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CASE STUDY

Upscaling community resilience through Ecosystem-based Disaster Risk Reduction in Indonesia

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EXECUTIVE SUMMARY

Since 2019, the United Nations Environment Programme (UNEP) in-collaboration with Partners for Resilience (PfR) have developed and implemented scalable Ecosystem-based Disaster Risk Reduction (Eco-DRR) models, working alongside various governments and their respective communities in strengthening their capacity and shaping Eco-DRR policy interventions.

This case study highlights Eco-DRR interventions in Indonesia focused on peatland restoration, conservation, and sustainable management. The key risk being addressed within this context is the fact that degraded peatlands are prone to fire and subsidence, and the latter results in prolonged flooding. To address this, the project aims to increase community resilience towards peat fire and peat subsidence, as well as enabling sustainable development through the implementation of Eco-DRR practices in peatland ecosystems in Indonesia. Specifically, the project seeks to increase the adoption of Eco-DRR practices in peatland ecosystems that contribute to increasing community resilience.

A model for upscaling community resilience has been developed through three core components of Eco-DRR: Ecosystem Restoration/Protection, Disaster Risk Reduction, and Climate Smart Livelihoods. In Indonesia, there is a greater emphasis on DRR through the combined peatlands and fire management approach. The project also employs the concept of Integrated Risk Management (IRM) which integrates ecosystem management and restoration with Climate Change Adaptation (CCA) and DRR. The project implemented peatland restoration activities through Rewetting, Revegetation and Revitalisation (3R) of livelihoods with capacity strengthening and policy dialogues for DRR in peat ecosystems. For the community development process, an innovative financing mechanism called Bio-Rights is applied to create an incentive for the community groups to conduct peatland restoration and its sustainable management, while advocating for peatland management through national training guidelines. 27 CBOs have been trained on Eco-DRR and 4,505 beneficiaries have been reached, of which 49% are women. A Cost-Benefit Analysis (CBA) performed by the University of Massachusetts Amherst demonstrated that the benefits of Eco-DRR and resilience enhancement interventions outweigh the value of their initial costs.

This case study lays the foundation for demonstrating the need for large-scale implementation of Eco-DRR in advancing the implementation of the Sendai Framework for Disaster Risk Reduction and the Sustainable Development Agenda. The content for this case study has been developed by the United Nations Environment Programme (UNEP) in collaboration with Partners for Resilience (PfR) – a global alliance between the Netherlands Red Cross, the Red Cross/Red Crescent Climate Center, Cordaid, Wetlands International, and CARE along with partner civil society organisations in the countries where they work.

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LIST OF ACRONYMS

BRGM	National Peatland and Mangrove Restoration Agency
3R	Rewetting, Revegetation and Revitalisation
CBA	Cost-Benefit Analysis
CBOs	Community-based Organisations
CSOs	Civil Society Organisations
CCA	Climate Change Adaptation
DG-INTPA	Directorate General for International Partnerships
DRR	Disaster Risk Reduction
EC	European Commission
EUR	Euro
EWS	Early Warning Systems
Eco-DRR	Ecosystem-based Disaster Risk Reduction
GDP	Gross domestic product
GHGs	Greenhouse gases
GIS	Geographic Information System
Ha	Hectares
IDR	Indonesian rupiah
IRM	Integrated Risk Management
KHG	Peat Hydrological Unit
PfR	Partners for Resilience
PNV	Present Value of Net Benefits
SMEs	Small- and medium-sized enterprises

INTRODUCTION

This case study documents the experiences, results, and lessons learned from the Ecosystem-based Disaster Risk Reduction (Eco-DRR) project undertaken by Wetland International in Indonesia with funding from the Directorate General for International Partnerships (DG-INTPA), European Commission (EC). The objective is to upscale community resilience through Eco-DRR activities in selected areas of Indonesia. The project was implemented from May 2019 to June 2022 in two villages: Muara Manompas and Terapung Raya of South Tapanuli district in Northern Sumatera. These areas were selected because they experience frequent prolonged flooding, peat fires, and land subsidence due to desiccated peatlands that are prone to fire. The frequent and massive fires caused by peatlands over-drainage effect millions of hectares and cause enormous economic damage and human suffering (particularly health impacts and loss of livelihoods). As most peatlands are located in tidal and lowland areas, subsidence will often lead to increased and prolonged flooding of these areas, ultimately resulting in loss of productivity and abandonment. This will enhance fire risks in the dry season, increase poverty, and reduce resilience of the communities that cannot go elsewhere.

Overall objective: Increase community resilience towards peat fire and peat subsidence, as well as enabling sustainable development through the implementation of Ecosystem-based Disaster Risk Reduction (Eco-DRR) practices in peatland ecosystems in Indonesia.

Specific objective: Increase the adoption of Eco- DRR practices in peatland ecosystems that contribute to increasing community resilience.

Project expected outcomes:

1. Communities and households receive grants and set up projects and businesses that incorporate (innovative) sustainable peatlands use.
2. (local) government actors are capacitated to support local communities in developing and implementing concrete proposals that apply community tenure rights and land use plans.
3. Civil society and (local) government actors are capacitated to support local communities in developing and implementing concrete proposals that apply community tenure rights and land use plans.
4. The Partners for Resilience (PfR) Indonesia country team has demonstrated the effectiveness of sustainable peatland management to reduce disaster risks to Civil Society stakeholders and governments at local, national, regional, and global level in a resource package that consolidates good practices and facilitates the replication and scaling up of the Eco-DRR approach.

Danau Toba, North Sumatra, Indonesia.
Photo Credit: Unsplash/Dio Hasibuan

INDONESIA PROJECT LOCATION

The project was implemented in two villages: Muara Manompas and Terapung Raya of South Tapanuli district in Northern Sumatera.

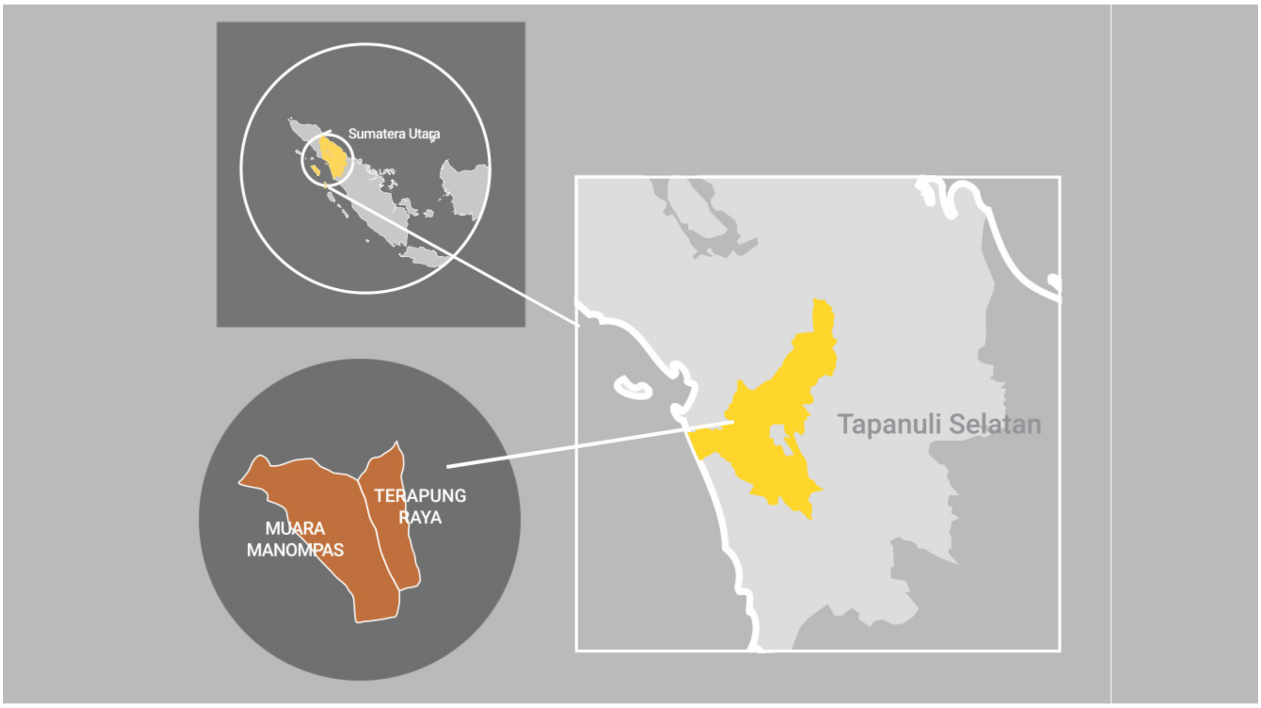

Table1: *Expected results/targets.*

Number of community-based / local level organisations that have been trained to implement Eco-DRR activities	15
Number of hectares of ecosystems restored or protected as a result of Eco-DRR field project implemented	50
Number of people who are benefiting (directly or indirectly) from community-based model of Eco-DRR field project	750

Key Implementing partners: Wetlands International Indonesia, village and sub district authorities, police and military forces, district level authorities (Development planning Agency), Disaster Management Agency, Agricultural and Fishery Agency), Provincial Development Planning Agency, National Development Planning Agency, Ministry of Environment and Forestry, National Disaster Management Agency, and Peatland and Mangrove Restoration Agency.

