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Wetlands and Disaster Risk Reduction: A Guide for Wetland Managers

Ramsar Convention on Wetlands

Ramsar Regional Center East Asia

Wetlands International

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Wetlands and Disaster Risk Reduction: A Guide for Wetland Managers

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Wetlands and Disaster Risk Reduction:

A Guide for Wetland Managers



FOREWORD

Disaster events driven by extreme hydro-climatic hazards are increasing worldwide, causing unprecedented human and economic losses. Over four billion people have reportedly been affected worldwide by these events in the last 20 years. However, no disaster is 'natural'. Climate change, ecosystem degradation, limited capacity within communities to cope with hazards, among others, are the leading factors that turn natural hazards into disasters. Well-functioning wetlands have the capacity to reduce the effects of hazards such as floods and water scarcity and are counted among Nature-based Solutions (NbS) for disaster risk management. Wetlands also contribute to strengthening the resilience of communities through the provision of livelihoods, food, and water.

The importance of wetlands in disaster risk reduction has gained global attention. In recognizing this important function of wetlands, the Convention on Wetlands adopted the Resolution XII:13 (Wetlands and Disaster Risk Reduction) in 2016. Other global treaties such as the Convention on Biological Diversity, the Paris Agreement, and the Sendai Framework for Disaster Risk Reduction 2015-2030, have also recognized the importance of managing healthy ecosystems, including wetlands, to reduce disaster risks. Nevertheless, there are many gaps in translating this policy level commitment into ground level actions. It is with the view of closing this gap that UNEP, the Ramsar Convention Secretariat, Ramsar Regional Centre - East Asia, and Wetlands International joined hands to prepare this guideline on "Wetlands and Disaster Risk Reduction: A Guide for Wetland Managers", with a special focus on the Asia and Pacific region. We hope that this guidance will provide insights to relevant national and regional agencies in advancing their disaster risk reduction and climate action strategies.

Cecilia Aipira

Head, Disasters and Conflicts Branch

United Nations Environment Programme

Water-related disasters such as floods, droughts and storm surges have affected communities on every continent this year, accounting for 90% of all global disasters. As highlighted by the Intergovernmental Panel on Climate Change, we can expect the frequency of these extreme events to increase with climate change, reversing critical progress towards achieving the Sustainable Development Goals.

Scaling healthy wetlands is key to tackling climate change and disaster risk. Ecosystems such as mangroves, seagrasses and coral reefs provide proven, cost-effective protection for coastal communities from extreme events. With their multiple benefits for water provision, food security and climate mitigation, wetlands also support communities to prepare for and recover from disasters. For these reasons, integrating wetlands as natural infrastructure for disaster risk reduction (DRR), can mitigate natural hazards and build communities' resilience across entire river basins or coastal zones.

Contracting Parties to the Convention on Wetlands recognize the importance of wetlands to DDR. At COP12, Parties adopted Resolution XII.13, which strongly encourages all Parties to mainstream DRR measures in management plans for wetlands, including Wetlands of International Importance, and in all relevant policies, action plans and programs. Prompted by the Resolution, this guidance offers best practices for Ecosystem-based Disaster Risk Reduction in Asia to help wetland managers formulate better wetland management plans against natural disasters. The Secretariat is delighted to have supported the development of this guidance and hopes it supports many wetland managers in their important work.

Beom-Sik Yoo

Senior Advisor for Asia/Oceania

Secretariat of the Convention of Wetlands

FOREWORD

The Ramsar Regional Center – East Asia (RRC-EA) is one of the regional initiatives formally recognized by the Convention on Wetlands and serves as a regional platform for capacity building, information exchange, and cooperation. One of the objectives of the RRC-EA is to assist Ramsar Site and wetland managers in their work to ensure effective conservation, wise use and management of Ramsar Sites and wetlands. Along these lines, the RRC-EA supports Ramsar Resolution XII.13 (Wetlands and Disaster Risk Reduction) in underscoring the essential role of wetlands for disaster risk reduction.

Through this publication "Wetlands and Disaster Risk Reduction: A Guide for Wetland Managers", we hope that Ramsar Site and wetland managers can better understand the approach of Ecosystem-based Disaster Risk Reduction (Eco-DRR) and the importance of wetlands as valuable assets in addressing disaster-related issues. We also encourage Ramsar Site and wetland managers to incorporate Eco-DRR into wetland management.

Under the RRC-EA's CEPA program, it is our aim to disseminate and promote this publication, and to translate this guidebook into other languages of Ramsar Contracting Parties in East, Southeast and South Asia to help effectively convey the messages of this guidebook at the site level.

The RRC-EA is grateful to be part of the process of developing this guidebook, together with partners: the United Nations Environment Program, Wetlands International – South Asia, and the Convention on Wetlands Secretariat. We look forward to the wide application of Eco-DRR guidelines for furthering wetland conservation and wise use.

Suh, Seung Oh

Executive Director

Ramsar Regional Center – East Asia

The world is witnessing disasters of biblical proportions. The very recent drought in China, floods in Pakistan, and extreme heat temperature and wildfires in Europe indicate that nowhere and no one is immune to the disaster risks exacerbated by climate change. In the past year alone, these events have resulted in loss of around 10,000 human lives and $280 billion worldwide. The trend is likely to persist as the current developmental regime is stripping off areas with their natural infrastructure, such as wetlands. The COVID-19 pandemic has also demonstrated the consequences of jeopardizing species and natural ecosystems on human wellbeing and developmental gains at global levels.

Wetlands are one such remarkable natural infrastructure, which not only buffer physical impacts of a hazard, but also contribute greatly in building resilience by provisioning an array of life sustaining ecosystem services. Wetlands of International Importance, also known as Ramsar sites, primarily designated for species conservation and wise use of resources, are increasingly recognized as effective instruments for disaster risk reduction.

Wetlands International South Asia is pleased to contribute to the development of this guidance to help wetland managers and stakeholders in initiating discussion on ecosystem-based disaster risk reduction (Eco-DRR). It explains the Eco-DRR approaches in a comprehendible manner with illustrative examples to guide wetland managers in addressing disaster risks through ecosystem based approaches and make progress towards conservation and wise-use goals of wetlands management.

Dr Ritesh Kumar

Director

Wetlands International South Asia

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ACRONYMS

CBD	Convention on Biological Diversity
CBDRM	Community-Based Disaster Risk Management
CEPA	Community Education, Participation and Awareness
CCA	Climate Change Adaptation
CSWMC	Cross-sectoral wetland site management committees
DM	Disaster Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
GIS	Geographic Information System
Ha	Hectares
HFA	Hyogo Framework for Action
HVCAs	Hazard, Vulnerability and Capacity Assessments
IRM	Integrated Risk Management
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resources Management
M	Meter
Msl	Mean sea level
NbS	Nature-based Solutions
RAWES	Rapid Assessment of Wetland Ecosystem Services
RRC-EA	Ramsar Regional Center – East Asia
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
Sq Km	Square kilometer
UNISDR	United Nations International Strategy for Disaster Reduction (precursor to UNDRR)
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Program
WI	Wetlands International
WWF	World Wildlife Fund



Unsplash/Rachel-C



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WETLANDS AND DISASTERS

Unsplash/Nathan Anderson

Introduction

This guide provides an introduction to the interconnectivity between natural hazards, disasters and wetlands. It outlines the key steps for integrating disaster risk reduction (DRR) with wetland management, to reduce hazard impacts to wetland ecosystems and the associated communities by promoting the approach of Ecosystem-based Disaster Risk Reduction (Eco-DRR). The guide explains the key concepts of DRR and Eco-DRR in simplified non-technical language to help the users to incorporate Eco-DRR thinking and activities at different stages of the wetland management planning cycle. The guidance provided by this document will support wetland managers in implementing Ramsar Resolution XII.13 – "Wetlands and disaster risk reduction" and the Ramsar Strategic Plan 2016 – 2024. It also illustrates practical implementation of Eco-DRR activities and steps for wetland management through best practice case studies. Part 1 of the document introduces useful concepts in DRR and Eco-DRR. Part 2 provides specific guidelines for incorporating DRR in wetland management. It is primarily aimed for those involved in the management of Ramsar Sites in Asia but provides guidance applicable to all wetlands.

Damage caused to human communities and ecosystems by natural hazard driven disasters has significantly increased in the past decades. Many hydrometeorological hazards such as floods or cyclones are to some extent connected with wetlands and their protective functions. Recognizing this connection, the Convention on Wetlands adopted Resolution XII.13 on "Wetlands and Disaster Risk Reduction" in 2015.

> Ramsar resolution XII.13 states: "wetlands in all parts of the world play an important role in disaster risk reduction if the wetlands are effectively managed and restored where necessary."

The resolution recommended:

- Highlighting the connection between wetland degradation and disasters and emphasized the importance of integrating wetlands management in National DRR strategies and planning.
- Embedding wetland wise-use within Eco-DRR policies and programs.
- Designing wetlands-related solutions to improve disaster resilience as collaborative projects of development, humanitarian, and environmental sectors.
- Promoting combining 'natural' methods with conventional 'hard engineering' methods to reduce the impacts of hazards such as floods and cyclones and build community resilience to disasters.

In addition to Resolution XII.13, the 4th Strategic Plan of the Convention on Wetlands (2016-2024) also cites the importance of integrating DRR as an objective of wetlands management. The document's Strategic Goal 3: "Wise Use of all Wetlands", sets a target of prioritizing restoration and conservation of wetlands which are "relevant for biodiversity conservation, disaster risk reduction, livelihoods and/or climate change mitigation and adaptation." The Convention on Wetlands recognizes the commitment to integrate wetlands management and DRR by National Focal Points and by Ramsar Site and wetland managers. The Convention on Wetlands also published a fact sheet on wetlands and DRR (The Convention on Wetlands) and the Global Wetland Outlook 2021 (The Convention on Wetlands), which also highlighted DRR as a key wetland ecosystem service.

Other global agreements and policy frameworks such as the Convention on Biological Diversity (CBD), the Paris Agreement, the Sendai Framework on Disaster Risk Reduction (SFDRR) 2015-2030 and the Sustainable Development Goals (SDGs), have also recognized the importance of Eco-DRR and Nature-based Solutions (NbS) in reducing disaster risk and contributing to sustainable development (notably SDG 13, climate action) but wetlands also help achieve a number of other SDGs: Protect life on land (SDG 15), Clean water and sanitation (SDG 6), Good health and well-being (SDG 3). Thus, this guide will focus on how wetlands can act to mitigate the impact of natural hazards (i.e. flooding, coastal storm surges). Natural wetlands and constructed wetlands can also be useful in purifying storm wastewater and certain types of pollutants caused by anthropogenic hazards (or technical hazards) but these are beyond the scope of this publication. Finally, wetlands management for DRR must imperatively be embedded in a holistic integrated watershed resources management (IWRM) approach, through coordinated policy and regulatory frameworks, management arrangements and financing (UNEP, 2021)

Disaster Risk Reduction and wetlands

In the last few decades, the discipline of disaster management (DM) has transitioned from a focus on conventional disaster response, hazard control and post-disaster relief and reconstruction to include prevention measures, under the broader approach of DRR. The Hyogo Framework for Action (HFA) adapted by 168 countries in 2005 at the World Conference on Disaster Reduction (Hyogo, Japan), was the first step towards this paradigm shift toward DRR. In its strategic goals, the HFA called for "integration of disaster risk considerations into sustainable development policies" and "reducing underlying risk factors" (UNISDR, 2005)[1].

> HFA encouraged "sustainable use and management of ecosystems, including through better land-use planning and development activities to reduce risk and vulnerabilities." (UNISDR, 2005: Page 10)

In 2015, the HFA was succeeded by the Sendai Framework for Disaster Risk Reduction (SFDRR), 2015-2030 with a vision for this fifteen-year period. SFDRR established DRR as a more integrated discipline and practice.

> SFDRR 2015-2030 identified "investing in disaster risk reduction for building resilience" as a key priority. Under this priority, one key action is "to strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction."(UNDRR, 2015: Page 20)[2]

The SDGs adopted by the UN General Assembly in 2015 to be achieved by 2030 also include DRR as a key task among its 17 goals. The SDGs recognize the link between disasters and environmental degradation. SDG 11: "Make cities inclusive, safe, resilient and sustainable" identified reducing the impact of disasters as a key task of sustainability, which includes "reducing adverse per capita environmental impact of cities". SDG 15: "Protect, restore and promote sustainable use of terrestrial ecosystems", highlights the importance of protecting sensitive ecosystem types (in particular forests, wetlands, mountains and drylands) in building sustainable and resilient communities.

Both HFA and SFDRR have contributed to strengthening DM in many developing countries and guided the development of national level DM frameworks. Many countries adopted national level policies and legislation for DM in the 2005 – 2015 period following the adoption of HFA. These policies and legislation had some common features.

First, they established dedicated institutional frameworks and agencies for DM. Second, they expanded the focus of DM from disaster response to DRR. In most countries, integrated approaches for DM have been nominally adopted. To some extent, they identify the significance of measures such as community engagement, ecosystem conservation and environmental management as part of DM.

