PLUM PROJECT

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Project Title	PLUM Peat and Mangrove Conservation and Restoration Project (PLUM Project)
Version	1.0
Date of Issue	23-February-2024
Project Location	Indonesia, Central Kalimantan
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Project Lifetime	01 August 2022 – 31 July 2082; 60-year lifetime
GHG Accounting Period	01 August 2022 – 31 July 2082; 60-year total period
History of CCB Status	Combined validation with VCS
Gold Level Criteria	Gold Level for Climate Change Adaptation Benefits (GL1), Exceptional Benefits for Community (GL2) and Biodiversity (GL3) GL1: The project will implement activities that increase the resilience of local communities and biodiversity to climate change, including activities for livelihood diversification and habitat conservation and restoration. GL2: A total of 13 villages adjacent to the project area are included as the target beneficiaries of this project, including six villages classified as

	underdeveloped villages. Over 50% of villagers in the project zone are below the national poverty line. The project will provide tangible benefits to local communities living in the surrounding area by working to improve local livelihoods, health, education, and well-being. GL3: The project area is home to 31 globally threatened species, including the Bornean orangutan (*Pongo pygmaeus wurmbii*), Proboscis monkey (*Nasalis larvatus*), and the Bornean white-bearded gibbon (*Hylobates albibarbis*). The project activities will contribute to the conservation of these species and their habitat, and restore the degraded peatland and mangroves to improve the habitat quality and reduce the threats to biodiversity.
Expected Verification Schedule	n/a

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Abbreviations

AFOLU	Agriculture, Forest, and Other Land Use
AGB	Above Ground Biomass
AMDAL	*Analisis Dampak Lingkungan* (Environmental Impact Assessment)
ANR	Assisted Natural Regeneration
APD	Avoiding Planned Deforestation
APL	*Areal Penggunaan Lain* (non-state forest land)
APWD	Avoiding Planned Wetland Degradation
ARR	Afforestation, Reforestation and Revegetation
AWS	Automatic Weather Station
Bappenas	*Badan Perencanaan Pembangunan Nasional* (Indonesia's Ministry of National Development Planning)
BGB	Below Ground Biomass
BHL	*Buruh Harian Lepas* (Daily/Casual Laborer)
BMKG	*Badan Meteorologi, Klimatologi, dan Geofisika* (Indonesia's Meteorology, Climatology, and Geophysical Agency)
BPS	*Badan Pusat Statistik* (Indonesia's Central Bureau of Statistics)
BRGM	*Badan Restorasi Gambut dan Mangrove* (Peat and Mangrove Restoration Agency)
BUMDes	*Badan Usaha Milik Desa* (Village Owned Enterprise)
CCB	Climate, Community and Biodiversity
CCBS	Climate, Community and Biodiversity Standards
CDM	Clean Development Mechanism
CH_4	Methane
CIDs	Climate Impact Drivers
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CIW	Conservation of Intact Wetlands
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
CR	Critically Endangered
CUPP	Conservation of Undrained and Partially Drained Peatlands
DBH	Diameter at breast height
EN	Endangered
ENSO	El Niño-Southern Oscillation
FDRS	Fire Danger Rating System
FGD	Focus Group Discussion
FPIC	Free, Prior and Informed Consent
GESI	Gender and Social Inclusion
GHG	Greenhouse Gas
GIS-RS	Geographic Information System – Remote Sensing
GMO	Genetically Modified Organisms
GoI	Government of Indonesia
GRTT	*Ganti Rugi Tanam Tumbuh* (an agreement where communities with cultivated areas and its crops are compensated by a company for the value of the crops and the rights of the land)
GWP	Global Warming Potential
HCV	High Conservation Value
HP	*Hutan Produksi* (Production Forest)
HPK	*Hutan Produksi Konversi* (Convertible Production Forest)
HTI	*Hutan Tanaman Industri* (industrial plantation forest)
IDR	Indonesian rupiah
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
KHG	*Kesatuan Hidrologis Gambut* (Peat Hydrological Unit)

KLHK / MoEF	*Kementerian Lingkungan Hidup dan Kehutanan* (Indonesia's Ministry of Environment and Forestry)
KPHP	*Kesatuan Pengelolaan Hutan Produksi* (Production Forest Management Unit)
KWT	*Kelompok Wanita Tani* (Women Farmers Group)
LPHD	*Lembaga Pengelola Hutan Desa* (Village Forest Management Institution)
MF	Methodology Framework
MoU	Memorandum of Understanding
MPA	*Masyarakat Peduli Api* (Fire Care Communities)
MRV	Monitoring, Reporting and Verification
MSMEs	Micro, Small, and Medium Enterprises
N_2O	Nitrous Oxide
NGO	Non-Governmental Organization
NP	National Park
NPV	Net Present Value
NTFP	Non-Timber Forest Product
PBPH	*Perizinan Berusaha Pemanfaatan Hutan* (Forest Utilization Business License)
PD	Project Description Document
PFVI	Peat Fire Vulnerability Index
PHBS	*Perilaku Hidup Sehat dan Bersih* (Clean and Healthy Behavior)
PKK	*Pemberdayaan Kesejahteraan Keluarga* (Family Welfare Empowerment Program)
PLUM Project	Project implemented on PT PUM concession area
PMT	*Pemberian Makanan Tambahan* (Supplementary Food Program)
Polindes	*Pondok Bersalin Desa* (Village Maternity Clinic)
Posyandu	*Pos Pelayanan Terpadu* (Integrated Health Service Post)
PRA	Participatory Rural Appraisal
PT AIS	PT Agro Inti Semesta
PT KMS	PT Katingan Mujur Sejahtera
PT KSB	PT Katingan Sawit Bersama
PT PUM	PT Pagatan Usaha Makmur
PT RMU	PT Rimba Makmur Utama
PT TBS	PT Trubus Bumi Sejahtera
Puskesmas	*Pusat Kesehatan Masyarakat* (Community/Public Health Center)
Pustu	*Puskesmas Pembantu* (Auxiliary Community/Public Health Center)
QA/QC	Quality Assurance/Quality Control
RCP	Representative Concentration Pathway
RDP	Restoration of Drained Peatlands
REDD	Reducing Emissions from Deforestation and Forest Degradation
RKT	*Rencana Kerja Tahunan* (Annual Work Plan)
RKU	*Rencana Kerja Usaha* (Business Work Plan)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-Term Development Plan)
RTE	Rare, Threatened, Endangered
RTRW	*Rencana Tata Ruang Wilayah* (Regional Spatial Plan)
RWE	Restoration of Wetlands Ecosystems
SDGs	Sustainable Development Goals
SIA	Social Impact Assessment
SIMURP	Strategic Irrigation Modernization and Urgent Rehabilitation Project
SLR	Sea Level Rise
SMART	Spatial Monitoring and Reporting Tool
SOC	Soil Organic Carbon
SOP	Standard Operating Procedure
SRN PPI	*Sistem Registri Nasional Pengendalian Perubahan Iklim* (National Registry System for Climate Change Control)
UKL/UPL	*Upaya Pengelolaan Lingkungan/Upaya Pemantauan Lingkungan* (Environmental Management and Monitoring Plan)
UNESCO	United Nations Educational, Scientific and Cultural Organization

USD	United States dollar
VCS	Verified Carbon Standard
VCU	Verified Carbon Unit
VDI	Village Development Index
VU	Vulnerable
VVB	Validation/Verification Body
WRC	Wetlands Restoration and Conservation

1 SUMMARY OF PROJECT BENEFITS

The PLUM Peat and Mangrove Conservation and Restoration Project (PLUM Project) is a conservation and restoration project of peat and mangrove forests located in Central Kalimantan Province, Indonesia. The project is implemented on a forest concession with Forest Utilization Business License held by PT Pagatan Usaha Makmur (PT PUM) for 60 years, covering a total area of 23,665 hectares. Prior to PT PUM receiving its principal PBPH license in 2022[1], the project area was planned to be developed as an oil palm plantation along with two other companies adjacent to the area.

