to complement or replace engineered options in providing coastal protection.

Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas

One of the priority actions identified is to integrate protected areas into wider land and seascapes to demonstrate the mainstreaming of biodiversity in other sectors and ecosystem based approaches to climate change adaptation.

Ramsar convention COP 12 national report

There were 26 new mangrove areas mapped in the country as a result of the project implemented by IUCN ORO entitled Mangrove Ecosystems for Climate Change Adaptation and Livelihoods (MESCAL). The new areas were largely on the other large island of Savai'i but it was a significant addition to the country's wetlands inventory.

UNCCD: Nation action plan to combat land degradation and to militate against drought

The promotion of subsistence and commercial farming has led to deforestation and poor land use practices and is one of the main drivers of land degradation. The progression of cultivation to catchments, steep slopes and upland areas have also contributed to soil erosion, flooding and landslides. Invasive floral and faunal species have also been a driver, the *Meremia* vine taking over large tracts of cleared forest. Climate change has contributed to both catastrophic floods associated with cyclones and droughts.

To address these issues, institutional frameworks have been strengthened governing the use of land resources, reforestation, agroforestry, community forest conservation areas and the establishment of national parks and reserves have been implemented.

National communication

In the Second National Communication (2009) the adaptation technology options for addressing catchment management and coastal zone management delegated engineered options to the Government to implement while the soft options of awareness raising and resource management plans were delegated to the communities and local NGOs.

National Adaptation Programmes of Action (NAPA)

Among the key adaptation needs identified for the biodiversity sector are marine and terrestrial conservation areas and enforcement of monitoring systems for such areas. To address this need, a project was proposed that had as its objectives the strengthening of community-based biodiversity management plans and high priority conservation areas. Actions required include setting up biodiversity management plans and conservation areas for the protection of priority species, the development of a community-based biodiversity inventory and capacity building for communities with conservation areas, both marine and terrestrial. There was no mention of any linkages between these proposed activities with DRR.

Disaster risk management action plans

Hyogo framework of action

Coastal Infrastructure Management (CIM) plans have been developed by all villages and contain local assessments of flooding and coastal erosion and include maps of Coastal Erosion Hazard Zones and Coastal Flooding Hazard Zones. The maps also include physical and community infrastructure that are prone to flooding and/or coastal zone erosion and adaptation options. DRR is an integral part of Climate Change Adaptation policies and plans. There is no counterpart for CIM plans in the non-coastal areas and non-coastal hazards that include floods and landslides.

Disaster risk management plan

The plan sets out the responsibilities of the different agencies during times of natural disaster and the institutional arrangements in place during disaster preparedness, response and recovery phases. No mention made of Eco-DRR.

5. Solomon Islands

Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas

Acknowledgement is made of the impacts of climate change and the associated natural disasters but that the impacts would be great on mangroves, coral reefs and wetlands rather than their provision of ecosystem services that would reduce impacts. One of the key actions suggested for PoWPA is a review of the existing Ridge to Reef conservation document to be completed 2012-2018.

National communication

The first National Communication (2004) highlights the dearth of knowledge that existed at the time on CC-related issues like its impacts on coastal and terrestrial ecosystems. It was the first time a vulnerability and adaptation assessment had been conducted in Solomon Islands and areas of high risk to flooding and inundation were identified. Coastal erosion was a concern. It was acknowledged that increasing populations and environmental pressure only served to exacerbate the impacts of climate change both on upland and coastal areas increasing the likelihood of flooding, costal inundation, increased erosion and sedimentation, of coral reefs and mangroves. Adaptation options suggested included protection of coastal ecosystems, revegetation and establishment of buffer zones. These are measures against CC impacts which is now recognised as essentially Eco-DRR.

National Adaptation Programmes of Action (NAPA)

One of the priority actions is to increase resilience and strengthen the adaptive capacity of coastal communities' socio-economic activities and infrastructure to impacts of climate change and variability. This will be achieved through integrated coastal zone management. Activities suggested include the replanting of coastal zone vegetation, establishment of buffer zones, protection and rehabilitation of coral reefs and mangrove areas, all of which is Eco-DRR.

Disaster risk management action plans

Hyogo framework of action

One of the areas to be addressed according to the report (2009-2011) is to strengthen institutional arrangements, mechanisms and capacities to increase resilience to hazards at national, provincial and village level. Village planning will involve community based disaster risk management (CBDRM) and NGOs will be used to work on these village plans with the communities. The Environment Act (1998) and the Protected Areas Act (2010) cover conservation issues including biodiversity conservation. The formation of the Environment Advisory Council ensures the inclusion of DRM issues in these Acts. Communities are taking the lead with the establishment of conservation areas that act to preserve ecosystem services thus promoting Eco-DRR. Again it is inextricably linked to CCA.