Some of these national policies and programs have officially identified the importance of ecosystems and wetlands for DRR. Examples include the Philippines' National Disaster Risk Reduction and Management Plan (NDRRMP) 2020 – 2030[3], and India's National Disaster Management Plan (2016)[4]. In Sri Lanka, proper management of wetlands around the capital city of Colombo has been identified as a key component of the city's flood protection scheme, both in DRR and urban development plans.

The significance of wetlands in DRR is now well established at both global policy directives and national level policies and programs. Therefore, the National Focal Points of the Convention on Wetlands, as well as the Ramsar Site Managers should strive to actively incorporate DRR into wetland planning and practice.

1. United Nations International Strategy for Disaster Reduction (UNISDR). (2005). *Hyogo Framework for Action 2005-2015:Building the Resilience of Nations and Communities to Disasters.* World Conference for Disaster Reduction. 2005. Hyogo Japan.

2. United Nations Office for Disaster Risk Reduction (UNDRR). (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030* . UNDRR. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

3. National Disaster Risk Reduction and Management Council (NDRRMC), 2020. National Disaster Risk Reduction and Management Plan (NDRRMP) 2020 – 2030. Manila: 2020-2030

4. National Disaster Management Authority of India (NDMA). 2016. National Disaster Management Plan. New Delhi: NDMA

Disasters and Disaster Risk Reduction

Disasters and the environment

Coping with disasters caused by natural hazards such as floods, cyclones or earthquakes has historically been a challenge to human communities. However, the frequency, scale and damage caused by such hazards have been rising worldwide since the last century, and a sharp increase was experienced in recent decades. It has been estimated that between 1900 and 2019, the total number of disaster events globally has increased tenfold. In 2017, global economic losses from such disasters totalled 330 billion USD, which are the second highest disaster losses ever recorded in a year. Despite short-term variations, it is clear that disaster events and impacts are clearly on the rise (see Fig 1).



Figure 1: *A. Cyclone Haiyan, the Philippines 2013 (Credit: Henry Donati/DFID), B. Pakistan Floods 2022 (Credit: Ali Hyder Junejo)*

Global climate change and degradation of ecosystems (especially coral reefs, mangroves, wetlands, forests), can contribute to increase the impact of hazards such as floods, landslides, and coastal erosion. Environmental degradation also makes communities more vulnerable to other (non - hydro-climatic) natural hazards such as earthquakes or tsunamis. Other socio-economic factors such as high population density, poverty, lack of disaster preparedness, lack of access to basic amenities and services such as water, sanitation, or health, also makes communities more disaster-prone.

Key principles of Disaster Risk Reduction for wetland management

There's no such thing as a 'natural' disaster.

Principle 1: A natural hazard such as a flood, or drought will not 'naturally' become a disaster.

A community's susceptibility to a disaster depends on how much they are exposed to hazards and the ability to cope with them – i.e., vulnerability and capacities. Following are the definitions given by the United Nations Office for Disaster Risk Reduction (UNDRR) of some commonly used terms in Disaster Risk Management (DRM):

Disaster: a serious disruption of the functioning of a community or society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope with using its own resources.

Disaster Risk: The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society, or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity.

Natural Hazard: Natural processes or phenomena that may [potentially] cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hazards may be single, sequential, or combined in their origin and effects. Each hazard is characterized by its location, intensity or magnitude, frequency, and probability.

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Capacity: The combination of all the strengths, attributes and resources available within an organization, community or society to manage and reduce disaster risks and strengthen resilience.

Source: **UNDRR, 2017a[5]**

Let's take an example. Think of a pair of scissors lying on the floor. It's a ***hazard***, but by itself the scissors will not injure someone. First, a person should come into contact with them – ***exposure***. Second, if the person has sufficient ***capacity*** to identify, understand and prevent this hazard, there would be no injury - ***disaster***. However, if a person with particular ***vulnerabilities*** such as an older person with poor eyesight or a child who cannot understand the danger comes to contact with the scissors, there is a potential for injury – ***disaster risk.*** (Adapted from WWF's "Flood Green Guide" 2017)

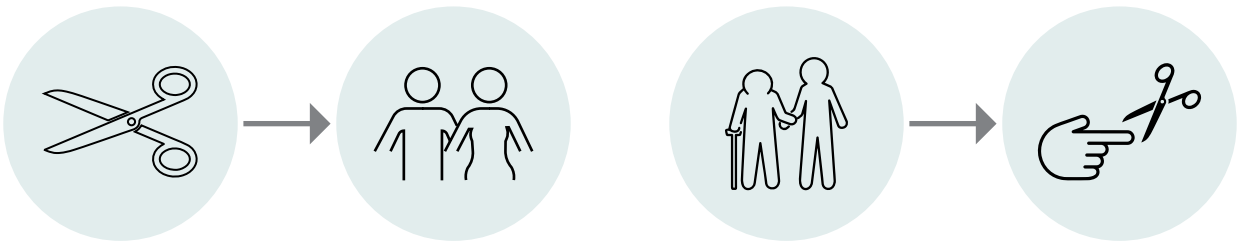


Figure 2: *Representation of hazard, exposure, vulnerability and disaster risk*

5. https://www.undrr.org/terminology

A more real-life disaster scenario may be as follows: a large rainfall event takes place (natural hazard event), people who live by the affected riverbank are flooded with little time to evacuate and hundreds of persons, especially the elderly (high vulnerability/ low capacities) succumb in the flooding (sudden on-set disaster). This disaster could have been avoided through several measures: 1. Reducing the exposure of the communities living along the river bank, either through early warning, or land use planning which does not allow construction so close to the river; and 2. Reducing the impact of the hazard through Eco-DRR measures, e.g. land use planning includes provisions to restore and conserve wetlands and vegetation, which contribute to infiltrate rainwater into soils, in conjunction with hybrid riverbank protection measures such as deep-rooted grasses or structural engineering measures if necessary.

Thus, disaster risk can be represented through a function:

Disaster Risk = Hazard x Exposure x Vulnerability

Different factors can contribute to aggravate or mitigate each of these risk components. For example, climate change or ecosystem degradation can intensify some hazards such as floods and landslides. Poor urban/ settlement planning can increase the exposure of communities to such hazards, and factors such as poverty and inequality can increase community vulnerability.

Vulnerabilities can be determined by a number of factors[6]:

- *Physical factors;* e.g. poor design and construction of buildings, unregulated land use change, etc.
- *Social factors:* e.g. poverty and inequality, marginalisation, social exclusion and discrimination by gender, social status, disability and age, psychological factors, etc.
- *Economic factors:* e.g. fragile informal economies, vulnerable rural livelihoods, disruption of markets etc.
- *Environmental factors:* e.g. poor environmental management, overconsumption of natural resources, decline of risk regulating ecosystem services, climate change, etc.
  (UNDRR, 2017b).

Coping capacity of a community to deal with hazard includes having proper physical infrastructure, strong organizations to deal with emergencies, knowledge and skills to mitigate the hazard impacts, and also certain social attributes such as social relationships, leadership and management. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions. Like vulnerabilities, capacities are also very complex.

Therefore, disaster risk can be reduced by three approaches:

1. Reducing hazard impacts through healthy ecosystems or in conjunction with structural engineering measures (e.g. wetlands in conjunction with flood control dams to reduce flooding, or forests on steep slopes with para avalanche barriers to reduce avalanches).
2. Reducing the exposure of communities to the hazard (e.g. early warning systems for temporary exposure reduction or resettlement of communities from disaster-prone areas for more permanent exposure reduction).
3. Reducing vulnerability and improving capacities of the communities to deal with hazards (e.g. reducing poverty, disaster resilient building codes, disaster preparedness).

Principle 2: Not all natural hazards are detrimental

Natural hazards such as floods and cyclones are ***essential processes in ecosystems*** and may not always become disasters with human or economic losses. In fact, most of these processes have many ***environmental and socio-economic benefits.*** For example, floods help replenish nutrients and silt in flood plains, and recharge ground water, which has direct benefits to agriculture and other livelihoods. In Bangladesh, communities have adapted their housing and livelihoods around flooding and, with the exception of large magnitude events, are rarely subject to human or economic losses. Abruptly altering such processes (e.g. flood control dams, sea walls which do not consider the negative impacts) may cause serious environmental damage and impacts.

6. https://www.preventionweb.net/understanding-disaster-risk/component-risk/vulnerability

Principle 3: Disaster risk can be reduced by addressing one or more components of risk

The main objective of DRR is to reduce risk by addressing one or more components of risk (hazard, exposure and vulnerability), while increasing capacities to manage hazard events. For example, reducing the risk faced by a community due to a riverine flood may include injuries, damage to houses or damage to crops. These ***risks can be successfully managed by a combination of options*** such as re-locating houses to a low flood risk area, restoring wetlands in the flood plain to improve the flood plain water holding capacity and better flood preparedness in the community.

Principle 4: Managing and reducing disaster risk goes beyond just planning for the next hazard event

DM goes beyond just preparing for and responding to hazard events. It is important to consider DM as a cyclical process with both prevention through DRR and post-disaster management, with actions that need to be taken before a disaster strikes and in the aftermath of a disaster (see Figure 3). ***Planning should start in the pre-disaster stage***, based on a proper disaster risk assessment and disaster preparedness strategies. Measures to mitigate disaster risk and to ensure effective preparedness should be planned and budgeted accordingly. After a disaster, immediate response and relief should be planned in the short term, and rehabilitation/ reconstruction in the medium to long term. DRR should address multiple hazards, considering landscape scales and physical, social, economic and environmental risks. This approach is also called ***integrated disaster management.***

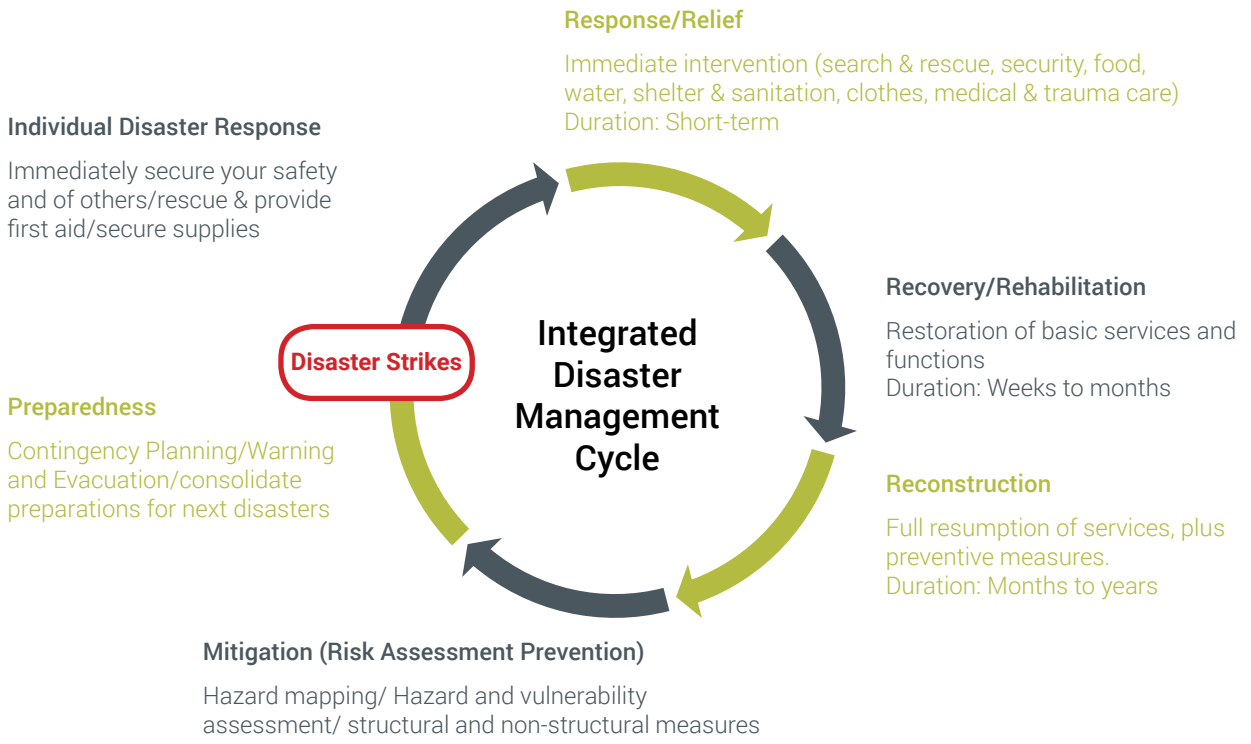


Figure 3: *Integrated disaster management cycle*

Principle 5: Engage affected communities and stakeholders

Integrated disaster management ***planning should involve all stakeholder groups*** such as affected communities, local governments, civil society organisations, and small business owners, and not confined to a narrow group of experts and government bureaucrats. ***Disadvantaged social groups*** such as the elderly, women, people with special needs or ethnic-religious-cast minorities should be fully integrated and given a voice in the planning process.