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Rationale

Indonesia has approximately 21 million hectares of peatlands and hosts the biggest tropical peatland area in the world. Peatlands provide enormous amounts of benefit to humans and are essential to biodiversity.

1.1 Drivers of Risk

Indonesia has approximately 21 million hectares of peatlands and hosts the biggest tropical peatland area in the world. Peatlands provide enormous amounts of benefits to humans and are essential to biodiversity. They have a significant role in water storage, and in the regulation of the water cycle, and in the storage of carbon, and thus play an important role in climate change mitigation. Simultaneously, peatlands contribute to sustainable livelihoods such as wood, latex, food, herbs, etc. However, they are mostly in degraded condition, mainly due to the development of massive palm oil and pulp wood plantations that have taken place over the last 30 years. Indonesia's palm oil plantation and processing industry is a key industry for the country's economy. The export of palm oil provides substantial revenues, and the industry provides employment opportunities to millions of Indonesians. In terms of agriculture, palm oil is the country's most important commodity, contributing to about 3.5 percent of the nation's GDP. In 2020, Indonesia produced almost 55% of palm oil globally and provide jobs for about 16 million workers in Indonesia. The pulp and paper industry also plays a role in the Indonesian economy: Indonesia is ranked ninth largest pulp producer in the world and sixth largest paper producer. On the labour side, the pulp and paper industry absorb 260,000 direct workers and 1.1 million indirect workers. Indonesia is highly competitive in the world market due to cheap labour and high productivity land area.

Dried peatlands are prone to fire, resulting in frequent and massive fire events that impact millions of hectares. Fire is however not a natural process in this ecosystem and would not occur on peat soils that are permanently saturated with water. The peat carbon oxidation resulting from drainage for agriculture and plantation industries result in major GHG emissions, contributing to over 650 million tCO2 per annum (or 50% of Indonesia's total anthropogenic emissions per year) without fires.

Another social and economic matter is the fact that the development process in peat ecosystems is conducted without taking into account the needs of local communities. These plantations and associated downstream productions have provided jobs for migrant workers. However, the associated economic development is mostly providing employment for uneducated workers without many employment opportunities beyond the plantation industry, hence keeping communities in a poverty trap. Large-scale industrial plantations also compete for land with local communities, causing numerous conflicts over land rights in peatland landscapes. This reinforces poverty, which makes these communities more vulnerable to climate change.

The main source of livelihood for people on peatlands is working on oil palm plantations. Initially, the management of oil palm plantations still used the fire system to clear the land. But now the tradition of burning land has begun to phase out, and a process has begun to build ponds to prevent fires.

The west coast of Sumatra is the last stronghold of Sumatran peat. Unlike on the east coast, peat on the west coast is only found in a few places, one of which is in South Tapanuli. The area of peat in South Tapanuli reaches 6,051.80 ha (*BBSDLP-Balai Besar Sumber Daya Lahan Pertanian*- Center for Agricultural Land Resources, 2018), which is included in 1 Peat Hydrological Unit, namely the Aek Sibirong and Aek Batangtoru, with an area of 3.907.96 ha of protected ecosystem functions and 12,802.79 ha of non-conservation functions. About 82% of the peat is located in non-forest areas, while the rest is in production forest areas (18%). Approximately 70% of the peatlands in South Tapanuli District are in the private concession area, most of which is planted with palm oil plantations. The rest of the area is also dominated by a palm oil plantation that is being managed by the community.

The current observation shows that palm oil cultivation in peatland area of South Tapanuli is costly and more difficult. The area is wet or inundated during the wet season and vulnerable to fire during the dry season. Peat fires often occurred in the dried peat areas. Smallholder/community often lack capital for purchasing fertiliser and other chemical inputs. Much of these substances will be washed into rivers during the wet season. Additionally, many palm oil trees have already leaned or collapsed because of peatland subsidence, and the productivity is also low. This shows the real picture of the impact of unsustainable peatland management that jeopardises the community's resilience and their livelihood.

1.2. Strategies for Addressing Drivers of Risk

The approach used in the project is the Integrated Risk Management (IRM) concept, which integrates ecosystem management restoration with Climate Change Adaptation (CCA) and Disaster Risk Reduction (DRR). The project combined peatland restoration activities through **Rewetting, Revegetation and Revitalisation (3R)** of livelihoods with capacity strengthening and policy dialogue for disaster risk reduction in peat ecosystems. For the community development process, an innovative financing mechanism called **Bio-Rights** is applied to create incentives for the community groups to conduct peatland restoration and its sustainable management.

Rewetting is the main priority in the restoration of peatlands. Peatland is formed from organic materials that are not completely decomposed and are accumulating because it is in a fully water-saturated state. Almost 90% of peat weight is water. Drainage activity causes peatland ecosystem degradation and makes it fragile towards other environmental pressures. To repair the damage, peats should be timely rewetted. To have these activities effectively implemented, rewetting activities should be conducted before the peat reaches the non-drainability limit, or the condition when the peat cannot be drained anymore. Several methods can be applied for rewetting activities, such as constructing dams in the drainage canals (canal blocking), closing the canals and ditches completely, or creating water reservoirs.

Revegetation is the second element of peat restoration. Aside from natural revegetation, it can be conducted through implementing paludiculture, which is a system of cultivating or utilising native peat swamp plants on wet or re-wetted peatlands in a sustainable way to increase land productivity and restore the environment. The main goal is to use the land in such a manner that peat degradation, greenhouse gas emissions, and nutrient losses are significantly reduced or avoided. This can be achieved when naturally high water tables are restored and native peatland plants that can grow under permanently wet conditions are used. For centuries, the local population has cultivated native species of peatland crops, such as *sago* (starch for noodles and cookies), *rattan* (for furniture), *galam* (for pole-wood and medicinal oils), *jelutung* (for rubber), *tengkawang* (illipe nut, for vegetable oils), and purun grass (for thatching and basketry). Wetlands International Indonesia has identified at least 28 native plant species that have potential for commercial uses in Indonesia. In paludiculture, communities need to re-gain ownership of their land and take responsibility for its sustainable management, providing equal opportunities for both women and men. Above all, paludiculture aims to provide cash, herbal medicens and food security, building materials and reduce disaster risks; all while preserving peatland and providing ecosystem services such as biodiversity, carbon storage, and water regulation.

The third element of peatland restoration is a **revitalization of livelihoods**. Switching to sustainable economic alternatives is a simultaneous action that needs to be undertaken to stop further peatland degradation, while it is being restored. In this element, much support will be required in the form of technical advice, research, community organization, management advice, post-harvesting (value added, market chain), and funding (including grants and micro-finance) to cover opportunity costs, risks, and investment needs. Therefore, the project implements this element through bio-rights mechanisms. **Bio-rights** is an innovative concept of sustainable development for conserving valuable but vulnerable ecosystems, along with poverty alleviation. It allows protecting the environment by compensating communities living in and dependent on these ecosystems for cash-generating/livelihood activities. Communities are being compensated for peat conservation and peat fire prevention activities by providing loans that can be turned into grants once the community successfully conducts those activities. The project assists the members of the community in using the loan to develop alternative sustainable livelihood.