The project is expected to have a range of climate, community and biodiversity benefits by preserving and restoring the integrity of the Peat Swamp and Mangrove Forest landscape and the rich biodiversity in the area while improving the well-being of local communities. In terms of climate benefits, it is estimated the PLUM Project will result in net emissions reductions and removals of 69,999,940 tCO_2e over 60 years of crediting period. This will be achieved through activities covered by the VM0007 REDD+ Methodology Framework including (1) Avoiding Planned Deforestation (APD), (2) Afforestation, Reforestation and Revegetation (ARR), (3) Restoration of Wetlands Ecosystems (RWE) on Peatland and Tidal Wetlands, and (4) Avoiding Planned Wetland Degradation (APWD) on Peatland and Tidal Wetlands. Additionally, the project will deliver Climate Change Adaptation Benefits by increasing the resilience of local communities and biodiversity to climate change.

The project meets the CCB criteria for Exceptional Community Benefits. There are 13 villages within the project zone and over 50% of villagers are below the national poverty line of IDR 2,120,371/month per household. Furthermore, six of the 13 villages in the project zone are underdeveloped villages. These six villages are the main target of the project's community development programs. The project activities will target the most vulnerable communities within the project zone, improve access to health services and provide fair and just employment opportunities. The project activities will provide a positive impact on communities' livelihoods and well-being.

The project also meets the CCB criteria for Exceptional Biodiversity Benefits. PT PUM's ecosystems are home to 31 globally threatened species with three Critically Endangered (CR) species (i.e., Bornean orangutan), eight Endangered (EN) species (i.e., Proboscis monkey, Bornean white-bearded gibbon), and 20 Vulnerable (VU) species. Furthermore, the project area is home to restricted range species that can only be seen on Kalimantan Island including four endemic mammals and one endemic bird. The project activities will contribute to the conservation of these species and their habitat, and restore the degraded peatland and mangroves to improve the habitat quality and reduce the threats to biodiversity.

1.1 Unique Project Benefits

Outcome or Impact Estimated by the End of Project Lifetime	Section Reference
1) A total of 21,010 ha peatland will be conserved and restored through peat rewetting (e.g., canal blocking) and fire prevention and management activities. This effort will allow degraded areas to recover and hence provide suitable habitats for key species. In addition, negative health impacts from fire smoke and haze to local communities will be reduced.	2.1.11, 3.2.2

[1] Principal license granted to PT PUM by the Ministry of Investment since 1 August 2022 (Decision of the Head of Investment Coordination No.01082211116206001), followed by the definitive license on November 27th, 2023.

1.2 Standardized Benefit Metrics

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario	26,536,036 tCO_2e	3.2.4
	Net estimated emission reductions in the project area, measured against the without-project scenario	43,463,904 tCO_2e	3.2.4
Forest[2] cover	For REDD[3] projects: Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario	5,523 ha	3.2.2
	For ARR[4] projects: Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario	Total 15,088 ha, composed of: 424 ha of mangrove, 1,306 ha of peatland, 13,358 ha of peatland (ANR)	3.2.2
Improved land management	Number of hectares of existing production forest land in which IFM[5] practices are expected to occur as a result of project activities, measured against the without-project scenario	Not applicable	-
	Number of hectares of non-forest land in which improved land management practices are expected to occur as a result of project activities, measured against the without-project scenario	Not applicable	-

[2] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)
[3] Reduced emissions from deforestation and forest degradation (REDD) - Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)
[4] Afforestation, reforestation and revegetation (ARR) - Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)
[5] Improved forest management (IFM) - Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*)

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
Training	Total number of community members who are expected to have improved skills and/or knowledge resulting from training provided as part of project activities	3,225	2.1.11
	Number of female community members who are expected to have improved skills and/or knowledge resulting from training as part of project activities	1,193	2.1.11
Employment	Total number of people expected to be employed in project activities,[6] expressed as number of full-time employees[7]	405	2.1.11
	Number of women expected to be employed as a result of project activities, expressed as number of full-time employees	77	2.1.11
Livelihoods	Total number of people expected to have improved livelihoods[8] or income generated as a result of project activities	2,550	2.1.11
	Number of women expected to have improved livelihoods or income generated as a result of project activities	1,125	2.1.11
Health	Total number of people for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	13,500	2.1.11
	Number of women for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	7,650	2.1.11

[6] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.
[7] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])
[8] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
Education	Total number of people for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	3,465	2.1.11
	Number of women and girls for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	1,733	2.1.11
Water	Total number of people who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	12,000	2.1.11
	Number of women who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	6,000	2.1.11
Well-being	Total number of community members whose well-being[9] is expected to improve as a result of project activities	19,455	2.1.11
	Number of women whose well-being is expected to improve as a result of project activities	9,752	2.1.11

[9] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Livelihoods, Health, Education and Water), and may also include other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
Biodiversity conservation	Expected change in the number of hectares managed significantly better by the project for biodiversity conservation,[10] measured against the without-project scenario	23,153.75 hectares[11]	2.1.7, 5.4.1
	Expected number of globally Critically Endangered or Endangered species[12] benefiting from reduced threats as a result of project activities,[13] measured against the without-project scenario	31	5.5

[10] Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g. enhancing the status of endangered species

[11] The project area is 23,153.75 ha which corresponds to the area of the approved coordinates for the principal license (23,631.51 ha) minus 477.76 ha of rice areas excluded from the project area, as explained in Section 2.1.7.

[12] Per IUCN's Red List of Threatened Species

[13] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit.

2 GENERAL

2.1 Project Goals, Design and Long-Term Viability

2.1.1 Summary Description of the Project (G1.2)

The PLUM Peat and Mangrove Conservation and Restoration Project (PLUM Project) is a conservation and restoration project of peat and mangrove forests located in Central Kalimantan Province, Indonesia. The project is implemented on a 23,665-hectare forest concession with Forest Utilization Business License, held by PT Pagatan Usaha Makmur (PT PUM) for 60 years. The project will implement activities to conserve and restore the peat and mangrove forests in the project area while delivering positive impact on the community and biodiversity. Among others, the project will implement forest patrols, fire prevention, and biodiversity monitoring activities to prevent forest loss and protect biodiversity. Peat ecosystems will be restored by blocking canals and rewetting the area to avoid further peat drainage. Approximately 15,088 ha of degraded land will be restored through reforestation and Assisted Natural Regeneration (ANR).

The eastern part of the project is a peatland forest area located in Katingan Regency, Katingan Kuala Sub-district, adjacent to the Sebangau National Park. The western part of the concession is located in East Kotawaringin Regency, Pulau Hanaut Sub-district, and mostly consists of mangrove forests (Map 2-1). Based on the conducted biodiversity assessment, the concession provides important habitat for 31 threatened species, including the Bornean orangutan, the Proboscis monkey, and the Bornean white-bearded gibbon. The area is also important for at least 17 migratory bird species from three families.

The project will provide tangible benefits to local communities living in the surrounding area by working to improve local livelihoods, health, education, and well-being. For example, the project will assist local coffee farmers and honey producers to improve harvesting, processing, and market access. The project will support the establishment of women's groups in the target villages to promote economic opportunities for women; and implement interventions that improve health and sanitation in the 13 target villages.

Prior to PT PUM receiving its principal PBPH license in 2022, the project area was planned to be developed as an oil palm plantation along with two other companies adjacent to the area. All three companies were owned by a company group named PT Agro Inti Semesta (PT AIS). Additionally, in 2022, an approval to convert forest land into oil palm plantation was given to another oil palm company located along the western boundary of PT PUM. Without the PLUM Project, it is highly likely that PT PUM's area would have been developed into an oil palm plantation by PT AIS.

The project will generate GHG emission reductions or removals by implementing activities covered by the VM0007 REDD+ Methodology Framework including (1) Avoiding Planned Deforestation (APD), (2) Afforestation, Reforestation and Revegetation (ARR), (3) Restoration of Wetlands Ecosystems (RWE) on Peatland and Tidal Wetlands, and (4) Avoiding Planned Wetland Degradation (APWD) on Peatland and Tidal Wetlands. It is estimated that the project will generate a total net Verified Carbon Unit (VCU) volume of 69,999,940 tCO_2e over 60 years of crediting period or 1,166,666 tCO_2e per annum (Table 3-44).

The project's goal is to conserve the remaining forest, restore ecosystem function, protect biodiversity, and improve the well-being of communities to become resilient to climate change. In conclusion, it is expected that the PLUM Project will contribute to preserving the integrity of the Peat Swamp and Mangrove Forest landscape and biodiversity in the area while improving the well-being of local communities.