Non-structural Measures: Methods which do not require physical interventions. Focused on behavioral or governance change. (e.g. flood preparedness).

Soft/Green Structural Measures: Methods involve physical interventions and can include based on natural and nature-based approaches. These are also known collectively as Nature-based Solutions – NbS (e.g. wetland restoration).

Hard/Gray Structural Measures: Methods that involve hard engineering structures. (e.g. sea wall).

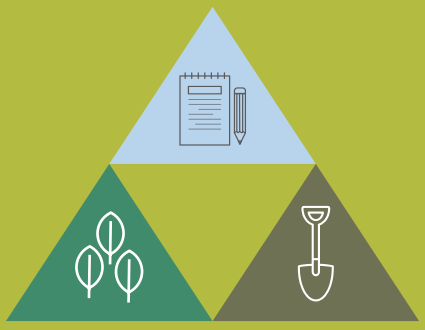


Figure 4: *Order priority of DRR measures (Adapted from WWF, 2017)*[7]

It is now commonly agreed that the decision makers should consider ***"non-structural" methods first.*** Non-structural methods cause the least socio-environmental impacts, as they do not involve any physical intervention. ***Second, the "soft structural measures"*** such as wetland restoration, upper watershed conservation should be considered. Some of these measures may bear moderate socio-environmental impacts. However, if properly planned, the negative impacts would be significantly less than hard engineering methods, and in some cases net socio-environmental benefits can be gained. ***"Hard engineering" measures*** should be considered the last, to manage any residual risks that cannot be reduced to an acceptable level by other measures. Methods such as flood control dams, sea walls, erosion prevention revetments may be necessary in areas with high population density and can be combined with NbS if planned properly. This is called a hybrid approach which can be very effective but which needs to be implemented with caution as hard engineering can cause severe social and environmental impacts.

Principle 6. Protect and maintain healthy ecosystems

Healthy ecosystems and their ecosystem services provide protection to communities from natural hazards. For example, wetlands act as buffers for flood waters in flood plain and protect some areas from inundation. Mangroves can act as barriers to strong waves and reduce plains from tidal waves, tsunamis and sea-erosion. When ecological features are degraded, this protection is reduced, which exposes communities more to natural hazards. Ecological degradation also has other negative impacts on health and livelihoods that can increase community vulnerability to disasters and increase disaster risk. Therefore, ***protecting ecosystems is an integral part of DRR.***

Principle 7: Build back safer and better

Even the best DRR plans cannot stop all disasters from occurring. Proper preparedness should be in place on the ground to provide quick and effective response (e.g. food, shelter, medical supplies) when a disaster strikes. However, in the aftermath of disaster events, careful planning is needed to rehabilitate communities and reconstruct buildings and other infrastructure ***in a manner that is more resilient to future disasters,*** provides better services than before and ensure the protection of vital ecosystems and ecosystem services.

7. World Wildlife Fund (WWF), 2017. Natural and Nature-based Flood Management: A Green Guide. Washington DC: WWF

Principle 8: Effective wetlands management for DRR can only be achieved through IWRM

Finally, but foremost is the importance of addressing wetlands management issues in a holistic manner. According to the UN Environment Programme, "IWRM is an approach that helps to balance competing water demands from across society and the economy, without compromising the sustainability of vital ecosystems. This is achieved through coordinated policy and regulatory frameworks, management arrangements and financing" (UNEP, 2021: VII). Wetlands are situated within geographic, economic and political contexts and effective wetlands management needs to consider the interconnections of these different spheres. IWRM brings together stakeholders to discuss competing needs for water and land uses with the objective of sustainable land and water management. Environmental degradation upstream of a watershed will significantly impact a wetland in the lower reach. Considering the importance for governments to adopt IWRM approaches, UNEP has established a special IWRM Support Programme, which assists governments in designing and implementing country-led responses to accelerate progress towards the achievement of water-related SDGs and other development goals[8].

Box 1: CASE STUDY 1 - Management of the Palisadoes - Port Royal Protected Area[9]



The Palisadoes-Port Royal Protected Area (Ramsar Site No. 1454) - located offshore of Jamaica's capital city, Kingston - contains mangrove lagoons, mangrove islands, seagrass beds, cays, coral reefs and shoals. It also serves as a natural protective barrier to communities in the low-lying areas of Kingston from coastal erosion, storm surges, flooding and hurricane strikes. However, due to pollution from a densely populated city and various coastal communities, the sustainability of the marine ecosystem and its ability to protect the island's shoreline is threatened.

The internationally funded Caribbean Biodiversity Fund (CBF) project – Kingston Harbour Ecosystem-based Adaptation Measures (#KHEAMproject) – developed innovative methods of engaging community members and raised their awareness of Eco-DRR measures. Central to the project's approach was the education and training of youth and women in audio-visual digital skills which provided them with alternative and supplemental livelihoods and practical pathways to become actively engaged in the everyday wetland management.

More information: https://kingstonharbourkheam.com/

Social aspect of disasters: Community-based Disaster Risk Management

Disasters cause massive social disruptions and impacts. Immediate social impacts of disasters include loss of life, immediate trauma, loss of shelter and health issues. In the medium term, issues such as caring for the disabled, elderly and children emerge along with the challenges of restoring quality of life (e.g. providing housing, health and nutrition) and livelihoods. In the long term, continuing psychological issues, impacts on education and cultural services and increased poverty continue to hamper social progress.

As discussed in the previous sections, wetlands provide mitigating and regulating services for certain hydro-meteorological hazards. This significantly reduces disaster risk to communities in watersheds and landscapes due to such hazards. Importantly, wetlands provide essential ecosystem services to help communities cope better with disasters. For example, livelihoods activities supported by wetlands, such as agriculture and fishing considerably help communities recover from disasters. Also, the thermal regulation function of wetlands helps communities to cope with hazards such as heatwaves. When wetlands are degraded, these ecosystem services wane, making the communities more vulnerable to hazards. At the same time, we must work with communities living in the vicinity of wetlands which may be exposed and vulnerable to the hazards that are associated with wetlands. For example, when healthy wetlands act as flood buffers, communities living adjacent to wetlands may face elevated flood risk. Affected communities may need to increase their capacities for disaster preparedness to safeguard lives and livelihoods. Wetlands and peatlands, where

8. https://www.unepdhi.org/sdg-6-support-programme/

9. CASE STUDY 1 (Case-study author: Vernon Barrett – Newer Worlds, UK)

seasonal bushfires occur during dry seasons, could pose a fire risk to neighbouring communities which may require a fire management plan.

How a disaster impacts each individual or community can vary and be shaped by their vulnerabilities and capacities. For example, an elderly person may be more vulnerable due to a certain flood situation than a younger person who has capacity to swim. Women are often caring towards children or the elderly and may be less inclined/able to evacuate an area. They may also have more restrictive clothes making fleeing/ swimming difficult compared to men. Similarly, a low-income community living in informal timber houses near the coast can be more vulnerable to high winds than a middle-income community living in masonry houses. Vulnerabilities can be reduced, and capacities can be enhanced by improving income, health and wellbeing, education and disaster awareness of community members. Importantly however is the notion that women, youth and many other groups have a high potential to act as agents of change when given the opportunity and leadership training.

Therefore, engagement of communities throughout the disaster cycle is very important. This process is called Community-Based Disaster Risk Management (CBDRM). CBDRM includes following essential steps:

- Identify groups/ communities vulnerable to particular hazard impacts;
- Identify what makes groups vulnerable and how they are affected;
- Assess the needs and capacities of these groups;
- Ensure that DRR projects and programs address these needs;
- Give special access to disadvantaged groups (e.g. elderly, women, minority groups);
- Involve the youth and children; and
- Actively engage the groups/communities in planning, decision-making and implementation.

All global humanitarian, disaster management and environmental organizations have identified CBDRM as a principle. Also, some important tools useful for CBDRM such as Hazard, Vulnerability and Capacity Assessments (HVCAs) and Community Mapping have been developed in the past decades and now used globally.



Figure 5: *community map on wetlands management for DRR*
Credit: Dhruv Verma/Wetlands International South Asia

Role of Wetlands in Disaster Risk Reduction

Wetlands and natural hazards

There are many natural hazards associated with wetlands such as floods, droughts, fires, tidal waves and sea erosion. Changes in ecological processes in wetlands can mitigate or intensify natural hazards and their impacts. At the same time, wetlands and their ecological processes can also be affected by natural hazards.

Wetland ecology is a unique balance among the processes associated with its hydrology, vegetation and soil characteristics (Hettiarachchi 2014)[10] (see Figure 6). Changes in any of these components can lead to overall ecological transformation of wetlands. Ecological processes associated with these three components can influence the nature, intensity and frequency of the above-mentioned natural hazards. For example, the hydrological character of wetlands determines the water flow and velocity of a flood and wetlands vegetation can influence the flow patterns, (e.g. channelized flow, sheet-flow). Soil characteristics and wetland morphology will determine the water holding capacity of the wetland. If a wetland can provide more storage and reduce the velocity of water, it will reduce the flood impact. Similarly, a coastal wetland with robust morphological and vegetation features which can dissipate wave energy will reduce the impact of tidal waves or sea erosion.

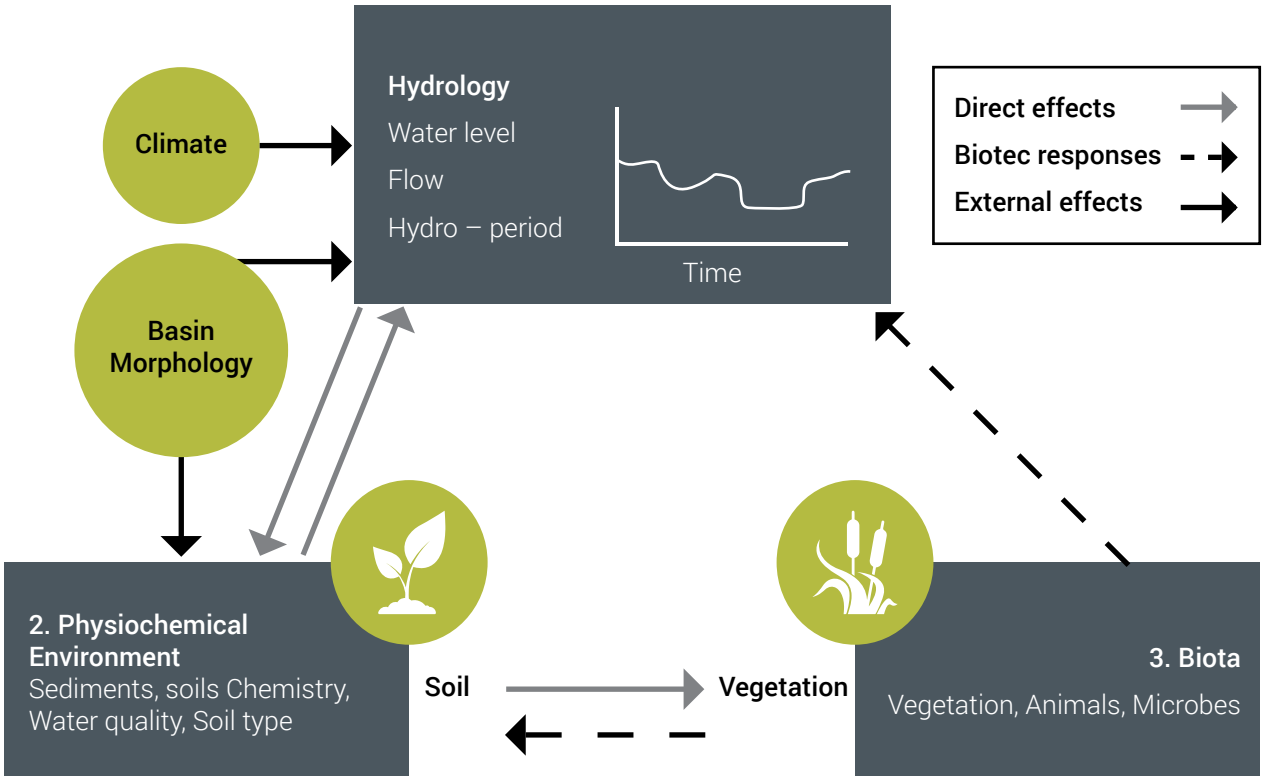


Figure 6: *Components of wetland ecology and ecological process (Source: Hettiarachchi, 2014[11])*

Wetlands interact with natural hazards in diverse ways. If we take the example of flooding, some wetlands accumulate runoff and contribute to flood flows, while others may detain the runoff and reduce the flood peak. Factors such as landscape location and configuration, vegetation, soil characteristics, topography, soil moisture status in wetlands determine how it interacts with flooding in a landscape. Hence, it should be noted that natural processes and hazards, such as water overflowing river banks can also be beneficial to wetlands ecology and for groundwater replenishment.