Awareness raising, capacity strengthening, and policy dialogue on disaster prevention are important elements in the Eco-DRR project. This element becomes an additional yet important activity of the above-described 3R approach. Awareness raising is conducted with both the local communities and the companies about the adverse effects of peatland drainage for palm oil and pulp wood plantations. Capacity strengthening activities included peat fire prevention, peat fire management simulation, peat restoration, and sustainable livelihood trainings. Fire prevention measures comprised of constructing deep wells, monitoring water levels, establishing fire early warning tools , constructing peat monitoring towers and water reservoirs. At the end, for programme sustainability, policy dialogue activities are conducted to ensure that Eco-DRR is mainstreamed into local development planning agendas.

Mount Sinabung, Indonesia.
Photo Credit: Unsplash/Fikry Anshor

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Success Story

“Our protected and rehabilitated peatland saves us and our valuable trees from peat fire”

The peat fire was so difficult to suppress. When the peatland were burned, we were so frustrated about its adverse impact on our health and how to stop the spread of fires

- Polaria Derita Sianipar.

Polaria is a 50-year-old woman who lives in Muara Manompas, a village located in the peatland of Muara Batang Toru Sub District, South Tapanuli, North Sumatera Province. On a daily basis, she helps her husband take care of their 2 hectares of palm oil plantation, which is a source of their income. Year after year, she notices that the harvests are decreasing, and many of the palm trees are uprooted because of peat subsidence. On August 9th, 2020, there was a peat fire incident. The fire originated from the area adjacent to the palm oil concession zone. It lasted for 9 days, and burnt down at least 55 ha of peatland on village land. The location was not particularly close to her plantation; however, the fire could rapidly spread below the peatland and reach her plantation. At that time, Polaria and several women decided to join the the community groups in the peat firefighting.

Female members of the community groups participated in firefighting activities. Photo Credit: Didik Fitrianto/Wetlands International Indonesia.

In the framework of the Eco-DRR project, Wetlands International Indonesia is supporting 15 community groups in Muara Manompas and Terapung Raya Villages, South Tapanuli District, to restore degraded peat ecosystems and improve livelihood and build resilience.

The programme is focused on enhancing the community's capacities in preventing and mitigating peat fires, which is combined with the efforts to restore the peatland hydrology, by rewetting, replanting the native tree species, gradually phasing-out the palm oil cultivations, and revitalizing the community's livelihoods. Community groups were established and trained in monitoring water levels to anticipate and assess the risk of peat fires, as well as in preventing and extinguishing peat fires. The bio-rights mechanism was implemented in the project: communities received certain trainings and limited conditional loans for alternative livelihood activities, and they actively participate in the peat restoration initiatives. The community members take part in peat water level measurement and the construction of early warning tools, boreholes, and dip wells (peatland water surface monitoring well). The community groups are required to prepare the seedlings for re-planting the degraded peatland and nurture the tree nursery. In return, they will receive an interest-free conditional loan for sustainable-small scale business development to generate additional profits and improve their livelihoods. This loan will turn into grant once the community groups are able to prevent peat fires in the project location and ensures an 80% survival rate of planted native peat plants.

Community participation in those activities makes them eligible for signing the bio-rights agreement (conditional loan). In this agreement, the community groups agreed to implement 10 collective activities in setting up the peat fire monitoring system. For example, they will schedule peat patrols, Early Warning Systems, maintain dip wells and boreholes, continue water level monitoring, and nursery maintenance, including preparation of *Jelutong* plantation.

In time, the community proposed new initiatives. For example, in response to the peat fire incident in August 2020, the community proposed to construct 4 large canals in locations that are prone to fire, to ensure that the peat is rewetted and thus less prone to fire. Betel nut stems were used to construct the canal blockings. It is a local material that is abundantly available in the project location. Aside from benefiting local residents, the use of these materials reduces transportation cost.

Canal blocking developed by the community groups to effectively keep peatland hydrated. Photo Credit: Malikah Amril/UNEP.

As the lesson learned from the peat fire in August, cooperation with the other agencies and local authorities, including the police department and military forces, was felt necessary and strengthened through combined activities. The community groups managed to set-up and operationalise the community-based fire brigades that work together with each community group, managing a regular fire patrol in the area. Regular coordination meetings on fire prevention are also conducted. The local communities, using their own resources, also managed to build 2 peatland monitoring towers to detect possible fire outbreaks in the coming dry season. Since the fire incident in August 2020, there have been no more large-scale peat fires reported, as the patrol team handled hotspots early on.

Polaria Derita Sianipar, with her colleagues conducting Jelutong planting. Photo Credit: Vernando Maruli Aruan/ Wetlands International Indonesia.

Community groups voluntarily build the peat fire monitoring tower using their own resource. Photo Credit: Vernando Maruli Aruan. Wetlands International Indonesia.

In addition to peat fire prevention and peat rewetting activities, the community members also planted Jelutong seedlings for revegetation. Jelutong is known for its latex, which can be used as the material for chewing gum or other latex-based products. It is expected that the community can harvest the latex around 7 years after cultivation. In the meantime, another source of income for small-scale businesses are developed using the bio-rights fund. 15 small-scale businesses of different types already run individually or in groups. With an initial capital of 100 to 150 EUR/person at the first stage, the profit made from the business ranges from 40 to 320 EUR/month.

> *We are very grateful that we can preserve our peatland through this programme. The impact on us, on our land, which is protected from fire, we can now accumulate savings in the form of plants that we can harvest in the future, and from the loans we can start small businesses at home and increase our family income*
>
> - Polaria Derita Sianipar.

3

Main components and model

Development of 3R approach for peatlands management through bio-rights funds, while advocating for peatland management through national training guidelines.

3.1. Eco-DRR Components

Capacity Building

Capacity strengthening is conducted from the very beginning of the project by organising the local communities and facilitating the establishment of Community-based Organisations. The selection criteria and several restoration measures were developed by referring to the big picture of restoration planning using the baseline analysis that related to peat and hydrological conditions, biophysical and vegetation conditions, socio-economic status, and risk status. A series of community development meetings were conducted with the community groups to facilitate the development of each group, including their internal rules and workplans. A facilitator also assisted the groups to develop proposals to be submitted to the project for sustainable livelihood initiatives to be funded through the bio-rights contract.

The project has demonstrated the following results:

- 15 Community-based Organisations (CBOs) established, trained and actively engaged in peatland restoration through the bio-rights scheme. The project also trained an additional 12 CBOs on Eco-DRR.
- 2 community-based fire-brigade groups established and trained to monitor and respond to peat fires.
- The training topics included: Paludiculture, Disaster Management and peat fire prevention and simulation, Peatland ground water level monitoring, Canal blocking construction, Canal blocking maintenance, Aquaculture, Maggot Culture, Fish processing and, Finance and administrative reporting.

Field Implementation

Field implementation is divided into several phases as follows:

a. Baseline analysis and the development of a restoration plan

Baseline analysis was conducted prior to implementation and simultaneously with the stakeholder identification. The analysis included peat and hydrological assessments, biophysical, landcover, and vegetation surveys, and socio-economic and risk assessments. A total of 1.5 months field surveys, ground truthing, and GIS analyses were performed. The analysis elaborated on the existing condition of the project area and proposed recommendations for the restoration plan, such as the number and location for dams and canal blocking, the location, and size of the restoration area, the type of paludiculture species, the number and location for early warning system tools, boreholes, and deep wells. The study also provided several recommendations for (1) alternative livelihood to be developed; (2) measures for increasing capacity of community in managing disaster risks, and (3) policy/development process that needs to be interfered.

b. Constructing the key infrastructures

Several key infrastructures have been recommended by the baseline study, including dam/canal blocking, peatland ground water monitoring wells, early warning system tools, and boreholes. The project managed the construction process simultaneously with the establishment of community groups. At the end of the first year, 4 dams, 83 units of dip well, 4 units of borehole, and 21 units of EWS tools have been constructed. The project worked together with the local communities to design and build the infrastructure. For example, for canal blocking, betel nut stem was used as the main material, which is a local produce and widely available in the project area. This approach triggers more eagerness in the local community to collaborate with the project.

c. Bio-rights Contracts

Bio-rights is an incentive mechanism to provide micro-credits to community groups for a defined obligation of restoration work. The loan will be eventually turned into a grant when the groups meet all their obligations. Each group received a 75 million Indonesian rupiah (IDR) (approximately 5.000 EUR) loan disbursed in 3 tranches. The requirement for the grant disbursement is that each group should achieve a minimum score of 80 points. At the end of this project, the loan will turn into a grant if there are no peat fire incidents and the survival rate of planted paludiculture tree species reaches a minimum of 80%. The score is also based on execution of certain collective works by the established community groups.

d. Bio-rights contract monitoring and evaluation

Bio-rights monitoring and evaluation were conducted one month prior to disbursement of the funds. The final evaluation was conducted 2 months before the project closure in deciding whether the groups meet the criteria for turning loans into grants.

e. Community voluntary action

Aside from the activities listed in the bio-rights contract, this approach allows for collective and voluntary community actions. Since the group members received the incentive for achieving certain scores, they voluntarily conducted several activities to mitigate peat fire and maintained a high survival rate of paludiculture species.