2.1.2 Project Scale

Project Scale	
Project	
Large project	x

2.1.3 Project Proponent (G1.1)

Organization name	PT Pagatan Usaha Makmur
Contact person	Mr. Handoko Limaho
Title	Chief Executive Officer
Address	Soho Capital Unit SC 3702, Jl. Letjen S. Parman Kav 28, Tanjung Duren Selatan, Grogol Petamburan, Jakarta Barat, 11470
Telephone	+62-21-39502295
Email	info@plumproject.id

2.1.4 Other Entities Involved in the Project

Other entities involved in the project are listed below. Please also refer to Section 2.4.4 for other partnerships of the project.

Organization name	PT Gaia Eko Daya Buana
Contact person	Mr. Joseph Hutabarat
Title	Chief Business Development Officer
Address	CEO Building Lvl 12, Jl. TB Simatupang No 18C, South Jakarta, 12430, Indonesia
Telephone	+6221 740 6475
Email	joseph.hutabarat@gaia.id
Roles and responsibilities	Technical support on carbon calculations and PD development

Organization name	PT Terrathrive Bakti Indonesia
Contact person	Mr. Eri Budiono
Title	President Director
Address	820, CityLoft Sudirman, Jl. K.H. Mas Mansyur No.121, Jakarta, Indonesia 10220
Telephone	+62 812 1812 1862

Email	eri.budiono@terrathrive.co.id
Roles and responsibilities	Technical lead for MRV

Organization name	Syngenera Pte. Ltd.
Contact person	Ms. Angela Joehl Cadena
Title	Head of Projects
Address	16 Jalan Kilang Timor, #03-03, Redhill Forum, Singapore 159308
Telephone	+65 8425 7314
Email	angela@syngenera.com
Roles and responsibilities	Project development and management support, Sustainable Development Goals (SDG) indicators, marketing of carbon credits. Syngenera is Hutan Kencana Group's partner under the joint venture in Singapore, Hutan Synergy.

2.1.5 Physical Parameters (G1.3)

The project area is located in two regencies of Central Kalimantan Province, namely Katingan Regency and East Kotawaringin Regency. The sub-districts that are the focus of the project activities are Katingan Kuala sub-district of Katingan Regency and Pulau Hanaut sub-district of East Kotawaringin Regency. The project area lies between 113°9'00" - 113°10'00" east longitude and 3°12'00" - 3°2'00" south latitude. The eastern part of project area is adjacent to the Sebangau National Park, the third largest national park in Kalimantan[14]. The physical parameters of the project are described below:

2.1.5.1 Topography and Slope

The topography of the project area shows that the entire project area is located in the lowlands and flat with the dominant altitude class 0-15 m above sea level, with 0-8% slope class, and without steep hilly areas.

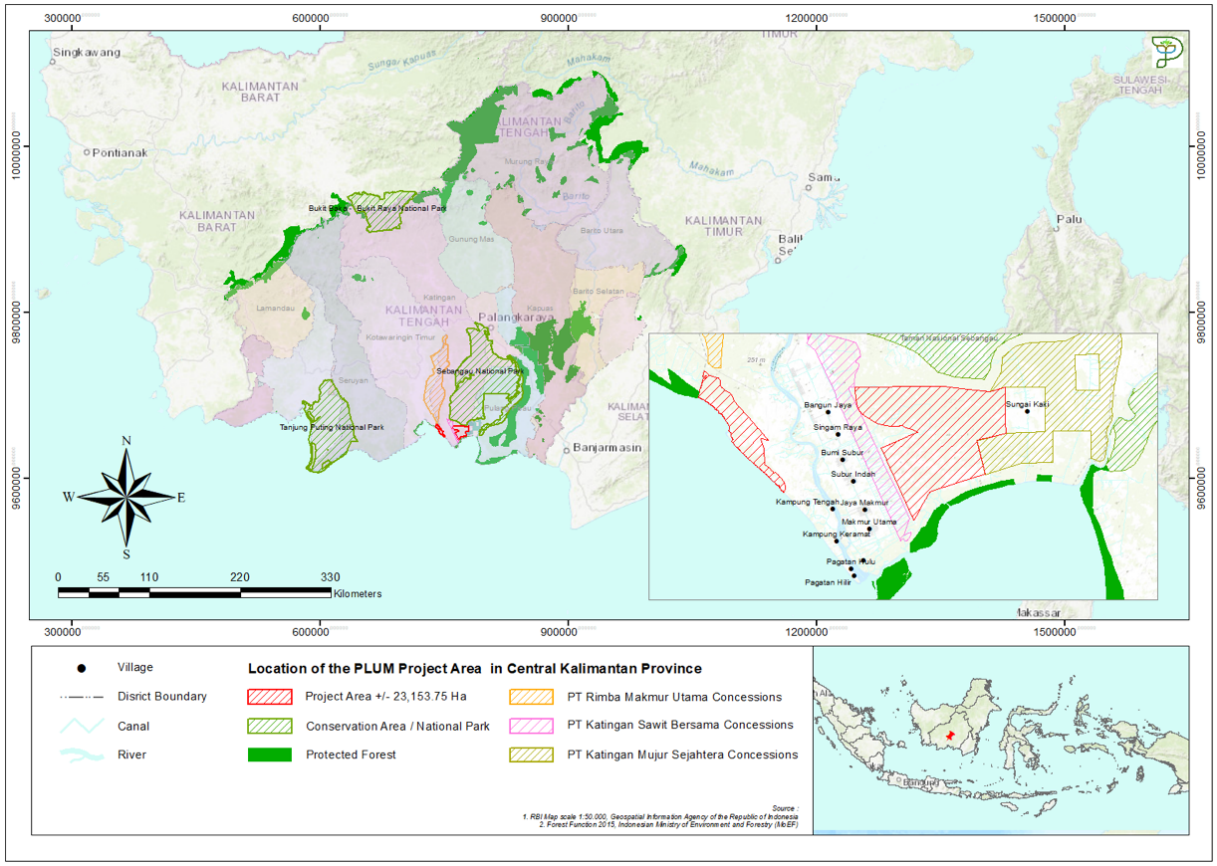
2.1.5.2 Soil

Soil type in project area is formed by entisol, inceptisol, and histosol[15]. The majority of soil type in the project area is histosol. Histosol soil is divided into three ordos namely tropohemist, tropofibrist, and troposaprist. Histosol is the most common soil type in the project area (74% of total area). This soil type is found in the northern and central parts of the project area (peat swamp areas). The peat in this area is generally quite fertile due to mineral enrichment from the overflow of the Katingan River to the west and the Kaki River to

[14] The Sebangau National Park wide area is around 542,141 hectares with rich biodiversity counting 808 species of flora, 35 species of mammals, 182 species of birds, and 54 species of snakes.
[15] Laporan Survey Flora dan Fauna (Flora Fauna Survey Report) - IUPHHK Restorasi Ekosistem PT. Pagatan Usaha Makmur. Kabupaten Katingan - Kalimantan Tengah (Remark Asia, 2022).