10. Hettiarachchi, M. (2014). Governing the urban wetland: Policy, Planning, History and Ecologies, PhD Thesis, School of Geography Planning and Environmental Management, The University of Queensland – Australia.

11. ibid



Flooding in the Delta de Casamance, Senegal. (Credit: The Convention on Wetlands)

Vegetation in urban wetlands of Colombo (Sri Lanka) transformed from grasses to shrubs has changed the flood flow pattern (*Credit: Missaka Hettiarachchi*)



Figure 7: *Examples of wetland hydrology, morphology, vegetation and soil factors influencing flood patterns in different ways.*

Although hard engineering structures, such as seawalls or river dykes are developed to reduce hazard impacts artificially and these are sometimes necessary in areas with high population density, they can also impact the ecological processes of wetlands and may cause overall undesirable ecological transformations. For example, arbitrary artificial ponds and channels within wetlands to increase the waterholding capacity and reduce floods, can lead to serious ecological degradation and transformation, that can actually increase the flood impacts in the long term (Hettiarachchi *et al*. 2014)[12].

Finally, wetlands themselves can be affected by floods. Depending on the magnitude and frequency, floods, tsunami, cyclones can cause damage to vegetation, harm animals and their habitats, and cause erosion, which can disrupt or even destroy the wetland ecological processes. The damages are higher when these hazards either created or intensified by human actions, such as conversion of wetlands for agriculture and urbanization and extreme climate events induced by anthropogenic climate change. Wetlands, like any other ecosystem, have a natural capacity to regenerate and recover from such damage. However, when their ecological health has been affected by human intervetions, their ability to cope with hazards and recover from damage is reduced.



Nepal's Koshi Tappu Ramsar Site, affected by heavy flooding

Figure 8: *Damage to wetlands from a flooding event*

12. Hettiarachchi, M., Morrison T.H., Wickramasinghe, D., Mapa, R., de Alwis A.P., and McAlpine C. (2014). The Environmental History and Ecological Transformation of the Colombo (Sri Lanka) Urban Wetlands. Landscape and Urban Planning. 132: 55–68

Wetland ecology is not defined by its physical and biological characteristics alone. How a wetland interacts with its users and surrounding communities is an essential part of its ecology. The Convention on Wetlands defined the "Ecological Character" of wetlands as "the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time" (Convention on Wetlands 2005a, Resolution IX.1 Annex A). Protection from natural hazards is an important ecosystem service that communities derive from wetlands. Therefore, maintaining healthy wetland ecosystems within their desirable ecological character is a key factor in building resilience of both communities and wetlands against natural hazards and potential disasters caused by them.

Wetland Ecosystem Services

Wetlands, as most ecosystems, provide services to human well-being and can be categorized into four types: provisioning, regulating, cultural and supporting (see fig. 9). Many of these ecosystem services can contribute to DRR through reducing the three components of disaster risk (hazard, exposure, vulnerability).

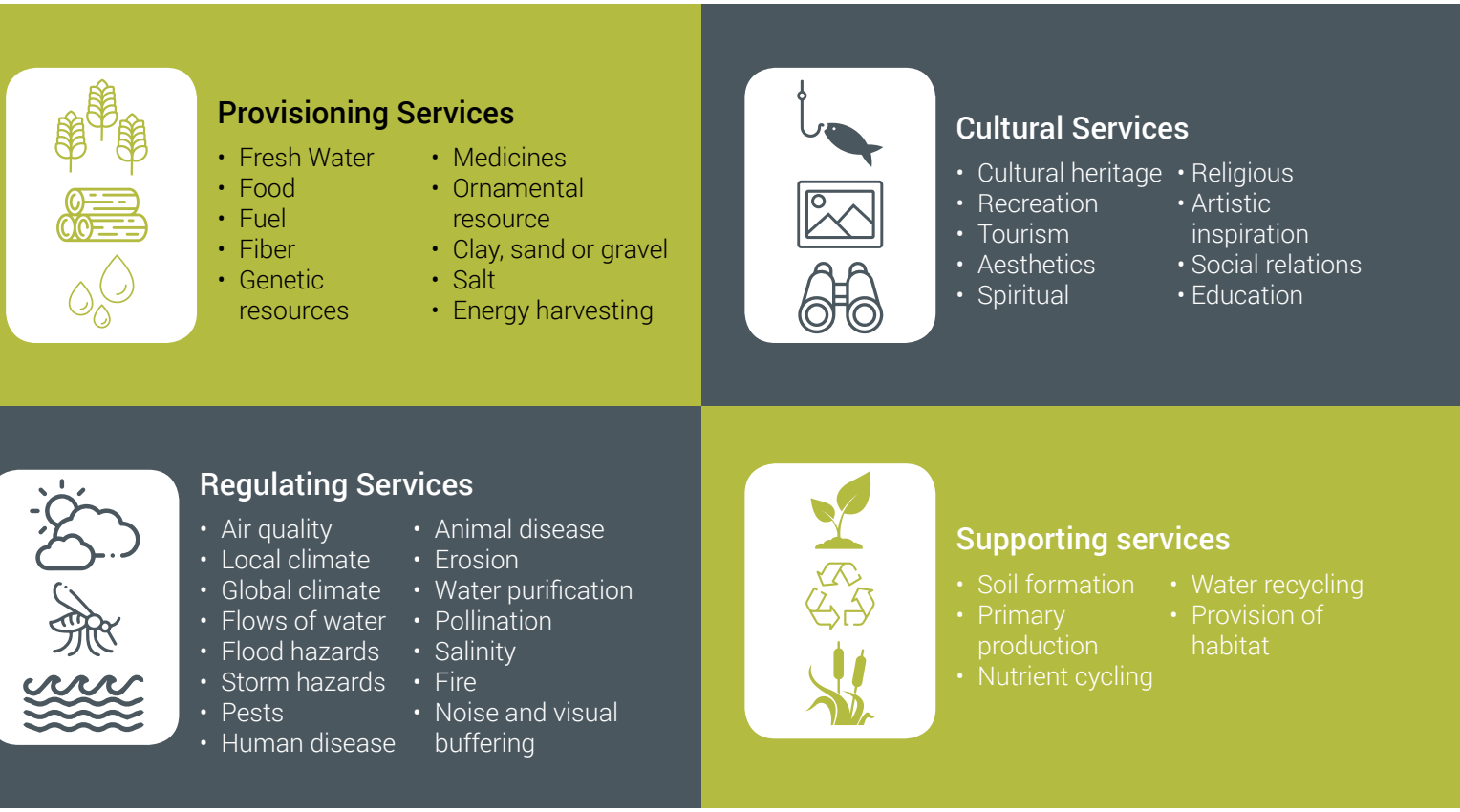


Figure 9: *Type of ecosystem services provided by wetlands (adapted from the Millennium Ecosystem Assessment, 2005[13])*

The main ways wetlands and other ecosystems such as forests contribute to DRR are through the Regulating Services which act directly by **reducing hazards and exposures** (Table 1).

13. Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Washington, DC: Island Press.

Table 1: Non-exhaustive examples of how regulating ecosystem services reduce hazards and exposure

Hazard	Ecosystem	Regulating Service for DRR
Landslides	Forested slopes	Erosion control
River erosion	River vegetation	Erosion control
Flooding	Watershed forests, wetlands	Water storage capacity / water flows
Drought	Watershed forests, wetlands	Water storage capacity / water flows
Storm surges/tsunami	Mangroves, sand dunes, coral reefs, coastal wetlands	Physical buffer
Avalanches	Forested slopes	Physical buffer
Cyclones	Forests, mangroves	Physical buffer
Heat waves	Trees, parks, wetlands	Local climate regulation

Ecosystems also help reduce vulnerability through their Provisioning Services, Supporting Services and Cultural Services. For example, food, water, fibre and timber provided by ecosystems' provisioning services support people before, during and after a disaster. Cultural services provided by ecosystems can support mental health of people during a crisis and without supporting services, nothing would grow.

The Convention on Wetlands has developed a comprehensive wetland values assessment methodology called 'Rapid Assessment of Wetland Ecosystem Services (RAWES)', adopted by Resolution XIII.17. The RAWES approach helps wetland managers to assess ecosystem services in an integrated manner.

However, a wetland's ability to mitigate hazards is compromised by anthropogenic changes (e.g. pollution, wetland loss, hydraulic modifications), as compounded by climate change which reduce the protection function of wetlands.

Managing wetlands to reduce disaster risks in a landscape through Eco-DRR

As mentioned above, the ability of wetlands to mitigate natural hazards is an ecosystem service upon which many communities are dependent. Wetlands managers should strive to optimize the provision of such ecosystem services for DRR through better management practices. This is what is known as Eco-DRR.

> Eco-DRR is the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development.

Eco-DRR is a disaster risk management approach which is based on all the points discussed in the above sections. The main principles of Eco-DRR can be summarized as below:

1. Natural hazards such as floods and tidal waves are also essential ecological processes.
2. Changing these processes in ad hoc ways can have serious environmental impacts and create elevated future risks.
3. The main task of DRM is not just to eliminate the hazards, but to eliminate or reduce the disaster risk of those hazards by reducing vulnerabilities and improving capacities.
4. Healthy ecosystems, including wetlands, provide ecosystem services which can reduce the risks posed by natural hazards.
5. Human (or development) activities not aligned with nature can degrade the ecosystems and weaken this risk reduction capacity. They may also introduce new hazards that were not there in the landscape previously (e.g. dam breach, chemical spills).

6. Human-induced climate change also increases extreme weather events and disaster risk. Ecosystems, especially wetlands, are vulnerable to climate change, which further reduces their risk reduction capacity.
7. All these factors increase the disaster vulnerability of communities in a landscape. Climate change and ecosystem degradation negatively impacts the livelihoods dependent on specific ecosystem services. This reduces the resilience of the communities to cope with future disasters.
8. The objective of Eco-DRR is to reverse this negative cycle, by restoring and maintaining health of ecosystems such as wetlands in a landscape, so that they can optimally provide ecosystem services that can help communities reduce disaster risk as well as mitigate and adapt to climate change.
9. An Integrated Risk Management (IRM) approach is essential, which strives to understand risk at a landscape level (not individual incidents) and combine Eco-DRR measures with conventional disaster management methods if required.
10. Eco-DRR cannot be realised without community engagement at all levels. Ecosystems protect communities, and strong community interventions are needed to protect ecosystems.

    Source: PEDRR, 2010

To fully implement Eco-DRR in wetlands, there are two key management concepts that are crucial:

Concept 1: Landscape approach

The landscape approach as a concept has been formally embraced by Care and Wetlands International, which define it as "a landscape approach is an interdisciplinary, cross-sectoral and holistic approach to help overcome barriers by sector and contribute to effective risk management by connecting all stakeholders involved, starting with the communities at risk in the landscape[14]." Similar approaches are being implemented by other organisations, based on the same principles – e.g., as outlined in the Flood Green Guide framework of the World Wildlife Fund (2017).

What is meant by landscape?

Here, landscape is not merely a geographical area, but a whole socio-ecological system within a geographic area. It can contain natural or modified ecosystems (including urban areas), its people, economic and livelihood activities and cultural practices.

The key features of the landscape approach are:

1. Placing communities at the center of risk assessments and taking into account all actors within the landscape.
2. Examining the entire landscape in which risks originate and manifest themselves and not just the site.
3. Understanding the hydrology of the landscape / watershed.
4. Integrating ecosystem management and restoration with DRR and manages trade-offs.
5. Being flexible to future changes and embracing uncertainties, which demands a long-term perspective.

   (Source: Care Nederlands and Wetlands International, 2017)

The landscape approach and related concepts are based on the premise that the environment and society are interlinked and impact upon one another in space and time. Thus, the landscape approach encourages looking at multiple risks in a broader landscape or a watershed, understand how that affect communities and collaboratively develop risk management methods, giving priority to non-structural and nature-based measures.

Therefore, the landscape approach for wetland management, is about looking at the wetland in the context of the landscape surrounding it, including the different stakeholders involved. This allows for example to understand how upstream events (e.g. deforestation) can impact a wetland site downstream, by for example increasing sedimentation and flooding.

14. Care Nederlands and Wetlands International. (2017). A Landscape Approach for Disaster Risk Reduction in 7 steps. Care Nederlands and Wetlands International. Available at https://www.wetlands.org/publications/

Concept 2: Adaptive Management

Factors requiring constant improvement necessary in a management process:

1. Incremental changes over time (e.g. ecological succession, population growth, economic growth).
2. Unanticipated changes (e.g. sudden disasters, civil strife, economic crises).
3. Emergence and proliferation of new technologies and management practices (i.e. GIS / Remote Sensing based tools becoming common, emergence of automation-based tools).
4. Emergence of new management concepts (i.e. shift from top down management to community-based management of natural resources).

To cope with such changes, an adaptive management approach is required. In simple terms, adaptive management is managing a system, while learning from the process and adjusting. It can also be thought of as in systematic ways 'learning by doing.' There are two important characteristics of adaptive management: 1) managing under conditions of ongoing uncertainty, 2) learning from systematic testing (Rogers and Macfarlan, 2020)[15]. The process can be conceptually presented by the diagram in Fig 10.