The project has demonstrated the following results:

- 4,505 beneficiaries reached of which 49% are women.
- 708 people (50 percent women) from 150 households are engaged through bio-rights financial schemes. These grants enable households to engage in peatlands restoration and rewetting.
- 4 canal blocking/dams constructed for rewetting of degraded peatlands, including instalment of 83 dip wells for water level monitoring and evaluation of the rewetting effect
- 53 ha degraded peatland restored by rewetting and revegetated by replanting with native tree species through paludiculture for fire prevention
- 5 boreholes installed to provide water supply for fire-fighting activities
- 22 early warning system devices installed to alert communities on peat fire incidents.

Advocacy with government

Policy dialogue is conducted to further sustain project implementation once the project is completed. It is conducted through the participation of the community groups in the development planning meeting at village level. Internally, this participation will add to the score of the community groups in bio-rights contract monitoring. At the same time, this participation will further mainstream Eco-DRR measures into village development plans. Several community members actively express their aspirations to their village government. They proposed several activities, that are related to capacity strengthening in livelihood activities, peat fire prevention, and sustainable peatland management. However, these initiatives are postponed for next year. Because village funds at that time were mostly used for handling COVID-19 at the village level.

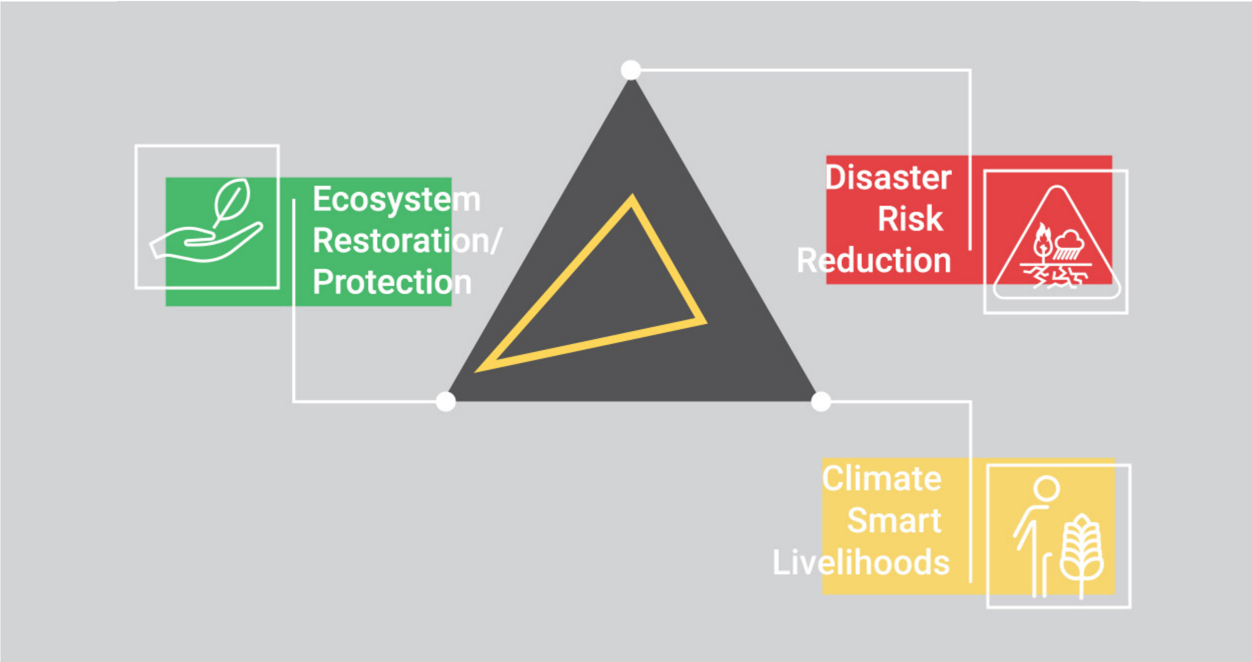
Another initiative with the Local Disaster Management Agency, aiming at developing community-based fire brigades was also undertaken. The brigades coordinate their work with the community groups, who conduct regular patrols and build the network with relevant peat prevention stakeholders and authorities at the district level. At the national level, dialogue has been conducted with the National Disaster Management Agency and the Peat and Mangrove Restoration Agency to further the upscaling and dissemination of the best practices into the relevant national programs.

The project has been successful in advocacy with the government, with the following results:

- Provided inputs to the environmental strategic assessment of midterm development planning of Tapanuli Selatan District on peat restoration.
- Advocated the integration of the Eco-DRR approach into national peatland management training programme. As part of these efforts a guideline manual on ‘Peatland Management without burning’ was developed in coordination with the National Peatland and Mangrove Restoration Agency (BGRM). BGRM will use this manual nationwide in their field farmer schools training on peatland management.
- Policy dialogues with village authorities conducted to allocate village government budgets for Eco-DRR measures and development of village regulation on sustainable peat restoration.

3.2. Indonesia Upscaling Model

Development of 3R approach for peatlands management through bio-rights funds, while advocating for peatland management through national training guidelines.



The model is demonstrated through sustainable peat management practices in community-owned peatland. Started with a proper baseline study and peat assessment, the project facilitated the community groups to organize themselves in developing peat restoration plan, reducing peat fire risks and increasing economic resilience's by their own.

To provide the financial incentive to the local communities in implementing the model, the bio-rights contracts were signed between the project and the community groups. Bio-rights is a financing scheme that ensures substantial engagement and participation of the local community in reconciling poverty alleviation and sustainable ecosystem management. This is conducted through the provision of conditional loans that will turn into grants when the community meets the agreed requirements of specific peatland conservation and restoration measures. This mechanism enables local communities to refrain from unsustainable livelihood practices, prevents further degradation, and directly involves them in peat restoration. The key components of this model include reducing drought and peat fire risks by restoring peatland ecosystems and enhancing the capacities of the local communities by using several restoration measures. The project also supported the community groups to further engage with the other local communities and mainstream the peat restoration activities into village and local government planning and budgeting. Similarly, this good practice has been advocated to the local Civil Society Organisations (CSOs) for further replications.

Ecosystem Restoration/Protection

- Peatland restoration through community-based 3R approach: Rewetting, Revegetation and Revitalisation.
- Paludiculture techniques are promoted through native peat species (e.g., Rattan, Jelutong and Sago).

Climate Smart Livelihoods

- Bio-rights financial schemes enable local communities to engage in more sustainable livelihood practices to prevent further degradation and directly involve communities in peatlands restoration.
- Implementation of training on native peat knowledge and sustainable livelihoods diversification in peat ecosystems.

Disaster Risk Reduction

- Peatland hydrological monitoring and water level management for preventing fires using early warning tools, boreholes, dip wells and canal blocking structures.
- Establishing and empowering community-based fire brigades to prevent, monitor and respond to peat fires.

3.3. Common roles or key issues to be considered

Peatland is a unique ecosystem requiring a landscape approach and interventions for its management. In this project, the landscape units are called Peat Hydrological Unit (KHG) and are based on large-scale hydrological characteristics. Each KHG covers large areas of intervention with different types of land use and involves a broad spectrum of actors and different authorities. Restoring the peat ecosystem requires a lot of resources, effort, and commitment. Therefore, enhancing collaboration among key stakeholders at different government administrative levels is essential for an effective and successful peatland restoration programme.