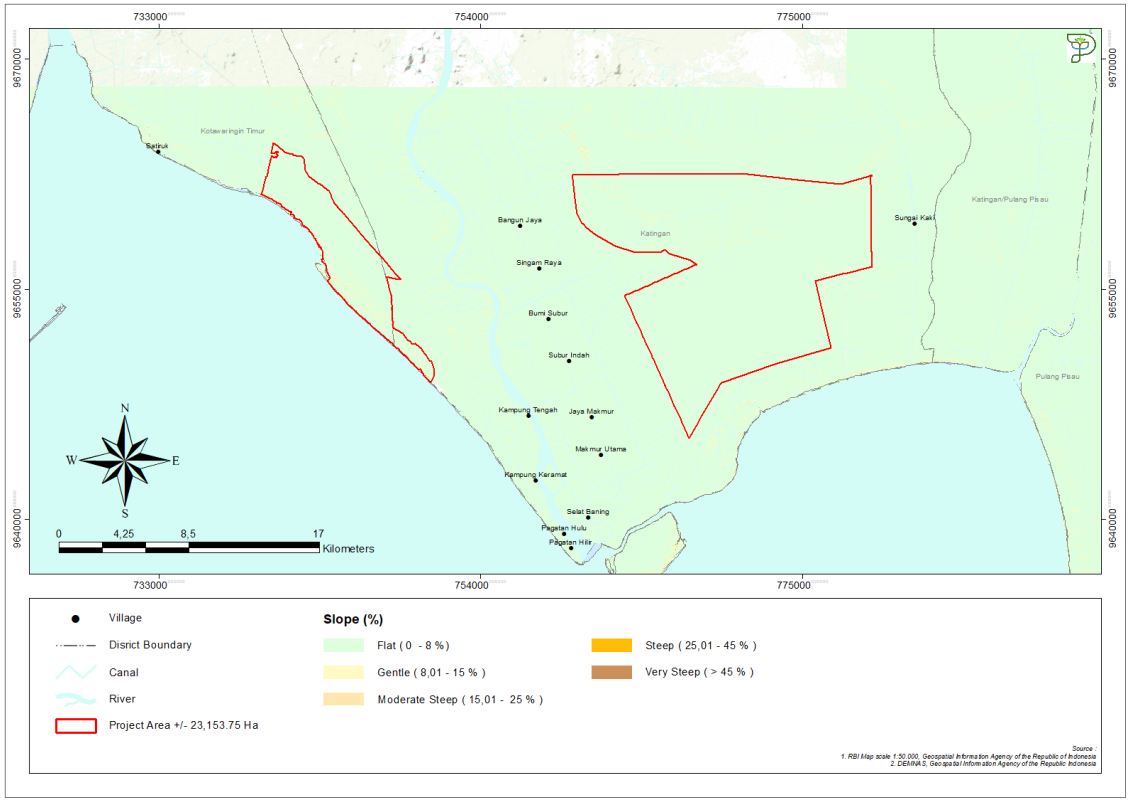
the east. The project area forms part of two Peat Hydrological Units (*Kesatuan Hidrologis Gambut* – KHG)[16], namely the Kahayan River – Sebangau River (KHG 62.11-14.02) and the Katingan River – Sebangau River (KHG 62.02-06.01).

Meanwhile, the entisol and inceptisol soils are spread across the central and southern parts of the project area with a coverage of 25.9% of the total area. Poor drainage conditions and moderate soil solum in this soil group association indicate that this area has a low water absorption capacity so that during the rainy season this area is often flooded. Finally, approximately 0.1% of the project area is tidal swamp area. The soil in this area contains sulphide material (pyrite), which, when oxidized, causes high acidity level (pH 3.5-4). This condition can damage plants. However, under anaerobic (flooded) conditions, the pyrite content in the soil is not harmful. Therefore, managing this area would require sound water management.

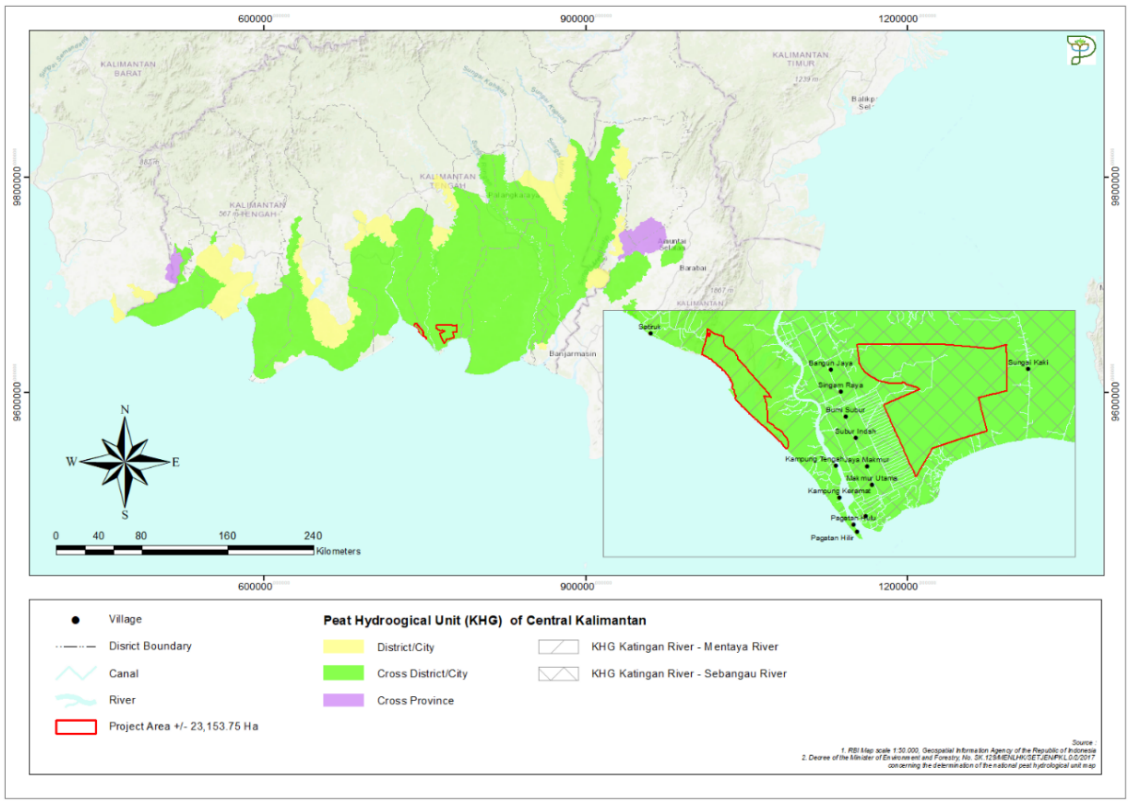


Map 2-1. Location of the PLUM project area in Central Kalimantan Province

[16] Decree of the Minister of Environment and Forestry No. SK.129/MENLHK/SETJEN/PKL.0/2/2017 concerning the determination of the national peat hydrological unit map



Map 2-2. Topography Map (showing slope class)



Map 2-3. Peat Hydrological Units (KHG) of Central Kalimantan

2.1.5.3 Climate

The project area and its surroundings have a tropical rainforest climate. It is usually warm, humid, and rainy all year round. The temperature averages are more stable throughout the year, with an average of 26.9°C (min 22.5°C, max 33.2°C), and an average humidity of 85.2%. The highest monthly average rainfall occurs during the DJF (Dec) period, with rainfall averaging > 400 mm/month. The lowest monthly rainfall occurs during the JJA period (Aug), averaging around 100 mm/month. Thus, based on the data, the project area is classified as a wet area throughout the year.