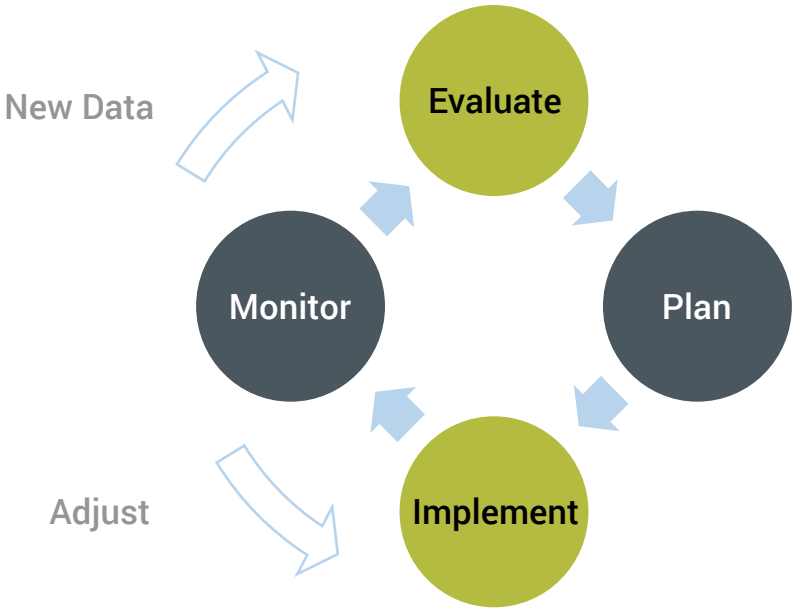


Figure10: *Conceptual diagram of stages in adaptive management (Adapted from - Rogers and Macfarlan, 2020)*

Adaptive management is now indispensable in any ecosystem or natural resource management program including wetland management, because of the deep uncertainties posed by climate change and other socio-economic factors. It is also required by the fast pace of development in science and technology. This is especially relevant to management of wetlands which provide ecosystem services for hazard regulation.

This guideline does not provide a comprehensive description or tools for adaptive management. There is a large body of resources on adaptive ecosystem and natural resources management that wetland managers can draw from.

15. Rogers, P. and Macfarlan, A. (2020). What is adaptive management and how does it work? Monitoring and Evaluation for Adaptive Management Working Paper Series, URL: https://www.betterevaluation.org/sites/default/files/MandE_for_Adaptive_Management_WP2_What_Is_AM_%26_how_does_it_work_202009.pdf

Climate change, uncertainty and increasing disaster risks to wetlands

Global climate change refers to long-term shifts in temperatures and weather patterns worldwide. Some of these changes are natural but since 19th century, human activities have been the primary driver of climate change. Burning of fossil fuels, and release of heat trapping gasses such as carbon dioxide to atmosphere is the leading cause of atmospheric warming. It is now well established that climate change is causing an increase in both intensity and frequency of natural hazard driven disasters. The Sixth Assessment Report of Intergovernmental Panel on Climate Change (IPCC) (2022) stated that even a low warming scenario (i.e. 1.5 - 2^0C increase in global average atmospheric temperature), would lead to a "severe and pervasive" risk of water-related disasters.

As discussed in the previous sections, the past three decades have seen an exponential increase in hydrometeorological (water-related) disasters incidents. Especially, cyclones and floods have not only become more frequent but more severe. Hurricane Katrina which hit the US southeast coast in 2005, Cyclone Haiyan that affected the Philippines in 2013, India's Uttarakhand floods in 2014 and 2021 floods in Central Europe were among the worst in recorded history. The challenge faced by disaster managers with climate change is not merely the increase in frequency and magnitude of certain hydrometeorological hazard events, they are also becoming more unpredictable. The conventional belief in engineering and disaster management that hazards such as floods or cyclones could be predicted with some level of certainty has been shattered with climate change. The notions such as '50-year flood or '100-year storm' have largely lost validity. It has become important to understand that 'uncertainty' is something with which we have to live. This does not mean that we are passively accepting uncertainty and leaving things to fate. The task is to incorporate uncertainty to disaster management plans which take into account various risk scenarios and the actions that are required in each context, or a 'Risk-based Approach.'

Wetlands have been identified as an ecosystem type that are very sensitive to climate change. Resolution VIII.3 of the Convention on Wetlands - "Climate change and wetlands: impacts, adaptation and mitigation (2002)" recognized the potentially serious implications of climate change and called upon the Contracting Parties of the Convention to manage their wetlands in such a way as to increase their resilience to climate change and extreme climatic events (The Convention on Wetlands, 2002)[16]. Temperature and precipitation changes and extreme whether events driven by climate change, impact both individual species and habitats and cause changes to wetlands' ecological regimes. Ultimately, such changes will lead to altered wetland functions and reduction in the ecosystem services provided by the wetland. A systematic methodology to assess the vulnerability of a given wetland to climate change was developed by the Convention on Wetlands in 2011 (Gitay *et al*, 2011)[17].

Furthermore, Ramsar Resolution X.24, also identified that wetlands provide ecosystem services relating to climate change mitigation and/or adaptation (The Convention on Wetlands, 2008)[18]. In addition to reducing the intensity of certain hazard impacts, as mentioned above, these may include capturing and storing carbon dioxide over long periods, reversing the effects of fossil fuel burning and mitigating climate change (Fig 11). Therefore, proper planning of wetland management and maintaining wetland ecological functions are needed for both climate change mitigation and adaptation.

As mentioned above, wetlands and other ecosystems are not immune to climate change. Impacts of climate change on wetlands and other ecosystems will mean that their ability to provide DRR-related ecosystem services will be reduced. For example, mangrove dieback due to climate related impacts will reduce their ability to break waves and dissipate the energy of storm surges. Climate scientists suggest that beyond a temperature increase of 2^0C the ability of ecosystems to regulate hazards will no longer be effective[19]. Therefore, while improving the management of wetlands for better DRR services and climate adaptation, broader global efforts to mitigate global warming and climate change are essential.

16. The Convention on Wetlands. (2002). *Resolution VIII.3: Climate change and wetlands, impacts, adaptation, and mitigation*. 8th Meeting of the Conference of the Contracting Parties to the Convention on Wetlands Valencia, Spain, 2002

17. Gitay, H., Finlayson, C.M. & Davidson, N.C. (2011). *A Framework for assessing the vulnerability of wetlands to climate change.* Ramsar Technical Report No. 5/CBD Technical Series No. 57. Ramsar Convention Secretariat, Gland, Switzerland & Secretariat of the Convention on Biological Diversity, Montreal, Canada. ISBN 92-9225-361-1 (print); 92-9225-362-X

18. The Convention on Wetlands. (2008). *Resolution X.24: Climate change and wetlands.* 10th Meeting of the Conference of the Parties to the Convention on Wetlands, Changwon, Republic of Korea, 2008.

19. Intergovernmental Panel on Climate Change (IPCC). (2022). Climate Change 2022: *Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*

Carbon Stores

Providing natural carbon capacity eg., mangroves, seagrasses, peatlands

Capturing CO2

Enhancing carbon dioxide capture in natural wetlands through restoration efforts especially. peatlands



Storm Shields

Reducing the risks of and impacts from extreme events

Coastal defense

Reducing the effects of sea level rise by establishing a coastal natural defense system

Climate Regulators

Fulfill increased need for local climate regulation

Figure 11: *Wetland ecosystem services in mitigation and adaptation to climate change*

Box 2: CASE STUDY 2 - Impact of Gaja cyclone and the issues related to mangrove recovery in Muthupet, Tamil Nadu, India[20]



In 2018, Cyclone Gaja made a landfall near Vedaranyam in Tamil Nadu, India with a maximum wind speed of about 120 km/hr causing extensive damage to the mangroves of Muthupet. The mangroves provide livelihoods for many surrounding villages. Extreme events of this nature increasingly occur along the East coast of India due to the impacts of climate change. They can impact the wetland ecosystems (mangroves in this case), reduce the wetland ecosystem services and increase the vulnerability of the stakeholder communities. M S Swaminathan Research Foundation, Tamil Nadu, conducted a GIS-based analysis to estimate the loss of vegetation due to Cyclone Gaja and the recovery time. It found that even after three years about 120 hectares (ha) of mangroves were not able to recover. Generally, the dense mangroves have the ability to recover within two years as the damage is only in the canopy. In Muthupet, the mangroves in Maravankadu were regenerated artificially through canal method. Dense mangroves were found only along the canals and the mangroves in between the canals were less and sparse. Only Suaeda sp. were found. This illustrates importance of restoring the mangroves with proper tree density and species diversity for better resilience against the increasing hazards induced by climate change.

There are some approaches that are useful in managing wetlands in a changing climate and rising hazards:

Ecosystem-based Adaptation (EbA): The use of biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse effects of climate change (SCBD, 2009)[21]. The core elements of EbA are: 1. The use of biodiversity and ecosystem services 2. To help people 3. Adapt to climate change 4. As part of an overall climate adaptation strategy.

Nature-based Solutions (NbS): Actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human wellbeing and biodiversity benefits[22]. NbS are dependent on the ecosystem services provided by healthy ecosystems. They are carefully planned and designed to address major societal and environmental challenges like climate change, DRR, food and water security, biodiversity loss and threats to human health.

20. CASE STUDY 2 (Case-study author: R. Nagarajan, S. Punitha and R. Ramasubramanian - M S Swaminathan Research Foundation, India)

21. Secretariat of the Convention on Biological Diversity (SCBD). (2009). Connecting biodiversity and climate change mitigation and adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Canada: Technical Series No. 41.

22. https://www.iucn.org/our-work/nature-based-solutions



2

DRR GUIDELINES FOR WETLAND MANAGEMENT

Unsplash/Kyle Glenn

Introduction

This section (Part 2) provides a step-by-step guideline on how to incorporate DRR considerations into wetland management using the concepts discussed in Part 1. It is based on the phases of the Wetland Management Cycle as outlined by the Ramsar guidelines. Fig. 12 gives the specific DRR actions / interventions applicable in the four stages of the Wetlands Management Planning Cycle, which will be elaborated in the following sections. The steps are explained in relation to the management of a hypothetical scenario called 'Fresh-Green Wetlands'. The guidelines were validated by consulting wetland managers from Asian countries during a workshop in 2022 undertaken by the Ramsar Regional Center - East Asia (RRC-EA) Asia and UNEP.

Hypothetical Scenario

Fresh-Green Wetlands



Fresh-Green Wetlands is a tropical coastal marsh (1,200 ha), in the Aqua River watershed. The river enters the wetland from the north-west direction and the southern edge of the wetland is the coastline, overlooking the Indian Ocean. The blue river watershed receives >2,000mm rainfall per annum, mainly during the monsoon season, May-September. Annual floods are experienced in the lower reaches along with several cyclones every monsoon.

Fresh-Green Wetlands gets flooded annually, which is an essential part of its growth cycle and faunal breeding cycles. It has been calculated that they can retain up to 5.5 million cubic meters water during a peak flood and substantially reduce the velocity of the flood waters and waves during cyclones. During the dry season, there is a potential of bush fires in the forest reserve adjoining wetlands. It has been assessed the wetlands can attenuate floods up to 1.2 meters (m) above mean sea level (msl) and storm surges up to 2 m height above msl.

Eighty percent of the wetland extent is grass dominated habitat with half-bog soils, which retain flood waters and maintain the sheet-flow hydraulic patterns beneficial for flood attenuation. Twenty percent of the extent in the periphery of the marsh is scrub (small tree) habitats with silty soils, which act as energy breakers during storm surges.

There are two villages, Alpha (400 families) and Beta (1,200 families), in the vicinity of Fresh Green Wetland in the north and the township of Omega (2,000 families) in the west. The two villages acquire many ecosystem services from the wetland including cultivation, fishing and different food items. However Alpha village, having been built in a flood plain, often gets flooded. This is also partly due to increased siltation generated by Beta Village's deforestation and its slash and burn agriculture means that bush fires are exacerbated. There is a high level of urban poverty in Omega, with both houses and infrastructure in poor conditions. Beta is an old village with traditional resilient practices, and strong community organisations. In the past two decades, climate change has caused an increased summer peak temperature by 1.2 C^0 and fires have become more frequent. The cyclones and high floods have also become more frequent. Two super cyclones hit the area in 2013 and 2019 causing massive damage to Omega. It has been assessed that storm surges beyond 4 m and floods above 2 m msl, can cause extensive erosion and destruction of vegetation that cannot recover within a single growth season.

Steps for incorporating DRR principles in Wetland Management

As described by multiple guidelines of the Convention on Wetlands[23], management planning of a Ramsar Site includes two key phases – 1) Site Designation and 2) Site Management. The steps in identification and management of important wetlands are equally applicable to all wetlands, regardless of their designation status. Therefore, the steps and strategies discussed in this guide on incorporating Eco-DRR to Ramsar Site management also have general applicability to other wetlands.