At the local level, peatland is usually underestimated in terms of size. Baseline and actual data are often inconsistent. The government's maps may have gaps between the official data and the factual findings in the field. The effort to improve data needs to be mainstreamed into local spatial planning and development agendas.

Most peatlands are used for plantations of oil palm trees or are located next to large private plantations. It causes a severe degradation of peatlands and drainage activities resulted in hotspots of fire occurrence. There is a regulation that obliges each company to develop its own peat restoration plan; however, many of them have not yet developed it.

In cases where peat areas belong to small holders (palm oil farmers), the community and village authority often pay little attention to peat restoration, due to a lack of awareness, knowledge, and capacity. Peat restoration is not a priority for the village-level authorities, and most of the village development funds are normally allocated for building infrastructure.

Due to erratic weather and climate patterns, the vulnerability to fire in degraded peatlands is increasing. Most degraded peatlands have low productivity and provide limited options for livelihood. The combination of unpredictable and more extreme weather events with low-productive peatland will prolong unsustainable use of this ecosystem and further expose the local communities to disaster risks.

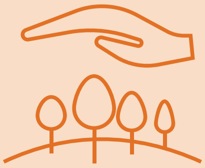
In the past, the restoration activities often neglected local communities' participation and ignored local and indigenous knowledge. This approach led to failure of the restoration project, lack of long-term effects and abandonment of peat restoration infrastructure by the local communities.

3.4. Scalable feature

This Eco DRR approach can be scaled up and applied to other areas with development of 3R approach using bio-rights scheme with these following actions:

- **Disaster Risk Reduction: Peatland hydrological monitoring:**

Peatland hydrological monitoring and water level management for preventing fires using early warning tools, boreholes, dip wells and canal blocking structures. Establishing and empowering community-based fire brigades to prevent, monitor and respond to peat fires.



- **Ecosystem Restoration/Protection: 3R Approach**

Peatland restoration through community-based 3R approach: Rewetting, Revegetation and Revitalisation. Paludiculture techniques are promoted through native peat species (e.g., Rattan, Jelutong and Sago) and mitigating peat drainage.

- **Climate Smart Livelihoods: Bio-right funds:**

Bio-rights financial schemes enable local communities to engage in more sustainable livelihood practices to prevent further degradation and directly involve communities in peatlands restoration.

Community-based peat fire monitor/fire brigade is essential in peatland restoration initiative:

- It plays an indispensable role in peat hydrological monitoring and identifying peat fire risks.
- It plays an essential role in patrolling and alerting local communities to the activities that could ignite peat fire
- It can extinguish fire early when it is still small and easier to manage.
- It can warn local communities of fire risks as results of hydrological monitoring
- Those critical actions will increase the likelihood of wet or hydrated peatland

How to scale up community-based peat fire monitor/fire brigade:

- Train these groups on hydrological monitoring and fire extinguishing
- Empower these groups to build community awareness on peat fire risks
- Empower these groups to advocate peat fire monitoring and extinguishing to village government
- Include technical and financial support for these groups in the annual village budget and plan

Supporting the fire brigade through bio-rights scheme with multi-year funding might not be feasible with the local government planning system. The local government budget is planned and allocated annually while peat restoration activities with bio-rights scheme requires longer period of planning and implementation (around 3-5 years).

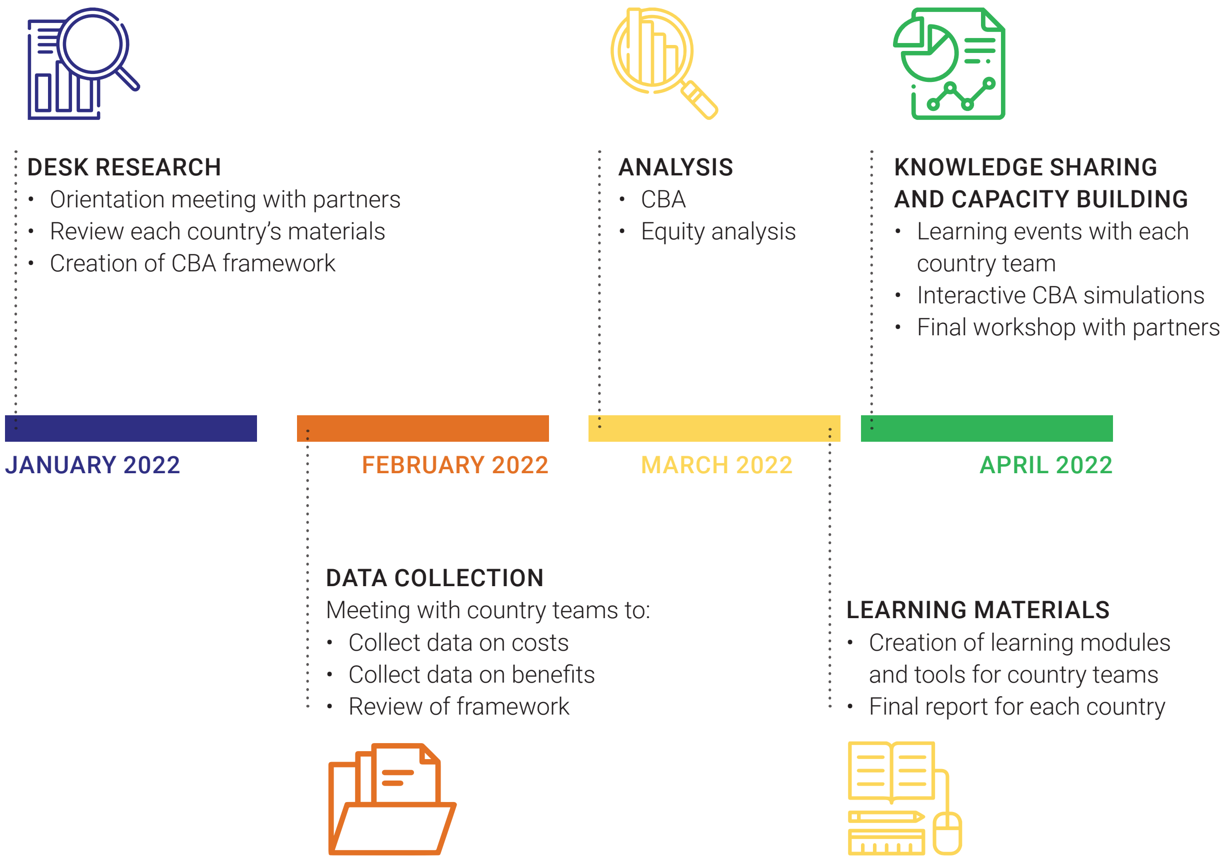
4

Eco-DRR Cost-Benefit Analysis (CBA) Study

This study was conducted when the project was still ongoing. The Eco-DRR interventions analyzed in this study, including the size of the target population and the extent of the ecosystems protected and restored have been evolved since then. The study presented the estimated economic net benefits of applying Eco-DRR approach.

4.1. CBA Methodology

The methodological approach adopted in this study includes five components: desk research, data collection, cost benefit and equity analysis, creation of learning materials, and knowledge sharing.



Overall project timeline and methodological approach for efficiency analysis (which includes a cost benefit analysis) and equity analysis

4.2. Strength, Limitations and Recommendations

The economic efficiency assessment of the project through a quantitative Cost- Benefit Analysis (CBA) and a qualitative analysis includes a vast array of non-monetary benefits too. The quantitative estimates show that the benefits of the Eco-DRR and resilience building interventions outweigh their implementation costs. The qualitative analysis complements these findings presenting a rich bouquet of long-lasting benefits associated with the three dimensions of the resilience triangle: DRR strategies, Ecosystem Management, and Sustainable Livelihood Practices. **This economic efficiency assessment is corroborated with an equity analysis providing a comprehensive overview of the distributional impacts of the intervention on different socio-economic groups.** The large amount of qualitative data and preliminary quantitative data provided by the country teams contributes to the strength and relevance of the analyses. Despite the tight time constraints, the country teams assisted the research team to the best of their abilities, often collecting new data from the field, thus laying the groundwork for possible future data collection efforts and analysis.