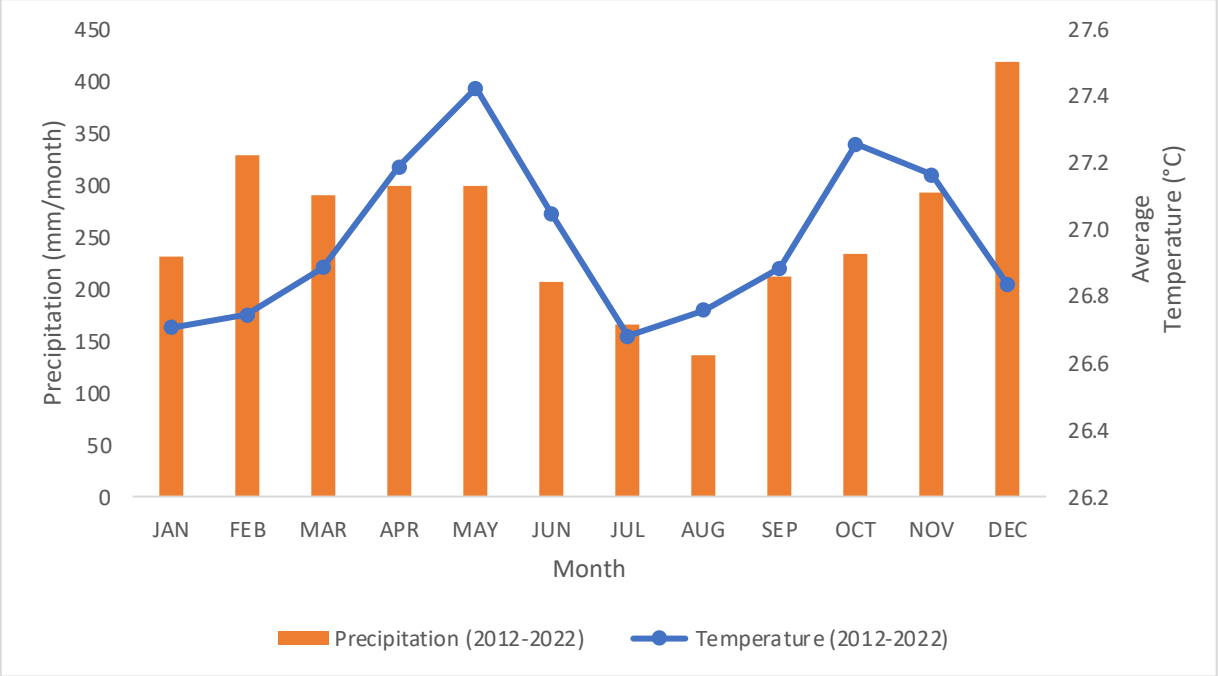
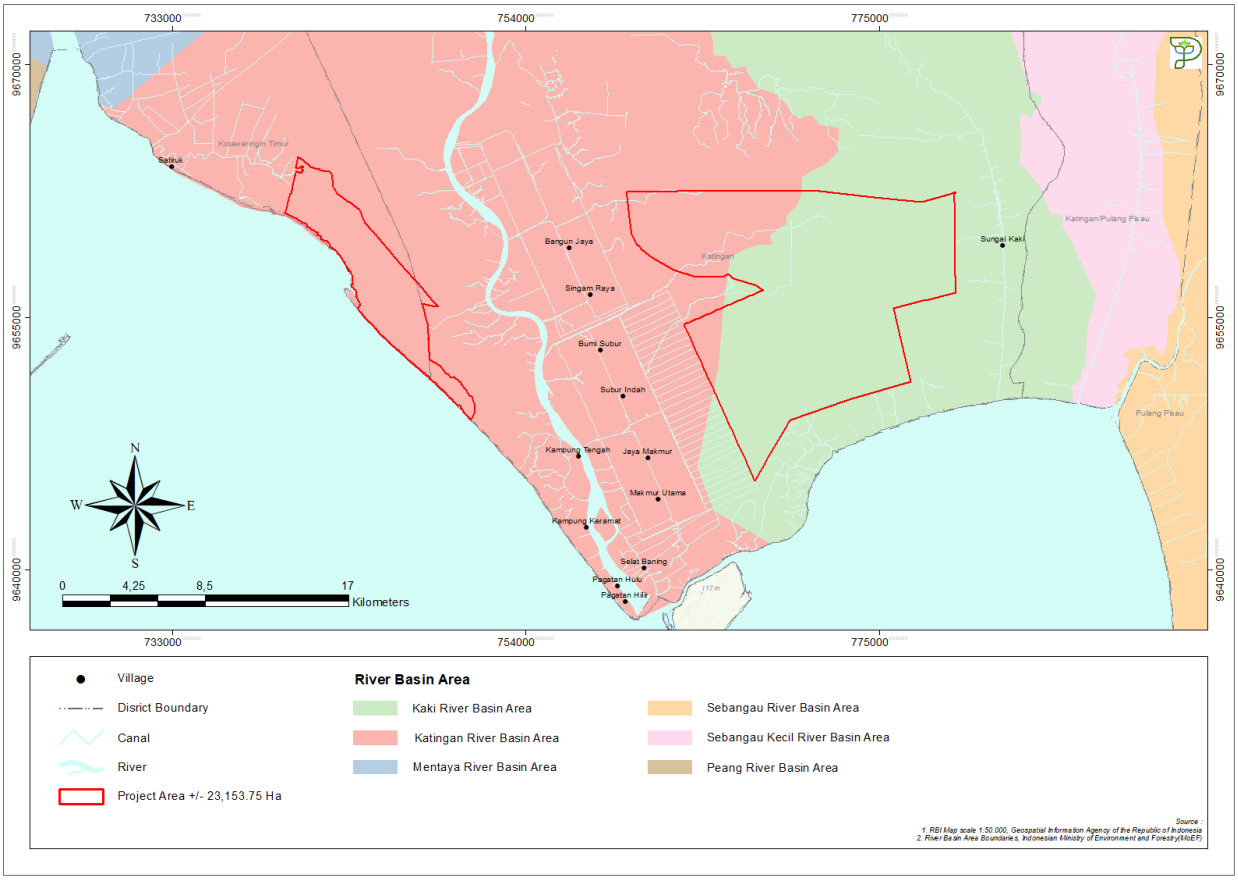


Figure 2-1. Monthly precipitation and average temperature in the project area

Source: BMKG Meteorological Station H. Asan, WMO ID: 96651, from 2012 to 2022`

2.1.5.4 Hydrology

River basins are ecological systems that consist of biophysical as well as social components. There are two river basins in the project area, namely 1) Katingan and 2) Sungai Kaki. The Katingan river basin is located in the western part, while the Sungai Kaki River basin is located in the eastern part of the project area. Some of the rivers in the project area flow to the west and east and end in the Katingan River; others flow southward and end in the sea.

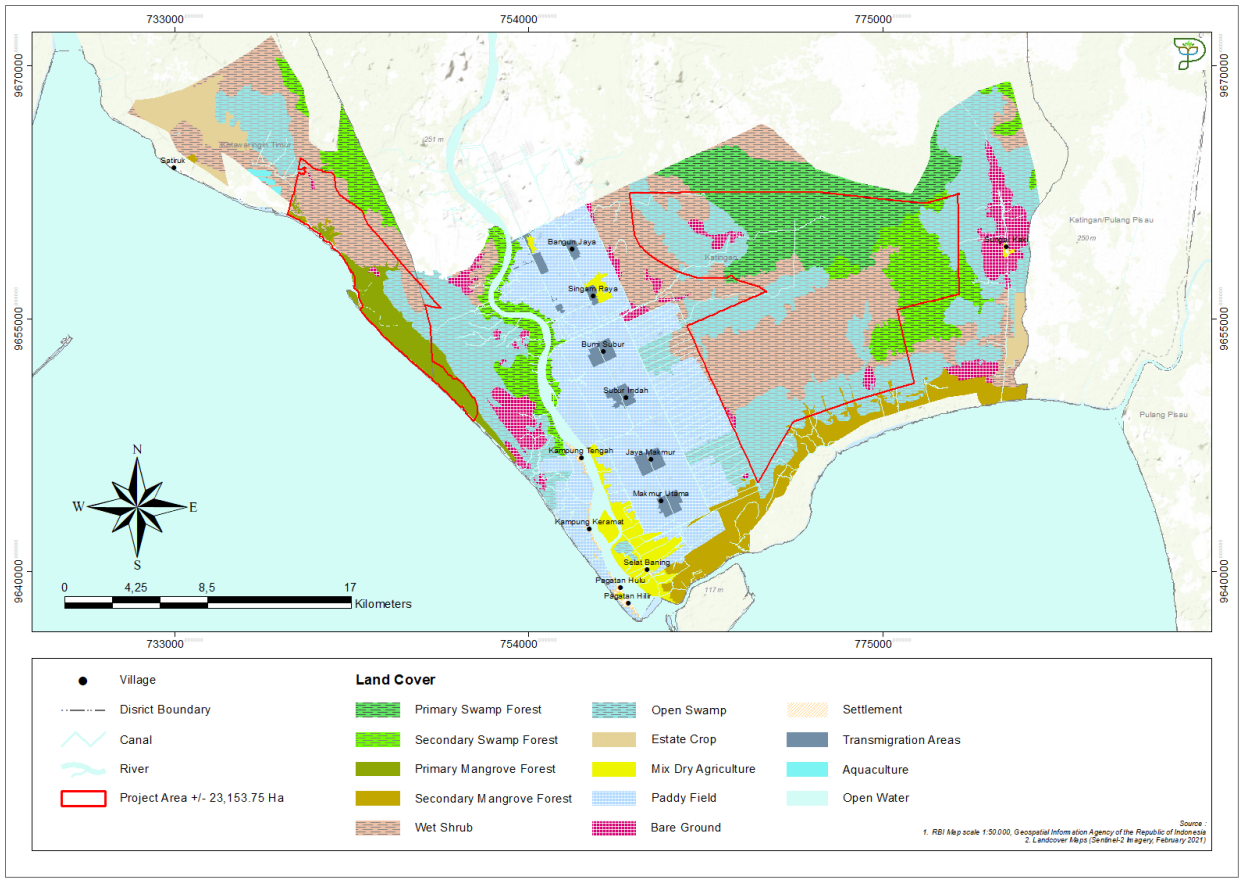


Map 2-4. Rivers and canals map

2.1.5.5 Land Cover and Vegetation Type

35% of the land in the project area is covered by peat swamp and mangrove forests and the remaining area is covered by non-forests with domination of wet shrub (36%) (Table 2-1). The peat swamp forest includes primary and secondary forest, part of which has been exploited but is still in good condition and has a dense canopy cover. Fallen trees can be found at a number of points therein and a fairly easy-to-pass trail which is suspected to be an earlier exploitation. Plant species that dominate the peat swamp ecosystem are Malam-malam (*Diospyros areolata*), Pisangpisang (*Mezzetia parviflora*), Bintangur (*Calophyllum inophyllum*), Katiau (*Madhuca motleyana*), and Jambu-jambu (*Syzygium* sp.). These species are generally found in the secondary forest and in abundance.