Disaster risk management plan

The National DRM Plan (2009) described the institutional arrangements for disaster preparedness, relief and recovery phases. No mention made of the role of biodiversity and/or ecosystems in DRR.

6. Tuvalu

National Biodiversity Strategies and Action Plans (NBSAPs)

Tuvalu's NBSAP (2012-2016) has as one if its actions under the theme Climate Change and Disaster Risk Management, to assess and establish effective coordination mechanisms to facilitate the mainstreaming of biodiversity conservation in CC and DRM policies and programs. Another proposed action was to identify options for ecosystem based adaptation and to promote the EbA approach.

Action Plan for Implementing the Convention on Biological Diversity's Programme of Work on Protected Areas

Under Climate Change Resilience and Adaptation Assessment, the value of natural barriers is acknowledged and the preservation of mangroves and corals reefs is critically important. Also recognised is the value of native coastal vegetation which should be actively promoted and grown e.g. *Barringtonia asiatica* and *Calophyllum inophyllum*.

UNCCD: Nation action plan to combat land degradation and to militate against drought

The main drivers of land degradation include saltwater intrusion from sea level rise, poor land use practices, coastal erosion from heavy swell is exacerbated by poor seawall construction, removal of sand and aggregates for construction and clearing of coastal vegetation. To address these issues, development of land use plans, monitoring of biophysical processes and strengthening of institutional frameworks are some of the proposed strategies.

National communication

The First National Communication (1999) highlights coastal erosion and salt water intrusion as major climate change-related impacts. Proposed actions include building a network of conservation areas across the nine islands and planting native trees to provide fuelwood.

National Adaptation Programmes of Action (NAPA)

The main impacts of climate change and variability are more intense tropical cyclones, drought, saltwater intrusion and coastal erosion. These in turn impact food and water security and people's livelihoods. To combat coastal erosion, coastal tree planting programs and coral planting have been implemented.

Disaster risk management action plans

Disaster risk management plan

The Plan (2012-2016) describes the processes involved in its formulation, stakeholders involved, policies that it is linked to, the main goals, outcomes, the institutional arrangements for implementation and the costs involved.

7. Vanuatu

National Biodiversity Strategies and Action Plans (NBSAPs)

The NBSAP (1999) mentions the need for community based mangrove conservation and rehabilitation plans but not in the context of Eco-DRR rather that of conservation of significant species and places. No Eco-DRR content.

Fifth national report

The Forestry Department in a bid to promote climate change adaptation measures has essentially been promoting the Eco-DRR approach without stating it as such. Measures have included the planting of coastal trees to address coastal erosion, the planting of vetiver grass on slopes to prevent erosion and rehabilitation of water catchment areas through reforestation.

Community conservation areas have been established in recognition of the link between biodiversity and ecosystems services, however, the link with DRR is not made.

National communication

Adaptation to the impacts of climate change in the coastal zone include banning the extraction of resources such as sand and mangroves and re-vegetation of the coastal zone to reduce coastal erosion. One of the hindrances to adopting adaptation strategies in 1999 when this communication was prepared was that climate change planning had not been mainstreamed into planning activities of the different government agencies and sectoral organisations.

National Adaptation Programmes of Action (NAPA)

Of the eleven priority adaptation strategies, the development of Integrated Coastal Zone Management programmes including mangrove and coastal flora management plans were ranked ninth out of eleven strategies. This was to address the coastal erosion due to sea level rise and storm surges.

Disaster risk management action plans

Hyogo framework of action

The report for 2011-2013 makes an interesting statement in that DRR is not directly addressed by government sectors other than the National Disaster Risk Management Office (NDMO), but it is considered under “other names”. This has been evident when reading of climate change adaptation strategies, invariably it includes ecosystem based measures that are designed for DRR.

Disaster risk management plan

The plan could not be accessed rather a slide presentation on the plan (2006-2016) that was presented at a regional meeting in Marshall Islands in 2007 was the source of information. The main challenges in developing a National Action Plan have largely had to do with Disaster Risk Management not being mainstreamed into government sector planning and the misconception of Disaster Management being the response and rehabilitation phases following disasters without considering disaster risk reduction options in a holistic manner. Other than outlining the challenges and the process involved in the development of the plan, there is no mention made of Eco-DRR.

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