Wetland site designation: **Identification of wetlands of international importance, assessment of ecosystem services and formal designation.**

Incorporation of Eco-DRR principles in wetlands management should start at the designation phase. Wetlands which have capacity to reduce the disaster risks of specific hazards such as floods or tidal waves should be identified for conservation (or as Wetland of International Importance in designated Ramsar Sites). Maintaining wetlands for DRR can be defined as their wise use, and a basis for designating under the wise use criteria. Also, in assessing wetland ecosystem services during the designation stage, it is important to consider the ecosystem services related to hazard regulation, DRR, and livelihood-related services that support disaster recovery. Ramsar Handbook 1 – "Wise Use of Wetlands" (Ramsar Convention, 2007) clearly identifies the importance of wetlands in DRR. The publication: "Rapid Assessment of Wetland Ecosystem Services – A Practitioner's Guide", published by the RRC-EA in 2020a, formally recognized the flood hazard and storm hazard regulation services of wetlands in its assessment framework.

Wetland site management: **site description, planning, management & monitoring, and evaluation & review.**

There are many specific steps that can be taken to incorporate Eco-DRR in wetland management. As discussed in previous sections, there is a large variety of potential Eco-DRR measures. For their best effectiveness, it is important to understand how to incorporate DRR into the various stages of wetlands management development:

- The wetland site description stage will require incorporating an assessment of the hazard regulation potential in the 'wetlands value and importance assessment.' When assessing the 'threats to the site' the impact of hazards, and climate vulnerability should be considered.
- During the planning stage, important steps include aligning wetlands management plans with national disaster management and Climate Change Adaptation (CCA) policies, and engaging disaster management authorities in wetlands management committees.
- Both planning and monitoring stages require including measures for DRR and CCA in wetlands management. For example, this includes synchronizing wetlands management and monitoring protocols with early warning systems and prediction mechanisms in the relevant countries and regions (e.g. flood prediction, cyclone warning, tsunami alerts) and preparing environmental contingency plans for such disruptions.

  (See Figure 12)

23. Ramsar Regional Center – East Asia. (2020a). Wetland Management Planning – A practitioner's guide. Available at www.rrcea.org
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Steps in incorporating DRR in the Wetland Management Cycle

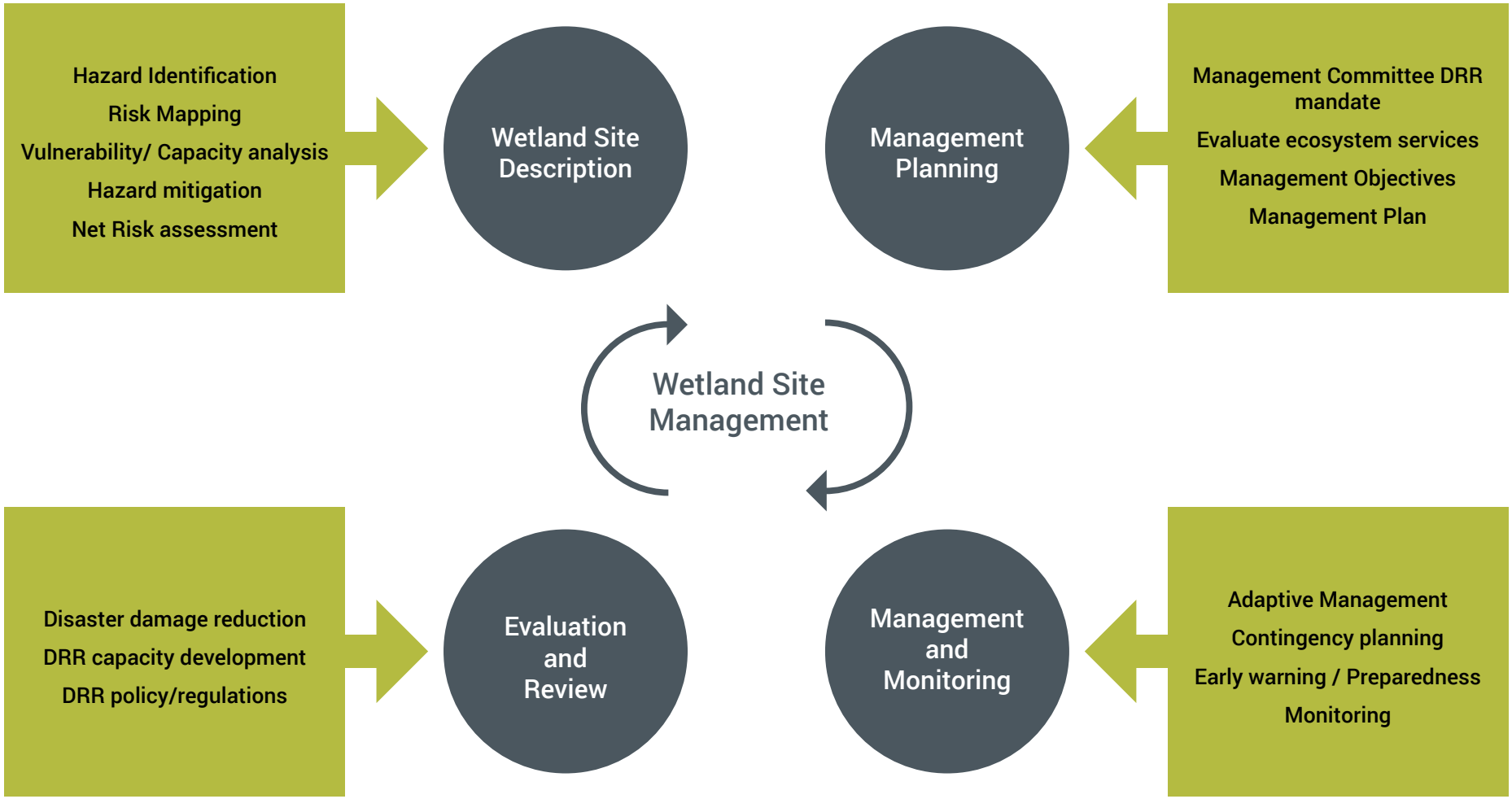


Figure 12: *Incorporating Eco-DRR steps into Wetland Management Planning Cycle*

Site Description

Preparing the wetland site description is the first step in planning the management of a wetland site. As given in the Ramsar Site Designation and Management Guidelines[22], the wetland site description has three sub-steps: 1) ***Acquiring/providing preliminary information,*** 2) ***Assess the wetland value/importance,*** 3) ***Assess the threats to the site.*** Assessing the wetland values and ecosystem services that contribute to reducing the disaster risks in a landscape and the hazard-related threats to a wetland ecosystem are important steps in incorporating DRR during the wetland site description process.

The first step is to understand the disaster risks in broader landscape or the watershed where the wetland is located. As discussed in the previous sections, disaster risk is the potential for damage created by hazards occurring in a landscape, the vulnerability of the communities in the landscapes, and the capacities of communities and ecosystems to cope with the hazards. Therefore, identifying the disaster risks associated with a wetland site involve four steps:

1. Identifying the hazards and threats in the landscape/watershed;
2. Assessing the vulnerabilities and capacities of the communities to the hazard;
3. Assessing the ability of the wetlands to mitigate hazards;
4. Assessing the net disaster risks to your wetland site and associated communities.

Step 1.1: Identify the hazards and threats

Collect the following data using Worksheet 1:

1.1.1 List the hazards that affect the wetland and the surrounding community: **Worksheet 1 column A.**

1.1.2 List whether the hazards impact only the site or also the surrounding landscape: **Worksheet 1 column B.**

1.1.3 List the intensity and frequency of the hazard, taking into account climate change forecasting: **Worksheet 1 column C.**

1.1.4 List the threats to the ecology of the wetland: **Worksheet 1 column D.**

There are numerous methods for hazard identification:

- Community / traditional knowledge (community consultation, community mapping);
- Expert opinions;
- Past data (e.g. flood levels, rainfall, wind speeds) and news records;
- Hazard maps (e.g. flood hazards maps, landslide hazard maps);
- Hazard modelling (e.g. flood hydrographs, flood probability density curves, climate models).

Please see Annex 1 for more information on these hazard identification methods and how to organize your data.

22. Ramsar Regional Center – East Asia. (2017). The Designation and Management of Ramsar Sites – A practitioner's guide. Available at www.ramsar.org and www.rrcea.org

Step 1.2: Create a Risk Map

1.2.1 Prepare a map of your wetland site within the wider landscape to ensure you capture the watershed (see principle 9 on IWRM). Consider how your wetland interacts within other geographical and environmental features within the watershed. The map can be hand drawn or built as a 3D model with local communities or created through GIS software.

1.2.2 Highlight areas where **hazards** impact the wetland site and surrounding landscape **(see worksheet 1, columns A and B)**.

1.2.3 Highlight areas where **threats** impact the wetland site and surrounding landscape **(see worksheet 1 column D)**.

1.2.4 Highlight areas were populations and assets are particularly vulnerable to **hazards**.

Features that should be included in your map (Fig. 13)

- Elevation;
- Constructed features: e.g. houses/villages/towns, major roads;
- Natural features: e.g. rivers, forest areas;
- Agricultural areas.

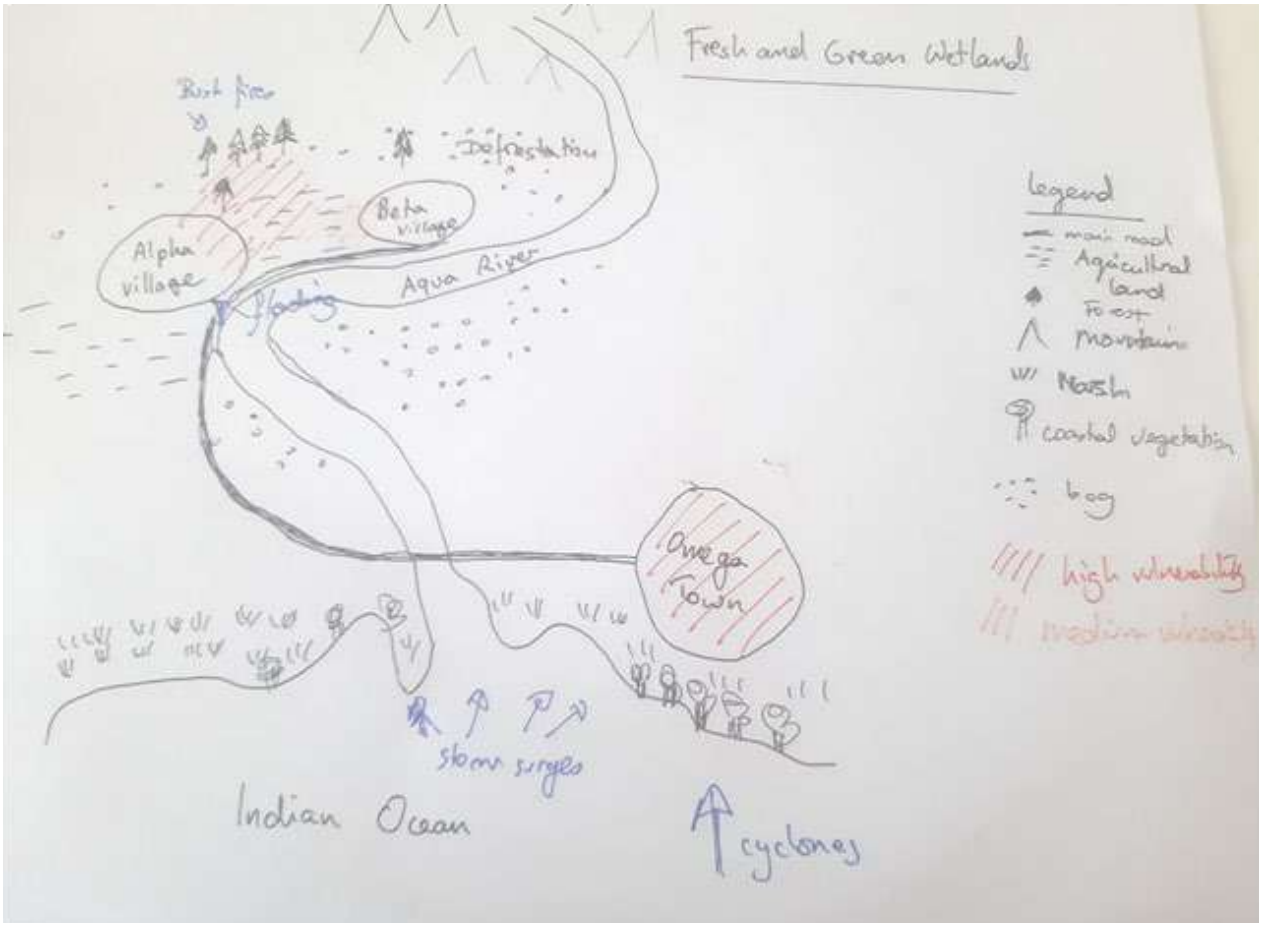


Figure 13: *Example Risk Map*

Step 1.3: Assess the wetland's ability for mitigating hazard impacts

Collect the following data using Worksheet 1:

1.2.1. Using RAWES[25], determine the state of the wetland for mitigating hazard impacts: **Worksheet 1 column E0.**

1.2.2. List the reasons for the wetland's ability for mitigating hazards: **Worksheet 1 column E1.**

1.2.3. List the reasons for the wetland's reduced ability for mitigating hazards, if applicable: **Worksheet 1 column E2.**

Step 1.4: Assessing the vulnerabilities and capacities

Collect the following data using worksheet 2:

1.3.1. List the vulnerabilities of the communities to the hazard identified: **Worksheet 2 column F.**



Types of vulnerabilities to consider

- *Physical factors;* e.g. poor design and construction of buildings, unregulated land use planning, etc.
- *Social factors:* e.g. poverty and inequality, marginalisation, social exclusion and discrimination by gender, social status, disability and age, psychological factors, etc.
- *Economic factors:* e.g. fragile informal economies, vulnerable rural livelihoods, disruption of markets, etc.
- *Environmental factors:* e.g. poor environmental management, depletion of natural resources, decline of risk regulating ecosystem services, climate change, etc.