In contrast, the mangrove forest is pre-dominantly in a pristine condition. In the western part of the project area, primary mangrove forest, beach forest and peatlands can be found. The Cemeti mangrove forest landscape has reached a climax succession; the mangrove stands are dominated by *Rhizopora stylosa* which is even and dense, with trees up to 15 meters high and more than 20 centimeters in diameter. Other types of mangroves that can be found include *Sonneratia alba*, *Avicennia alba* and *Avicennia marina*. A large population of Nipa palm (*Nypa fruticans*) can be found 500 meters from the estuary mouth where the tides are not too high. Meanwhile, other mangrove associate species such as *Cerbera odollam* and *Barringtonia asiatica* can also be found.



Map 2-5. Landcover of the project area

Table 2-1. The land cover classification in year 2021 prior to the project initiation.

Land Cover Classes	Area size (ha)		Total	
	West	East	ha	%
Primary Swamp Forest	-	4,018	4,018	17.3%
Secondary Swamp Forest	-	2,311	2,311	10.0%
Primary Mangrove Forest	1,613	-	1,613	7.0%
Secondary Mangrove Forest	31	62	93	0.4%
Bare Ground	39	281	320	1.4%
Open Swamps	492	5,863	6,361	27.5%
Paddy Field	-	8	8	0.0%
Wet Shrub	1,848	6,498	8,346	36.0%
Open Water	88	-	88	0.4%
Total	**4,111**	**19,042**	**23,154**	**100%**

Source: PT PUM's Land Cover Analysis Report (2022).

2.1.6 Social Parameters (G1.3)

The project zone consists of an eastern part and a western part. The eastern part is located in Katingan Kuala sub-district, part of Katingan Regency, while the western part is located in Satiruk village, part of Pulau Hanaut sub-district, East Kotawaringin Regency. The project area, especially in the eastern part, is surrounded by villages. A total of 17 villages[17] are located in the vicinity of the project area, of which one in the western part and the remainder in the eastern part. Out of these 17 villages, the project proponent will be engaging with 13 of them (see Table 2-2). The other four villages, located to the north of the project area, based on the Free, Prior and Informed Consent (FPIC) process conducted, have no significant interaction with the project area. In consultation with these villages, it was therefore decided that they would not be included.

In accordance to BPS Statistics Report (2023), the population in the 12 engaged villages of Katingan Kuala Sub-district in 2022 is 17,323 people consisting of 9,009 (52%) men and 8,314 (48%) women. The total population in Satiruk Village of Pulau Hanaut Sub-district is 1,340 people consisting of 688 men (52%) and 652 women (48%).

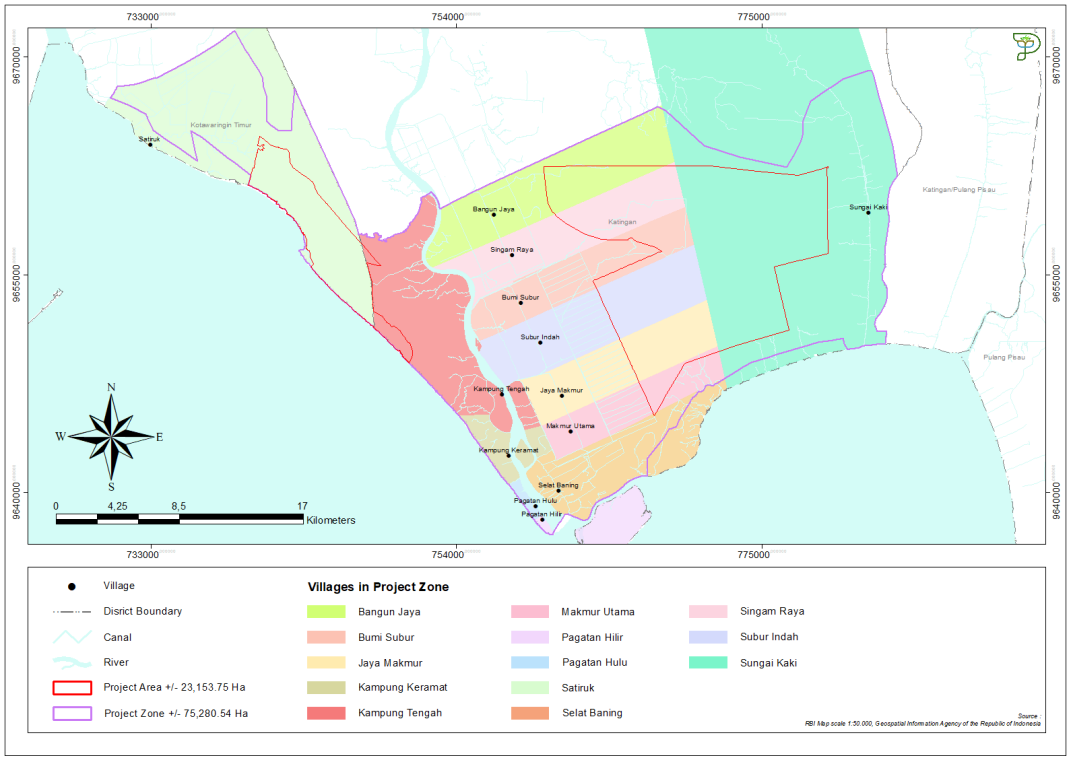
The communities in the engaged villages are ethnically diverse, consisting primarily of local residents and transmigrants. The transmigrant population is mostly from the Javanese ethnic group (West Java, Central Java and East Java), while the local population is from the Banjar ethnic group.

The primary livelihood in these villages is paddy farming. Other livelihoods found in these villages include fishermen, handymen, traders, laborers, civil servants, teachers, health workers, entrepreneurs, water transport taxis, breeders (goats, cows, chickens and ducks) and fish farmers. Based on these livelihoods, the project team identified several community groups in the villages such as paddy farmers, fishermen, coffee farmers, water taxi operators, and others. In Satiruk Village[18], villagers mostly rely on farming and fishing for their livelihood.

Table 2-2. List of potential impacted villages

Katingan Regency (Katingan Kuala Sub-district)		East Kotawaringin Regency (Pulau Hanaut Sub-district)
Urban Villages (Kelurahan) & Villages:		Village:
1. Urban Village Pagatan Hilir	7. Bangun Jaya	1. Satiruk
2. Urban Village Pagatan Hulu	8. Kampung Tengah	
3. Jaya Makmur	9. Sungai Kaki	
4. Subur Indah	10. Selat Baning	
5. Kampung Keramat	11. Makmur Utama	
6. Singam Raya	12. Bumi Subur	

[17] Of which 15 rural villages (desa) and two 'urban villages' (kelurahan).
[18] Peat care village profile (Satiruk Village), BRG, 2019



Map 2-6. Village administrative boundaries in the project zone

2.1.6.1 Land Tenure

As mentioned in the previous section, there are 13 villages in the project zone. At the project start, various physical interactions were identified between villagers and the forest in the project area for livelihoods such as removal of timber for house construction, fishing, wild honey harvest, and other activities. There are no villages or community's land within the project area[19]. However, some villagers have informal management rights over tatah/canals in the project area.