The analysis presented in this report is based on an approximation of the frequency and magnitude of fire hazard in the region. More precisely, the key figure relevant for the CBA is the yearly average of the economic impact of the damage due to fire hazard. The analyses assume that the local population experiences 2% yearly loss in properties and GDP per capita in the project area. This assumption is based on a conservative approximation of historical trends estimated in peer-reviewed studies (Kiley et al., 2021) and based on the data provided by the country team. Dry conditions and peatland fires are expected to worsen with climate change, therefore the CBA could be underestimating the benefits of peatland restoration. This would make an even stronger case in support of the Eco-DRR intervention. We performed robustness checks applying a 5% yearly loss in properties and GDP per capita in the project area and found similar results, available as supplementary materials. We assume that the Eco-DRR intervention will be able to reduce this risk and mitigate losses.

Ideally the CBA estimation performed in this study should consider:

1. Historical frequency (i.e., probability of occurrence) and magnitude of climatic extremes (i.e., El Nino and Climate Change) that may induce peatland fire in the project region, at least over 30 years;
2. Observed correlation between intensity of extremes (e.g., dry conditions) and damages to properties;
3. Observed correlation between intensity of extremes (e.g., dry conditions) and income losses.

Such data would allow us to better ground the value of the yearly economic damages due to climatic extremes into a robust statistical framework. Due to limited data availability the above components were not included in the analysis. Moreover, the short time available to complete the analysis did not allow us to collect primary data about these components.

Another variable that would need to be better estimated in order to strengthen the robustness of the CBA is the percentage of damage avoided due to the Eco-DRR intervention. Since the project is in its early stages, there is not ample empirical evidence of the protective power of the nature-based solutions implemented in the project area. Country team members indicated that since the beginning of the intervention (peatland restoration combined with early warning systems and fire monitoring) no fires have taken place. The estimation assumes that, starting in year 6 after the end of the project implementation, the Eco-DRR intervention can completely prevent the annual damage to properties and income losses. We adopted a conservative approach in assuming that until the 5th year after the end of the project implementation (included), while the ecosystem is maturing, there is progressive increase in benefits (i.e., 10% of benefits the first year, 20% the second year, 30% the 3rd year, 40% the 4th year and 50% the 5th year). This may lead to an underestimation of the benefits.

The quantitative analysis lays the foundation for a possible future broader CBA of the Eco-DRR intervention in this region. Recommendations for future research, if a longer time frame for data collection and analysis is possible, include the following: collect data related to the three components highlighted above and reproduce the CBA estimation; plan a rigorous data collection schedule in the project area to measure the observed efficacy of the local Eco-DRR interventions in limiting disaster risk. In five to ten years, the collected data could be used to perform an empirically rigorous project evaluation.

4.3. Scenarios

SCENARIO 1: Eco-DRR intervention

Benefits include reduction in property damages and income losses
Benefits **do not** include carbon capture and pollution reduction

SCENARIO 2:

Benefits include reduction in property damages and income losses
Benefits include carbon capture and pollution reduction

4.4. Results

SCENARIO 1: After **5 years** (at a 0.07 discount rate) - when benefits **do not** include carbon capture and pollution reduction, but do include reduction in property damage, and income losses - the present value of net benefits (PNV) is negative **24,137.64 USD**

After **10 years** the present value of net benefits is positive and equal to **149,876.31 USD**

SCENARIO 2: After **5 years** (at a 0.07 discount rate) - when benefits include carbon capture and pollution reduction, reduction in property damage, and income losses - the present value of net benefits (PNV) is **5,968.47 USD**

After **10 years** the present value of net benefits is **503,345.31 USD**

Assumptions

The Cost-Benefit Analysis framework adopts the following assumptions and specifications:

- The Present Value of Net Benefits (i.e., Net Present Value, NPV) is estimated over a time horizon of 10 years from the end of the project implementation.
- The full costs of the project implementation are paid only once in year 0, which corresponds to the end of the implementation.
- The ecosystem associated with the eco-DRR intervention (i.e., restored peatland) reaches maturity after 5 years.
- There is a 2% yearly loss in properties and GDP per capita in the project area (we also perform robustness checks with a 5% yearly loss, available as supplementary materials).
- Until year 5 included, while the ecosystem is maturing, there is a progressive increase in benefits (i.e., 10% of benefits the first year, 20% the second year, 30% the 3rd year, 40% the 4th year and 50% the 5th year).
- The ecosystem restored/protected by the eco-DRR intervention reaches maturity after 5 years, and starting in year 6 it provides full benefits.

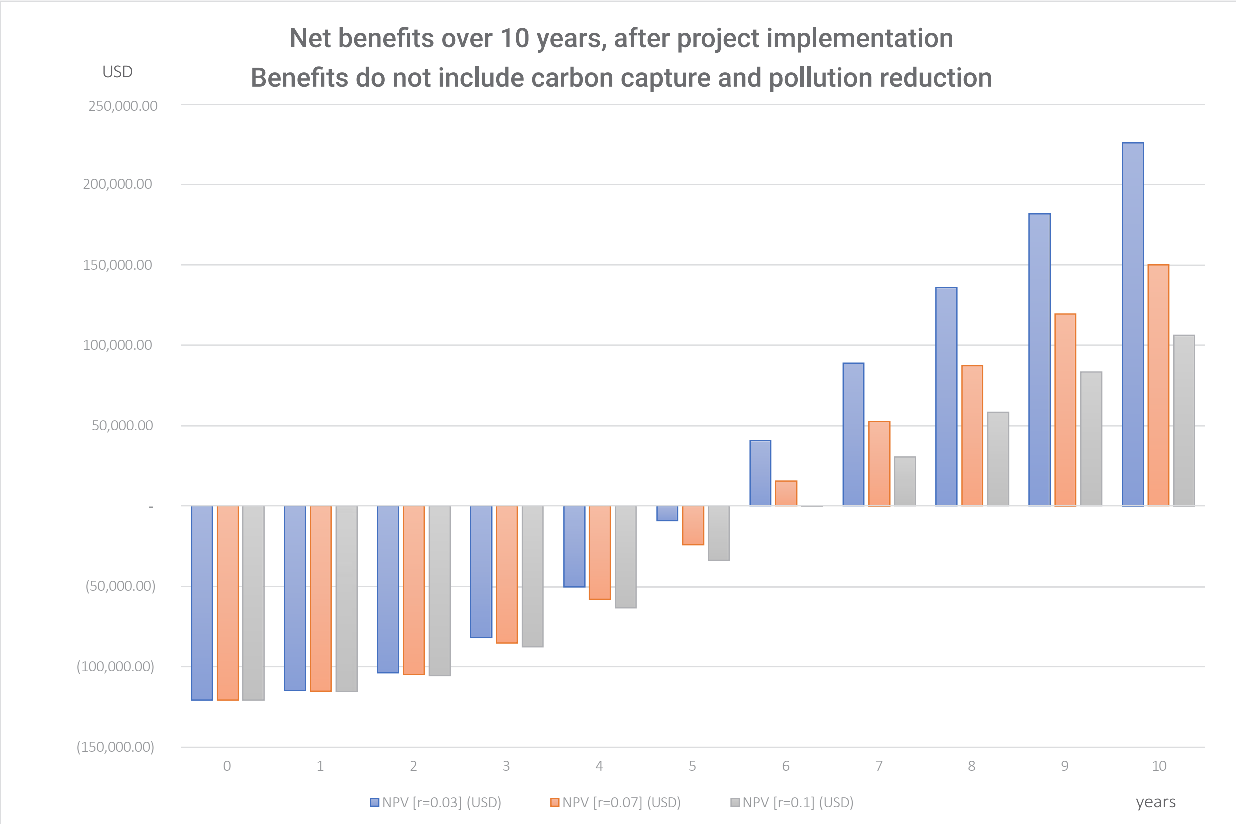
Discount rate

The CBA estimations are performed using three discount rates (i.e., 0.03, 0.07, and 0.1) to allow comparisons across outcomes and robustness checks. Higher discount rate values lead to a lower weight of future benefits and costs in the CBA estimation. Ecosystem-based interventions may generate long-term benefits that might be underestimated with high discount rates. For this reason, it is important to adopt a range of discount rates and perform sensitivity tests. Three percent and seven percent are the discount rates generally recommended by the US Office of Management and Budget (OMB) (Congressional Research Service, 2016; Li, Q. and Pizer, W.A., 2021). It is worth emphasizing that these estimates are very conservative and net benefits might be much higher than these calculations indicate.