1.3.2. List the capacities of the stakeholder communities to address identified hazard impacts: **Worksheet 2 column G.**



Some sample questions which may be helpful in capacity assessment.

- Does the community have defined strong organizations (e.g. farmer organizations, village committees) to deal with an emergency or implement DRR measures?
- Do individuals and/or organizations have sufficient resources to cope with a hazard (e.g. household income, local government budgets, Community-Based Organization (CBO) resources)?
- How good is common knowledge about hazards and preparedness?
- How strong are the social networks (e.g. family networks, religious organizations)?

Step 1.5: Assess the net disaster risks

1.5.1. Assess the net disaster risks: **Worksheet 2 column H**



Use all of the information collected so far to assess net disaster risks.

Following are the essential guiding questions that can be useful in assessing net risk in the landscape:

1. What is the potential damage that can be caused by the identified hazards to communities and wetlands?

2. How will potential damage be reduced by the hazard protection functions provided by the wetlands?

3. To what extent does community vulnerability make communities susceptible to damage and what capacities do they have to mitigate them?

4. How will uncertainties such as climate change affect the potential hazard impacts?

5. What is the remaining likelihood of hazard impacts when all the above factors are considered?

25. RRC-EA (2020b) Rapid Assessment of Wetland Ecosystem Services: A Practitioner's Guide. Ramsar Regional Center - East Asia, Suncheon, Republic of Korea http://rrcea.org/rawes-practitioners-guide/?ckattempt=1

Worksheet 1: Hazards identification and assessing the threats to wetlands sites and abilities to mitigate hazards using the Fresh-Green Wetlands Example

Type of Hazard (A)	Do they occur in the wetland site/ landscape? (B)	Intensity & frequency (Consider Climate Change forecasts) (C)	Threats to the wetland system (D)	Wetland's ability to mitigate hazard impacts (E)		
				RAWES score (E0)	(+) Ve (E1)	(-) Ve (E2)
Example: Riverine floods	Yes, Flooding occurs on site, also affects surrounding Alpha Village	Annual flood 1.25 m >2 m floods have occurred 2 times (2012, 2017) last 10 years There is an increase in extreme floods in the last 30 years.	Road constrution along the eastern boundary of the wetland. Deforestation is causing siltation.	+	Holds flood water, and protects surrounding Beta Village and Omega town from inundation in annual floods. Reduces flood water velocity, reducing the probability of damage to nearby settlements and infrastructure in Omega town.	Road construction along the eastern boundary of the wetland has changed hydrological patterns. May affect the flood mitigation ability. Deforestation is increasing flood risk for Alpha town.

Some common hazards associated with wetlands: Riverine floods, flash floods, groundwater floods, landslides, mudflows, tidal waves, droughts, fires, sea erosion, cyclones, tsunamis.

Worksheet 2: Vulnerability, Capacity and Risk Assessment using the Fresh-Green Wetlands Example

Type of hazard and location (Col. B – Worksheet1)	Vulnerabilities of stakeholder communities (F)	Community capacities to cope with hazards (G)	Risks to the communities (H) (Consider Col. E – Worksheet1)
Example: Riverine floods Affects the site and Village Alpha	High poverty among >30 % of the families in Alpha Village. Poor quality buildings in Omega township. Health conditions are poor. Many families depending on cultivation in the wetlands.	Good flood preparedness mechanism for annual floods (<1.25 m) within the community in Beta village. Strong farming organizations.	Risk of property damage from extreme floods. Potential ecological transformation can impact wetland-based livelihoods. Both can further increase poverty within the community in Alpha.

Incorporating DRR in Wetland Management Planning

Adding DRR to the management stage of the wetland management cycle (Fig 12) involves including DRR stakeholders in the development of the management plan. Use the information from the DRR assessment to evaluate the importance of wetland features/services and the impacts to these to formulate management objectives.

Step 2.1: Inclusion of DRR stakeholders in cross-sectoral wetland management committees

Cross-sectoral wetland management committees (CSWMCs) can play an important role in incorporating DRR into wetland management planning.

2.1.1 Invite DM organizations (e.g. district disaster management committees, humanitarian organisations, community organisations such as village cyclone preparedness committees) to participate in CSWMCs



Increasing DRR impact at your site and in your country (see Annex II for an example)

Step 1. Understand the existing DM local and regional/ national policies and programs pertaining to the site

Although the DM policy framework of a given country can be vast to be fully studied while developing a wetland management plan, it is important for the wetland managers to get a basic understanding of the main provisions. One good approach, as discussed above, is to invite a representative from the DM sector to join cross-sectoral wetland management committees (CSWMC). In most countries, the national DM agencies are represented at the regional administrative offices or local government. Wetland managers can also invite a regional DM officer to develop an awareness program on the DM structure of the country and locality prior to developing the wetland management plan. It is important to understand DM policies, regulations, and programs:

- Some DM measures are mandatory;
- Avoid duplicating measures that are already implemented by the DM agencies;
- Benefit from DRR measures already in place.

Step 2. Integrate DRR measures planned for the site with broader DRR measures in the landscape.

When incorporating DRR into wetland management plans, wetland managers should both try to benefit from the existing DM programs in the country and the area, and also contribute to those programs through the activities in their site.

In combining Eco-DRR with broader DRR measures, it often becomes necessary to compare and prioritize between them. Prioritizing non-structural measures first, soft measures second and hard-engineering last, is a useful principle. However, more advanced comparison might be needed when the projects become larger.

Step 3: Engage stakeholders and communities to build Eco-DRR awareness.

Use the communication, capacity building, participation and awareness (CCPA) programme to build awareness and capacity of communities on Eco-DRR. Co-design Eco-DRR activities with communities from the very beginning. (See Step 2.6)

2.1.2. Include DM and DRR related issues to the regular agenda of CSWMCs. The disaster management-related stakeholders can lead the task of incorporating DRR activities into wetland management planning.

Step 2.2: Evaluate the importance of wetland ecosystem services and benefits

2.2.1 Using the information reported in worksheets 1 and 2 and the risk map, next, wetland managers should evaluate and confirm the importance of the wetland ecosystem services and benefits identified.

This should be undertaken with full community engagement especially when assessing the socio-cultural values and benefits. To incorporate DRR into the evaluation stage, the following questions can be added to the evaluation criteria (Table 2):

Table 2: Incorporating DRR features and benefits to the evaluation criteria

Questions	Evaluation criteria
Ecosystem Services and Benefits	
Does the wetland regulate the identified natural hazards in the landscape?	How is the wetland providing protection against the identified hazards and where? What is the level of hazard reduction provided by the wetland? Factors impacting the wetlands' ability to produce the required service?
Ecological Components and Processes	
Are the wetlands sensitive to the disturbance caused by the hazards in the landscape?	Scale of the hazards that may cause ecological disturbances (e.g. 6 m flood level, saltwater intrusion, >100 Km/hr winds) What are the potential damages caused by these hazards?

2.2.2 If necessary, update **worksheet 1** after the evaluation.

2.2.3 Complete **worksheet 3** to organize the information on potential impacts of the hazards to the wetland, other (anthropogenic) threats to the wetland.

2.2.4 Complete **worksheet 4** on wetland ecosystem services that mitigate hazards and conditions to maintain them.

Worksheet 3: Threats to the sites using the Fresh-Green Wetlands Example

Hazard and affected areas (Col. B – Worksheet1)	Potential impacts of the hazard to the wetland site	Other threats to the wetland site (Col. D – Worksheet1)
Example: Riverine floods Affects the wetland site and Alpha Village	The site is resilient to annual floods, essential for growth cycles /water birds. Extreme floods (>2 m) can cause silting, erosion in marsh habitats, pollution and invasive species.	High risk of reduction of water holding capacity due to silting during extreme floods (>2 m) and overall ecological transformation due to pollution and invasive species brought by flooding.

Worksheet 4: Hazard protection services and conditions to maintain them using the Fresh-Green Wetlands Example

Hazard protection ecosystem service (Col. E – Worksheet1)	What is the ideal condition for provision of this service?	What are the factors that can change this service?
Holds flood water (5.5 million cu. m), and protects Villages Alpha and Beta from annual floods up to 1.2 m. Dissipates energy and reduces velocity of storm surges during cyclones, protects Villages Alpha and Beta from storm surges up to 2 m.	Flood attenuation: grass-dominated habitats and half bog soils in the inner marsh areas, holds flood water. Storm surge attenuation: Scrub vegetation habitats absorb energy from the storm surges. Ecosystem is stable over time to maintain the right balance of marsh and scrub wetland habitats.	High risk of reduction of water holding capacity due to silting during extreme floods (> 2m) and overall ecological transformation due to pollution and invasive species brought by flooding.

Step 2.3: Formulate Management Objectives

2.3.1: Formulate management objectives for DRR in wetland management

There can be two types of objectives in incorporating DRR into wetland management. Which type to utilize depends on your needs:

1. To maintain and enhance the protection provided by the wetland against hazards.
2. To protect the wetland from the potential damage by hazards.

Based on Worksheets 3 and 4, we can prepare the following DRR-related management objectives:

Objective 1: "Maintain the ecosystem conditions required for natural attenuation of floods (<1.2 m) and storm surges (<2)".

Objective 2: "Minimize the damage to the wetland and Villages Alpha and Beta by floods >1.2 m and storm surges > 2 m".

Use Ramsar Handbook 18 for a refresher on how to set management objectives and prepare an action plan.

Step 2.4: Prepare the Management Action Plan

2.5.1 List the management objective (s): **Worksheet 5 Column A**

2.5.2 Describe the ideal ecosystem conditions to achieve the management objective (s): **Worksheet 5 Column B.**

2.5.3 List the actions required to achieve the ideal ecosystem conditions for meeting your management objectives: **Worksheet 5 Column C.**

Actions can be routine or emergency-related

A **routine action** is something that is undertaken to achieve your management objectives under normal circumstances.

An **emergency action** is undertaken after a hazard event.

Worksheet 5: Developing action items using the Fresh-Green Wetlands example

Objective (A)	Ideal Conditions (B)	Actions (C)	Monitoring (D)
Objective 1: "Maintain the ecosystem conditions required for natural attenuation of floods (<1.2 m) and storm surges (<2)".	Zero encroachment or conversion of the wetland. 80% of the wetland extent grass habitats and bog soils. Tree density of 120 trees per ha in scrub habitats and silty soils. Ambient water quality conform to national standards.	Review and strengthen the legal protection against encroachment and conversion of the Tall Roots mangrove – e.g. obtaining protected area status, proper demarcation. Allocate staff to enforce legal protection – e.g. recruit park rangers. Collaborate with communities and other stakeholders to reduce water and solid waste pollution in watershed – e.g. disconnect the sewage lines.	Weekly field inspections identify any encroachment or clearing of trees. Monthly water quality testing according to a monitoring plan based standard procedure. Annual survey of watershed conditions involving community volunteers. Annual ecological survey to assess the diversity, richness and health of the mangroves.
Objective 2: "Minimize the damage to the wetland and Villages Alpha and Beta by floods >1.2 m and storm surges > 2 m".	Habitat damaged due to floods/ storms regenerating in a single growth season. No permanent species loss or erosion in the wetland. No major personal risks (deaths, injury, diseases) or property damage in the villages Alpha and Beta.	Protection of fish and crustacean species which support mangrove health. Replanting programs in areas damaged by storm surges, if they are unlikely to recover in a single growth season. Replenishment of sediment and restoration for areas severely eroded by storm surges Early warning system to inform and evacuate (if necessary) villages H and J, in case of > 2m storm surges. Conducting flood and cyclone preparedness training for villages Alpha and Beta.	Conduct post-event situation assessment in the wetland after flood/ cyclone. Annual ecological survey to assess the diversity, richness and health of the mangroves. Annual assessment of early warning system and flood/ cyclone preparedness programs.