Historically[20], the land in the surroundings of the project area was held/used by Banjarese communities[21]. Forest was cleared for agriculture and settlements. Land ownership at this time was generally obtained through inheritance from generation to generation from their parents or from their ancestors or by buying from other people. Evidence of ownership of community lands is generally only based on planting and natural boundaries in the form of rivers and trees (rubber, durian, etc.). The existing land is currently cultivated for various types of agricultural commodities such as paddy fields and plantations such as rubber, corn, vegetables, fruits, and others. Over time, land rights have evolved from informal to formal legal binding.

[19] Note that although the administrative boundaries overlap with the forest area, the villages are located outside of it. No settlements are located in the forest concession area.
[20] Based on direct interview with villagers. Source: FPIC report.
[21] The Banjarese or commonly called Urang Banjar, originate from the South Kalimantan region. Some of them are also in Central Kalimantan and some in East Kalimantan.

In 1984, Indonesia performed a transmigration program in Katingan Regency. There were 12 transmigration villages[22] at that time, including Bumi Indah, Singam Raya, and Setia Mulya. At present, more than 30 years later, the transmigration villages have grown. Eight out of the 17 villages surrounding the project area are transmigration villages[23]. The transmigrants had a right to 2.25 hectares of land (one hectare of cleared land, 0.25 hectare for housing, and the remaining area in the form of forest). The majority of the population of the transmigration villages came from West Java, Central Java, and East Java.

In addition to land tenure rights, there are also customary management rights over tatah/canals by villagers, especially the Banjarese. Based on the FPIC report, the history of making tatah/canals started since 1938 when they were used as a source of inland fisheries. Over time, the tatah/canals were also used as transportation channels for illegal timber extraction especially after year 2000. However, since the Indonesian Government banned logging activities, many of the canals have been neglected and are no longer used by villagers. The tatah/canals were then returned back to their original function, as a source of inland fisheries. Currently, the tatah/canals have grown with many branches or intersections. However, only a few tatah/canals are still used for fishery.

2.1.6.2 Land Use

The land use in the surroundings of the project area is divided into several types of use, namely paddy fields, plantations, and settlements.

Most of the land is used for paddy fields. Such conditions occur in almost all engaged villages, both transmigrant and local. From 2018 to 2023, the Government of Indonesia constructed irrigation canals for paddy fields under the SIMURP project. The SIMURP project supports around 13,000 ha of existing paddy fields. A 10-km stretch of these irrigation canals is located inside the PUM concession, along its boundary.[24]

Besides paddy fields, there are plantations cultivated by the villagers such as rubber and coconut plantations. The coconut plantations are mainly cultivated by the local community in coastal villages such as Selat Baning and Satiruk. Besides, there is also land used for vegetable gardens and fruit trees such as durian. Villagers usually plant vegetables and fruit trees in their yard. Yard land is also commonly used to raise livestock, especially cows and goats. Another use of land in the villages is for construction of swiftlet houses in the residential yards.

Finally, the settlement areas consist of housing of villagers, public facilities such as schools, health centers, economic facilities, livelihood areas such as paddy fields, yards/fields, and economic facilities such as markets, stores, and others.

2.1.6.3 Local Transportation

The project area and surroundings are located in a remote area, about 200 km from the capital of the province, Palangkaraya, reached by land and water transportation. Land transportation using motor

[22] Manpower Agency of Katingan Regency.
https://distransnaker.katingankab.go.id/statis-14-datajumlahtransmigrasikab.katingan.html
[23] There are six transmigration villages out of the 13 project villages: Bumi Subur, Subur Indah, Makmur Utama, Jaya Makmur, Bangun Jaya, and Singam Raya.
[24] The overlapping area with SIMURP has been excluded from the project area.

vehicles takes about 5 hours' drive from Palangkaraya to Sampit, followed by water transportation from Sampit to the villages which takes about 5-6 hours.

Transportation is described to obtain a better understanding of the social parameters in the project area. The communities use both land and water transportation for their daily activities, such as accessing schools, public health facilities, or markets. The choice of transportation mode is influenced by factors including distance and accessibility.

2.1.6.4 Economic Activities

The livelihood patterns in villages surrounding the project area are directed at agriculture and fisheries, especially plantation crop farming. In addition to agriculture, the communities are engaged in the inland fisheries and marine fisheries sectors. Some local farmers also cultivate perennials/plantations. In addition to the agricultural sector, the population is engaged in services and home industries, such as making tofu and tempeh, home industry, and other micro, small, and medium enterprise (MSME) activities.

There are various types of economic facilities in the villages especially in the engaged villages of Katingan Kuala sub-district. These include, among others, markets, banks, kiosks/shops, restaurants, mini markets, mini-ATMs, and Village Unit Cooperatives or Village Unit Non-Cooperatives and village owned enterprises (BUMDes). In Satiruk Village, there is one village market in the area.

The market is a place of economic interactions among communities. It also serves as a place to observe the local business such as food crop agricultural products, home industry products (tofu, tempeh, noodles), and other home industry products.

2.1.6.5 Health and Sanitation

Health facilities in Katingan Kuala sub-district especially in the engaged villages are limited. Based on the statistical data, in the 12 villages of Katingan Kuala sub-district, a population of 17,062 is served by two community health centers (*Pusat Kesehatan Masyarakat*, Puskesmas) and 16 auxiliary community health centers (*Puskesmas Pembantu*, Pustu). The nearest hospitals are located in Banjarmasin and Sampit about 4-5 hours away by water taxi. There are 36 health workers in Katingan Kuala sub-district (1 doctor, 15 nurses, and 20 midwives).

Sanitation issues in the engaged villages include access to clean water and open defecation. The villages' proximity to the peatlands is the main cause of the lack of clean water for consumption due to high acidity and high iron content (pyrite, FeS_2). There are several water sources used by the villagers, among others river water, harvested rainwater, and wells. The most common source for washing and bathing purposes is river water, either used directly in the river or pumped and filtered. Communities in villages surrounding the project area still practice open defecation in the river.

Table 2-3. Water sources and usage by communities.

No	Water Sources	Drinking (%)	Cooking (%)	Washing clothes and kitchen utensils (%)
1	Rainwater	71.8	75.5	1.8
2	Refill Water	11.9	5.9	-
3	Bottled Water	0.4	0.2	-
4	River Water	11.3	12.2	35.3
5	Water spring in the forest	0.2	-	-

No	Water Sources	Drinking (%)	Cooking (%)	Washing clothes and kitchen utensils (%)
6	PAMSIMAS[25]	0.5	0.5	-
7	Wells	2.0	3.1	60.1
8	Drilled Wells	1.5	2.2	2.2
9	Did not answer	0.4	0.4	0.5

Source: Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project PT. Pagatan Usaha Makmur (Yayasan Puter, 2022)

Table 2-4. Bathroom and toilet facilities

No	Bathroom	%
1	Bathroom in their own house	68.6
2	Public bathroom	0.2
3	Pool	0.4
4	River	29.3
5	Did not answer	1.6

No	Toilet	%
1	River	22.7
2	Toilet at their own house with septic tank	46.6
3	Toilet at their own house without septic tank	27.8
4	Public Toilet with septic tank	0.9
5	Public Toilet without septic tank	0.7
6	Did not answer	1.3

Source: Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project PT. Pagatan Usaha Makmur (Yayasan Puter, 2022)

2.1.6.6 Education

Education facilities available in the villages for basic education include primary schools and junior high schools. Elementary school is available in each village, while junior high school is available in certain villages. The middle level education facilities or senior high school and vocational school are available in certain villages. Higher education, such as university or academic institution, is available in the cities such as Sampit or Palangkaraya (the capital city of province). A list of educational facilities is provided in Section 4.1.1.1. The distance and transportation between villages to the education facilities is one of the concerns in the project zone. The table below shows the classification of ease of reaching the education facilities.