There are two main reasons. First, the CBA assumes a 2% yearly loss in properties and GDP per capita in the project area, however historical data shows higher losses, particularly in El Nino years. Moreover, weather and fire risk is expected to increase in relation to climate change. Second, the CBA assessment considers only socio-economic benefits associated with reduced losses in properties and GDP per capita. Because of lack of data we could not include other important benefits of the Eco-DRR intervention such as, for instance, health improvements and increased agricultural productivity (discussed in Section 4.2)

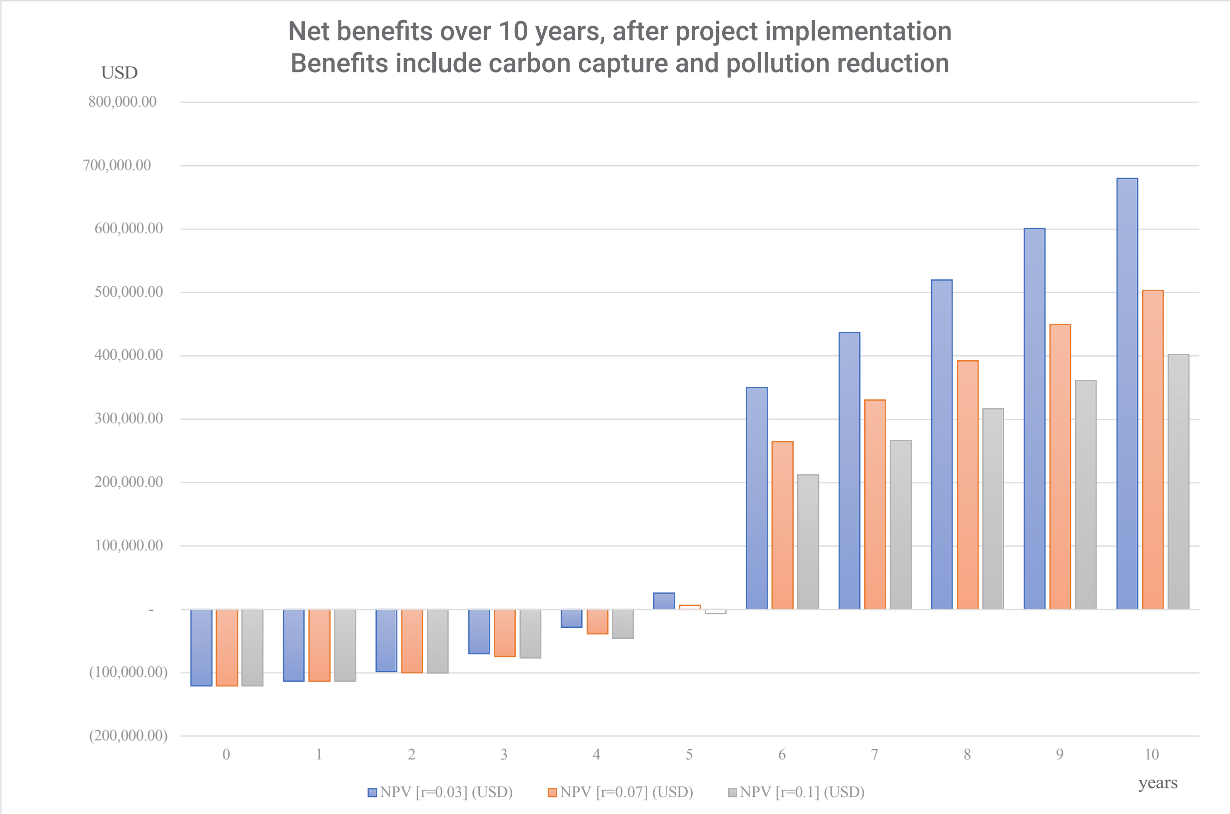
This means that the interventions could be even more beneficial to local communities than estimated in the quantitative analysis.

Scenario 1



SCENARIO 1 - Present Value of Net Benefits			
Benefits do not include carbon capture and pollution reduction			
Discount rates	r=0.03	r=0.07	r=0.1
year	**NPV (USD)**	**NPV (USD)**	**NPV (USD)**
0	-$120,734.00	-$120,734.00	-$120,734.00
1	-$114,954.89	-$115,170.93	-$115,322.65
5	-$9,134.31	-$24,137.64	-$33,633.13
10	$226,018.29	$149,876.31	$106,475.25

Scenario 2



SCENARIO 2 - Present Value of Net Benefits			
Benefits include carbon capture and pollution reduction			
Discount rates	r=0.03	r=0.07	r=0.1
year	**NPV (USD)**	**NPV (USD)**	**NPV (USD)**
0	-$120,734.00	-$120,734.00	-$120,734.00
1	-$113,153.72	-$113,437.09	-$113,636.10
5	$25,647.88	$5,968.47	-$6,486.47
10	$680,028.94	$503,345.31	$401,859.91

4.5. Details about benefits used in the calculations

BENEFITS					
			SCENARIO 1	SCENARIO 2	
Year		Maximum Loss	USD (3/29/22)	USD (3/29/22)	source
1	**Reduction in property damages** from avoided hazards (annually)	236,572.00	4,731.44	4,731.44	information about property values was collected by country team
2	**Avoided income losses** reduction of losses from business interruption (annually)	2,739,669.72	54,793.39	54,793.39	GDP per capita (World Bank, 2020)
3	**Carbon stored in trees** (this benefit is not an annual rate)			281,801.00	benefits are estimated using program iTree
4	**Carbon Capture** and sequestration (annually)			21,518.00	benefits are estimated using program iTree
5	**Other pollution** reduction (annually)			24,862.15	benefits are estimated using program iTree
		2,976,241.72	**59,524.83**	**387,705.98**	

The cost-benefit analysis includes all ecosystem restoration implementation costs (120,734 USD)[1] and the following benefits:

- **Reduction in property damage from avoided hazards**

  Future benefits include a reduction in property damage. The following estimates were communicated by the country teams:

  - Number of individuals in the project area: 708
  - Number of properties exposed to hazards in the project area: 142
  - Property price (approximately): 1,666 USD
  - Total property value in the project area = 1,666 USD*142 = 236,572 USD

- **Reduction in income losses from avoided damages**

In 2020, Indonesia GDP per capita was 3,869.69 USD (World Bank data in 2020). The total population in the project area is 708 people.

  - Total annual GDP in the project area = 3,869.59*708 = 2,739,669.72 USD
  - Estimated avoided yearly GDP losses = 2% of annual GDP in project area

In 2015, total losses and damage associated with peatland fires were equivalent to 3.3% of Indonesia's Gross Domestic Product (GDP); in other years, loss and damage were equivalent to 1.1%–2.4% of Indonesian GDP, meaning Indonesia's economy is one of the most heavily impacted by peatland fire (Kiely et al., 2021). Based on these estimates, the analyses assume a 2% yearly loss in property values and GDP per capita in the project area; moreover, the analyses assume that the Eco-DRR intervention will be able to reduce this risk and mitigate losses.

1. Budget documents provided by the country teams show that the cost of the intervention associated with *Community-based Eco-DRR Planning and Ecosystem Restoration and Protection* activities amount to 365,594 USD. We assume no maintenance after the end of the project implementation (June 2022).

- **Carbon stored in trees**

Carbon stored in restored peatland area of 53 ha. This is not an annual benefit; it is a one-time benefit reached at maturity of the forest in year 6. Benefits estimated using the software iTree.

The software iTree Canopy is a global forestry analysis and benefits assessment tool from the United States Department of Agriculture's (USDA) Forest Service. iTree allows to calculate carbon sequestration and storage as well as pollution reduction of a given vegetation area, selected via Google Map. The 53 ha of land reforested in Indonesia is estimated to sequester roughly 258.18 tons of carbon annually, and the overall carbon storage capacity for the same area is estimated at 3,380.30 tons. iTree also provides estimates of the corresponding monetary values, which were used in the CBA calculations.

- **Carbon sequestered thanks to Eco-DRR reforestation efforts.**

Surface currently restored: 53 ha - Benefits estimated using iTree.