Note that some of these actions and monitoring requirements might be met by other management objectives for protecting different wetland features and ecosystem services. There can be an overlap of objectives and activities in a wetland management plan.

Step 2.5: Include communication, capacity building, participation and awareness (CEPA) - related DRR actions in the wetland management plan

CEPA strategies are equally useful in incorporating DRR into wetlands management.

Following are some CEPA activities that can support DRR:

- Engaging the DM-related stakeholders of CSWMC when preparing the CEPA plan at the management planning stage and also during implementing, monitoring and evaluation of those activities.
- Communicating the importance of maintaining healthy wetlands and watersheds for reducing disaster risks to the public and targeted communities. Understanding the role of wetlands in DRR can gain broader support for wetlands conservation among communities. CEPA activities such as wetland visitor centers and guided tours can be used to build this improved understanding.
- Building awareness and strengthening the wise use strategies for DRR in wetlands. Doing this in a participatory approach will raise disaster resilience among stakeholder communities of the wetland site and broader landscapes. For example, this may include promoting cultivation or fishing practices that are beneficial to wetland ecological features as well as mitigating hazards.
- DM agencies can use the wetland CEPA strategies and mechanisms in place, such as wetland education centers, community education programs and events to build better disaster awareness and preparedness among communities.

Management and Monitoring

Step 3.1: Essential steps for adaptive management

When a wetland management plan has been completed based on steps described above, it is expected to be strong and resilient. However, no plan can be static over time and would need constant adjustment and improvements. Wetland managers should strive to achieve active adaptive management where conscious and active effort is put to monitoring and learning.

3.1.1 Educate CSWMCs about the importance of adaptive management.

3.1.2 Schedule at least bi-annual meetings with DM agencies to understand recent hazard patterns, get their recommendations for the management plan.

3.1.3 Schedule regular discussions on monitoring outputs within the wetland management team and CSWMCs, to adapt any minor changes required in the activities.

3.1.4 Conduct periodic community meetings or consultations to discuss any trends or concerns identified through monitoring regarding DRR.

3.1.5 Carefully compile 'lessons learned' through monitoring and above stakeholder / community engagement to be presented at the periodic evaluation sessions to review management plans.



Tips for enhancing adaptive management

- Strive to understand the changing conditions in the wetland and the broader landscape.
- Be alert to the advancement taking place in science and technology,
- Take into account the broader political, social and policy changes that may impact the management process.

Step 3.2: Plan for contingencies

Why plan for contingencies

Being prepared for potential future disruptions to the site management process is an important step of wetland management planning. Potential significant events that can cause disruptions to normal management activities are called "contingencies." Contingencies may arise due to sudden and in some cases unanticipated social, political, economic reasons (e.g. wars, insurgencies, economic crises), or by hazard events.

Planning for contingencies related to hazard events is a key component of integrating DRR into wetland management planning. Contingency planning is different from incorporating regular DRR measures in the management plan, where we assume that hazards and their impacts are reasonably predictable. As discussed in above sections, all efforts should be made to predict the frequency and the nature of the hazards and the scale of impacts to the best possible extent. However, such prediction are always approximations.

There are uncertainties about all natural hazards that cannot be fully forecasted. For example, seasonal rainfall, flood levels, intensity of cyclones and widely deviate from the predictions. When such deviations occur, the regular DRR measures will not be adequate to prevent those hazards from becoming disasters.

The most important thing about contingency planning for DRR is to accept that hazards can be uncertain and cannot be always accurately predicted. Through contingency planning, we strive to reduce the risks of "not knowing." This is known as a "risk-based approach."

3.2.1 Consider what aspects of a hazard are most uncertain and list these: **Worksheet 6 Column A.**

3.2.2 Consider how can such deviations disrupt the wetland management process and regular DRR measures: **Worksheet 6 Column B.**

3.2.3 Consider what are the potential community impacts of these disruptions: **Worksheet 6 Column C.**

3.2.4 Consider what are the potential impacts on the wetland ecosystem: **Worksheet 6 Column D.**

3.2.5 Identify the measures that can be taken to reduce disruptions or mitigate these impacts: **Worksheet 6 Column E.**

3.2.6 Identify what resources are required for these measures: **Worksheet 6 Column F.**

Worksheet 6: Planning contingency activities using the Fresh-Green Wetland example

Regular DRR measures in the Management Plan for the Fresh-Green Wetland are designed to sustain the wetland to provide protection for average floods (<1.2m) and storm surges (2m) and to support the ecosystem and the communities to cope with moderately larger floods and storm surges. The management plan is not equipped to cope with extreme events (floods> 2m or surges >4m). Contingency planning is required to cope with such events.

What are the uncertainties? (A)	Disruptions (B)	Community impacts (C)	Ecosystem impacts (D)
Storm surges exceeding 4m	• Wetland cannot mitigate surges >2m • DRR measures are designed for surges up to 4m	Alpha and Beta villages can become vulnerable to damage.	Replanting and restoration planned for <4m surges may not be sufficient for full recovery.
Flash floods due to extreme storm event	• Some DRR activities are planned only for riverine floods.	Livelihoods of Alpha and Beta communities can be severely disrupted.	Disruption of ecosystem management activities due to silt and garbage brought in by flash floods.

Contingency measures (E)	Activities / Resources (F)
Obtain cyclone/flash flooding warnings in advance.	Work with Meteorology Agency to obtain advance warnings.
Prepare to evacuate Alpha/Beta communities during surges larger than 4m.	Work with Disaster Management Agency to include J and H in their evacuation plans.
Obtain additional resources and staff to expedite restoration work after severe surges.	Coordinate with other wetland management committees to exchange resources (including staff) during contingencies.
Provide emergency support to fisher families to continue their livelihoods in case of extreme storms.	Approach government/non-governmental agencies to secure finances for contingency livelihood support fund.

Step 3.3: Monitoring

Alongside regular monitoring and the monitoring identified for your action plan (worksheet 5) collect monitoring on:

3.3.1 Hazard events (e.g. rainfall, wind speeds, water levels) either collected on-site or obtained from DM agencies.

3.3.2 The conditions of DRR measures in place within the site (e.g. evacuation paths, early warning systems, temporary flood barriers).

3.3.3 Budgeting and institutional functioning of the DRR activities.



Use Ramsar Handbook 13 for a refresher on monitoring.

Following questions provide a basic framework to prepare a monitoring plan:

A. What do you want to know through monitoring?

B. What are the exact parameters to be measured quantitatively or evaluated qualitatively to answer the monitoring questions?

C. Can the monitoring data be obtained from external sources or collected on-site?

D. If sourced externally: Where to get the data? Which organizations to partner with?

E. If collected on-site: How to measure or evaluate the parameters and frequency of monitoring?

F. Who will conduct the monitoring (wetland management staff, external experts, community monitoring)?

G. What are the resources required to conduct monitoring (e.g. cost of data (for external), staff time, fieldwork costs, equipment)?

Evaluation and Review

In the evaluation and review phase, there are no additional specific tools or procedures to incorporate DRR. Different regions, organisations and managers may use different evaluation methods. Therefore, this guide will not go into details of evaluation techniques. However, wetland managers must ensure that DRR-related issues are considered during the evaluation and review processes. Following are some guiding questions to include DRR in evaluation criteria:

1. Is there a net reduction in disaster-related damage to the communities or the wetland site?
2. If there is a net reduction, what DRR-related actions in the management plan have contributed to this reduction?
3. If there is no reduction or a net increase, what actions were ineffective?
4. What other environmental/climate/socio-economic factors may have contributed to an increase?
5. What are the additional benefits created by the DRR-related actions implemented in the period other than disaster reduction?
6. Has there been an increase in the capacity of wetland managers to cope with hazards and disasters associated with wetland sites?
7. Has there been an increase in the capacity and awareness of wetland communities to better cope with hazards and disasters?
8. What are the future plans for improving DRR-related capacity among wetland managers and stakeholder communities?
9. What are new DRM legislation, regulations, and practices, that have been introduced during the evaluation period?
10. Are there any specific steps taken to integrate these new institutions to the wetland management process?



Unsplash/Ashley Inguanta

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Annex I: Data collection for hazard identification

Methods for hazard identification

1. Community/traditional knowledge (community consultation, community mapping).
2. Expert opinion.
3. Past data (e.g. flood levels, rainfall, wind speeds) and news records.
4. Hazard maps (e.g. flood hazards maps, landslide hazard maps).
5. Hazard modelling (e.g. flood hydrographs, flood probability density curves, climate models).

Any combination of these methods could be used to identify the hazards. Starting with news records, past data and hazard maps will be the most cost-effective. Hazard maps are usually prepared by disaster management agencies or relevant technical agencies and can be acquired easily in many countries. Past records related to hazards (e.g. rainfall, wind speed, flood levels) are recorded by different technical agencies such as meteorological bureaus or irrigation departments. Hazard trends identified from historical data or maps can be verified by consulting experts and local communities knowledgeable about the hazards in the areas. Traditional or local knowledge can be gathered through various methods such as surveys, key informant interviews, focus group discussion and community mapping. In hazard identification, it is also important to keep in mind that intensity and frequency of hazards change substantially due to climate change.

Community mapping is a very powerful participatory tool to capture local/traditional knowledge. It helps to bring out instinctual knowledge within communities and present it in a visual and defined manner. In community/participatory hazard mapping, a group representing a good cross-section of the given community could be invited to a workshop where they map the landscape, mark where potential hazards can occur. Other information such as natural resources, and infrastructure can be included in the same map. It is very important that all social groups are engaged in a participatory mapping exercise (e.g. all genders, ethno-religious groups, youth, elderly, different education levels), as perceptions of hazards and risks are different among them.

Predicting hazards using calculations or models can be costly. They are however very useful when large investments have to be made for disaster risk reduction and sophisticated project planning (e.g. feasibility studies, cost-benefit analysis) is required. Identification of hazards includes not only tracking their occurrence, but also understanding the potential magnitude of the hazards such as potential flood levels, and inundation areas.

Table A1:1: Methods, Parameters and Data-Sources for Hazard identification and Risk Modelling

Hazard identification methods	Examples for parameters	Sample Information and Data Sources
Past data and news records	flood levels, rainfall, wind speeds	https://reliefweb.int/disasters https://www.preventionweb.net/knowledge-base/hazards/flood
Hazard maps	flood hazards maps, landslide hazard maps	https://www.geonode-gfdrrlab.org/layers/?limit=5&offset=0 https://www.ospo.noaa.gov/Products/ocean/tropical.html https://www.ospo.noaa.gov/Products/atmosphere/rain.html
Hazard and Risk modelling	flood hydrographs, flood probability density curves, climate models	http://www.bom.gov.au/waterdata/ https://www.dhigroup.com/business-applications/dhi-floodrisk

Annex II: Example of combining DRR methods

[A hypothetical example adapted from WWF's "Flood Green Guide" (WWF, 2017)]



To protect the township of Omega from floods, the Disaster Management Authority is planning a flood control dam in the mid-reaches of the Blue River watershed. The original plan was to build a dam with a reservoir area of 5 sq. km., impounding 100 million cubic meters of waters. This will cause acute environmental and social issues, such as inundation of forest land, biodiversity loss and having to relocate a traditional village of 50 homesteads. Environmental organizations in the watershed and the wetland managers of the Fresh-Green wetland site developed an alternative plan to complement this hard-engineering method with Eco-DRR measures. They suggested implementing a soil and vegetation conservation program in the upper watershed and restoring the currently degraded areas of the Fresh-Green Wetlands.

The upper watershed conservation project will improve the permeability of upstream areas and reduce the run-off flowing into the dam. Restoration of the Fresh-Green Wetland, which is in the Blue River flood plain near the Omega town, will provide more water holding capacity and reduce the inundation downstream of the dam. With these two Eco-DRR measures, the engineers calculated that the dam size can be reduced to a 1 sq. km reservoir with 20 million cubic meter impoundment. Forest inundation was much less, and there was no need to relocate the traditional village. Part of the money saved from downsizing the dam could be allocated to the Eco-DRR measures and no additional funding was needed.



In addition to the flood reduction benefit, upper watershed conservation helped to regenerate the upper-montane forest cover in the watershed by 25%. It provided livelihoods in forest product collection and tourism. The new wetland management plan will restore an additional 300 ha of marshland adjacent to Fresh-Green Wetlands and is expected to contribute to the rejuvenation of the wetland while providing additional nesting and roosting grounds for migratory birds. Fifty hectares were also converted into a wetland nature park, serving the recreational needs of the Omega town population.

Wetlands and Disaster Risk Reduction:
A Guide for Wetland Managers

This guide provides an introduction to the interconnectivity between natural hazards, disasters and wetlands. It outlines the key steps for integrating Disaster Risk Reduction (DRR) with wetland management, to reduce hazard impacts to wetland ecosystems and the associated communities by promoting the approach of Ecosystem-based Disaster Risk Reduction (Eco-DRR).