- **Pollution reduction thanks to Eco-DRR reforestation efforts.**

Surface currently restored: 53 ha

Pollutants reduced: Carbon Monoxide, Nitrogen Dioxide, Ozone, Sulfur Dioxide, Particulate Matter less than 2.5 microns, Particulate Matter greater than 2.5 microns and less than 10 microns -- Benefits estimated using iTree

4.6 Equity analysis

In addition to the benefits described above, these interventions promote socio-economic and gender equity in the target communities. This equity assessment considers the equity implications of the interventions from four perspectives: inclusivity, economic equality, participation, and capacity building.

Inclusivity

The interventions have been developed and implemented in an inclusive manner that aligned with the project's goal of capacity building. Local communities were central to the planning and implementation process, with stakeholders including women, youth, and other marginalized groups. Additionally, Indigenous knowledge and practices were incorporated into the interventions where possible.

Economic Equality

The interventions in Indonesia ensure basic human needs are fulfilled and socio-economic statuses of women, men, and communities are improved. Fire prevention and mitigation strategies—firefighting training, hydrological monitoring, installation of Early Warning Systems (EWS), and peatland restoration—reduce the likelihood and severity of property damage and occupational interruptions from fire. Hence, communities are likely to experience higher economic security in coming years.

The Bio-rights financing mechanism is specifically designed to benefit impoverished members of the community while promoting ecosystem conservation, supporting sustainable livelihood practices, and enhancing community resilience. Bio-rights funding boosts local economies by promoting development of small- and medium-sized enterprises (SMEs) and generating new jobs and revenues.

Women's empowerment is facilitated by the Bio-rights financing scheme and the paludiculture technique. Women's training encourages their participation in income generation and other community activities, gives them access to credit, and promotes economic equality of women and men.

Ecosystem restoration with paludiculture technique, and fire prevention, awareness and monitoring programs promote basic human needs to clean air and food security. As a result of the peatland restoration and replanting of trees on peatland, communities will benefit from cleaner air due to the increase in number of trees and reduction in CO2 emissions. Additionally, as a result of sustainable agricultural practices, communities benefit from greater food security and access to nutritious food.

Participation

The participation of diverse groups of community members is central to the interventions in Indonesia. The Bio-rights scheme supports the engagement and participation of community members by distributing grants to local residents upon completion of peatland conservation and restoration efforts. As a result of this program, 15 small community groups received training and credits to run businesses as individuals or as groups, while actively participating in peatland conservation and management. These community groups are also involved in regular meetings and planning for fire risk monitoring and assessment, working with local authorities on fire risk management plans on disaster preparedness and prevention through eco-DRR.

Capacity Building

The interventions in Indonesia supported peatland conservation and the development of alternative livelihood activities through training initiatives for groups and individuals (e.g., fire awareness and prevention, paludiculture) and sustainable financing mechanisms (e.g., Bio-Rights scheme). These initiatives have been building local capacity toward fire risk reduction, community resilience, and economic development.

Training and financing initiatives focused on sustainable livelihoods promote local economic growth, an important component of resilience, by creating a solid web of economic, social and environmental benefits for community members and local organizations. The transfer of knowledge created by the interventions has also contributed to women's empowerment and participation, which are key elements to the development of more educated, healthier, wealthier, more just, and more inclusive communities.

The centrality of training and community participation to the interventions ensures that stakeholders have the necessary knowledge, skills, processes, and resources to continue these sustainable practices in the future, as well as adapt to future challenges that may arise.[1]

1. Vicarelli, Marta, Anamaria Georgescu, Kerry Judge, Asiel Arroyo, Htike Htike Aung, Jennifer Nelson, Jessica Mooring, Nujhat Purnata, Yin Yin Win. *"Ecosystem-based Disaster Risk Reduction and Community Resilience in Indonesia: a Cost-Benefit and Equity Analysis"*. (2022) School of Public Policy, University of Massachusetts Amherst, MA, USA.

5

Lesson learned

Eco-DRR is still a new approach for some government offices, both at the village and district levels.

5.1. Project lessons learned

- The design of this project went through several stages, including a study of the socio-economic opportunities and biophysics of the location, programme socialisation, securing support from several government entities, community group formation, developing work plans, conducting trainings, preparing bio-rights agreements, implementing project activities, and monitoring. Bio-right agreements with the community groups should be developed at a certain level of detail to allow mutual knowledge and understanding of the rights and obligations of the community groups. This will enable them to carry out the expected activities according to the agreed work plan and schedule.
- The development of village regulations on sustainable peatland management requires a specific and longer timeline. It is essential to develop an effective timeline and speed up the deliberation process at the hamlet level and then agree on it at the village level. Similarly, coordination with the legal department of local government is inevitable to ensure the compliance of the regulation contents and applicability with the government standard.
- There is a time limitation for using local material (betel nut) for canal blocking to sustain the humidity of peatland. Although routine maintenance will prolong its lifespan until the end of the third year. It is necessary to propose the construction of new canal blocks to related parties, such as the village government using stronger materials to reach more than 5 years of age.
- To prevent the adverse impacts of slash and burn activities by people who owned palm oil plantations around the project areas require intensive peat patrol by community groups (fire brigade) to improve the awareness of people also ensure the functionality of early warning tool and timely information dissemination.
- Flexibility to adjust with the changing priority of national government is a key to successfully influencing the national level peatland management. The project initially planned to upscale the model into the National Peat Village Care Programme. In the middle of the way, BRGM shifted the priority to focus on Mangrove Programme. Despite this challenge, the project successfully identified the other peatland related initiative and worked with BRGM to develop the technical manual of 'peatland management without burning'. BRGM will actively use it nationwide, implementing it in every farmer field school on peat management.

5.2 Gender Mainstreaming

In the selection of group members, the project set 30% as the needed participation of women. However, the project was able to reach 49 percent of women as project beneficiaries. Women were engaged as bio-rights group administrators (such as the secretary of treasury). Further engagement included a woman who chaired the bio-rights group empowering this group to coordinate its members in carrying out all bio-rights activities including field activities. Women groups are now more vocal in expressing their interests, particularly in accessing and managing livelihood activities funded by bio-rights.

5.3. Recommendations for upscaling

- Eco-DRR is still a new approach for some government offices, both at the village and district levels. For this reason, it is necessary to involve the district government more specifically from the planning stage to the field monitoring stages.
- Village regulations on peat management need to be drawn up by involving representatives from the local community to secure ownership and ensure effectiveness of its implementation in the field.
- Ascertain the marketability of paludiculture products by investigating and opening new markets for these specific commodities, likewise enhancing the capacity of community groups to increase the values of agriculture and aquaculture products. These could be done by connecting community groups with government/sectoral agencies to get further assistance on capacity development and market access and promoting development of community based -village cooperatives.
- Identifying and linking the relevant national government efforts such as 'peatland management without burning' training programme. This will facilitate the uptake of Eco-DRR approach in national government initiative in restoring peat ecosystems across the countries.

5.4. Recommendations for future Eco-DRR projects

- Ensure sustainability of peat restoration activities and advocacy to village government at community groups level. It requires strong motivation and initiative of this group to take care of canal blocking, monitor peat water levels and nurture the planted native peat seedlings on their land. This could be achieved by providing intensive mentoring, regular meetings, and sufficient technical training.
- Promote voluntary work from community groups. This activity will enhance ownership and participation from community groups by engaging them in investing their own resources to support peat fire monitoring and response such as building peat fire monitoring tower and water reservoir.
- Coordinate with neighborhood private sector concessions that own larger-scale palm oil plantations. Reaching out to this group is instrumental in advocating and promoting sustainable peatland management, especially with a 'no burning' approach and the need for continuous humidity of peatlands.
- The community facilitator is the strategic person in the process of building trust with the local community. The individual needs to comprehensively understand the program to facilitate the delivery of the program. The facilitator is also leading all the mentoring processes from planning to monitoring. A multi-disciplinary team is also needed to provide technical support such as biodiversity, mapping, and products/commodities marketing expertise.

This case study documents the experiences, results, and lessons learned from the Ecosystem-based Disaster Risk Reduction (Eco-DRR) project undertaken by Wetland International in Indonesia with funding from the Directorate General for International Partnerships (DG-INTPA), European Commission (EC). The objective is to upscale community resilience through Eco-DRR activities in selected areas of Indonesia.