Table 2-5. The ease of reaching the education facilities

Village	Elementary School		Junior High School		Senior High School			Higher Education
	SD	MI	SMP	MTS	SMA	MA	SMK	
Pagatan Hilir (urban-local)								
Pagatan Hulu (urban-local)								
Jaya Makmur								
Subur Indah								
Kampung Keramat (local)								
Singam Raya (local)								
Bangun Jaya								

[25] Clean water program and sanitation program https://pamsimas.pu.go.id/

Village	Elementary School		Junior High School		Senior High School			Higher Education
	SD	MI	SMP	MTS	SMA	MA	SMK	
Kampung Tengah								
Sungai Kaki								
Selat Baning								
Makmur Utama								
Bumi Subur								
Satiruk (local)								

Note:[26]

Available	Easy	Very Easy	Difficult	Very Difficult

Source: BPS Statistic Report of Katingan Kuala and Pulau Hanaut sub-districts 2021

The ease of reaching public education facilities is the main factor that determines education attainment in the villages. In 2020 the economically active population in Katingan Regency had limited educational attainment. The majority of this group has attained a basic level of education (elementary and junior high school). The statistical data on the education attainment is available for the regency level as seen in the table below.

Table 2-6. Population 15 Years of Age and Over by Educational Attainment in Katingan Regency

No	Educational Attainment	Katingan Regency	
		2016	2020
1	No Certificate	7.21%	12.17%
2	Elementary School	51.02%	28.11%
3	Junior High School	13.06%	30.61%
4	Senior High School	20.21%	22.06%
5	Vocational High School		1.49%
6	Associate degree (diploma 1 & 2)	2.03%	0.50%
7	Associate degree (diploma 3)	1.01%	0.94%
8	Professional	0.00%	0.00%
9	Bachelor degree and higher	1.22%	4.23%

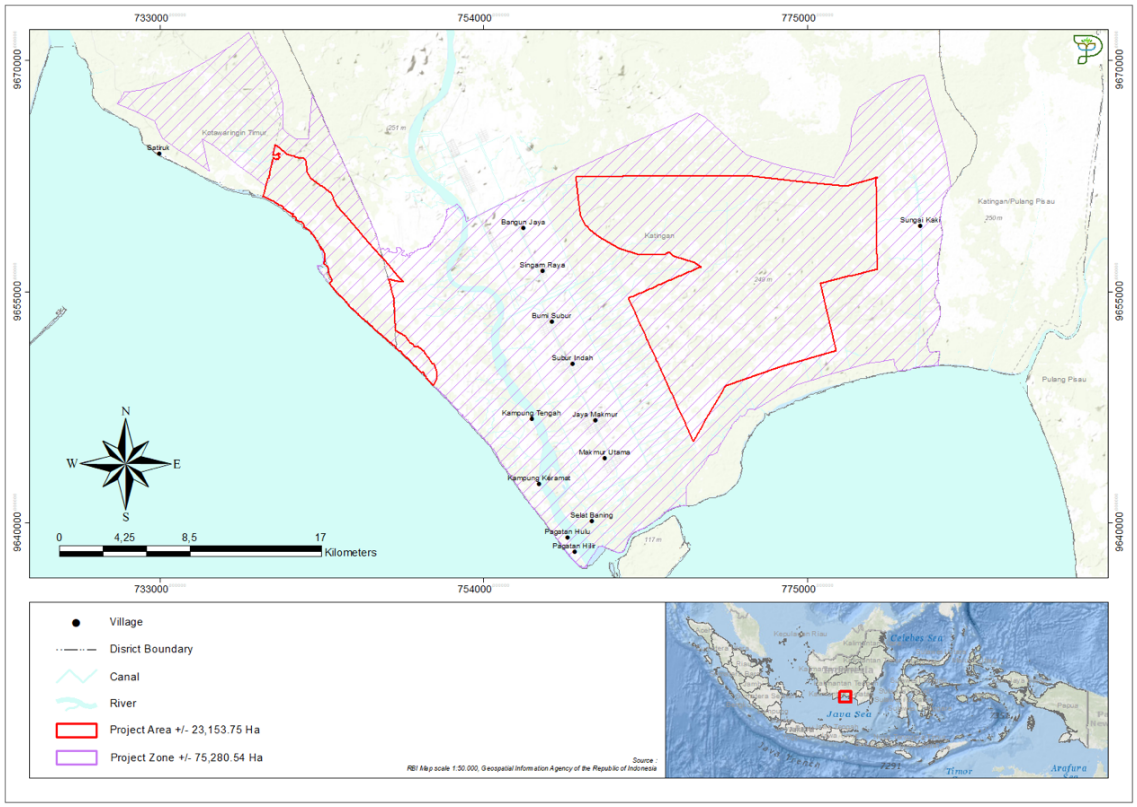
Source: BPS Statistic Report of Katingan Regency year 2016 and 2020

2.1.7 Project Zone Map (G1.4-7, G1.13, CM1.2, B1.2)

The PLUM Project has two boundaries, the boundary of the project area and the boundary of the project zone. The project area is the concession area of PT PUM with a total size of 23,631.51 ha, minus 477.76

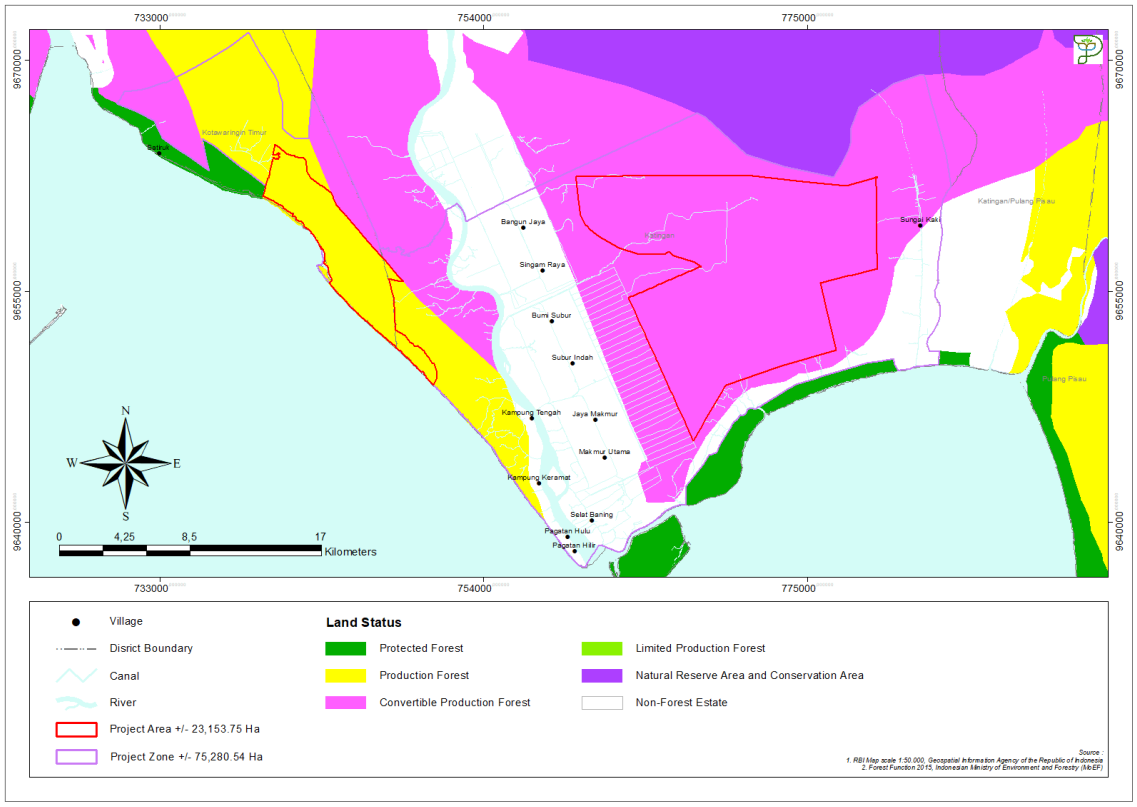
[26] Ratings were initially obtained from BPS data, but cross-referenced by the PLUM Project team based on field data of number of schools available and ease of access (see also Section 4.1.1.1).

ha of rice areas that were excluded from the project area in consultation with local stakeholders[27]. This project area (23,153.75 ha) is where the project activities aim to generate net climate benefits. The project zone is defined as the project area plus the surrounding area where the project activities directly affect land and associated resources, including activities related to the provision of livelihood improvement and community development. This project zone covers 75,280.54 ha of land (Map 2-7). The project zone boundary was determined based on village administrative boundaries (13 villages) and exclusion of conservation/protection areas (e.g., national park, protection forest, other ecosystem restoration concession).

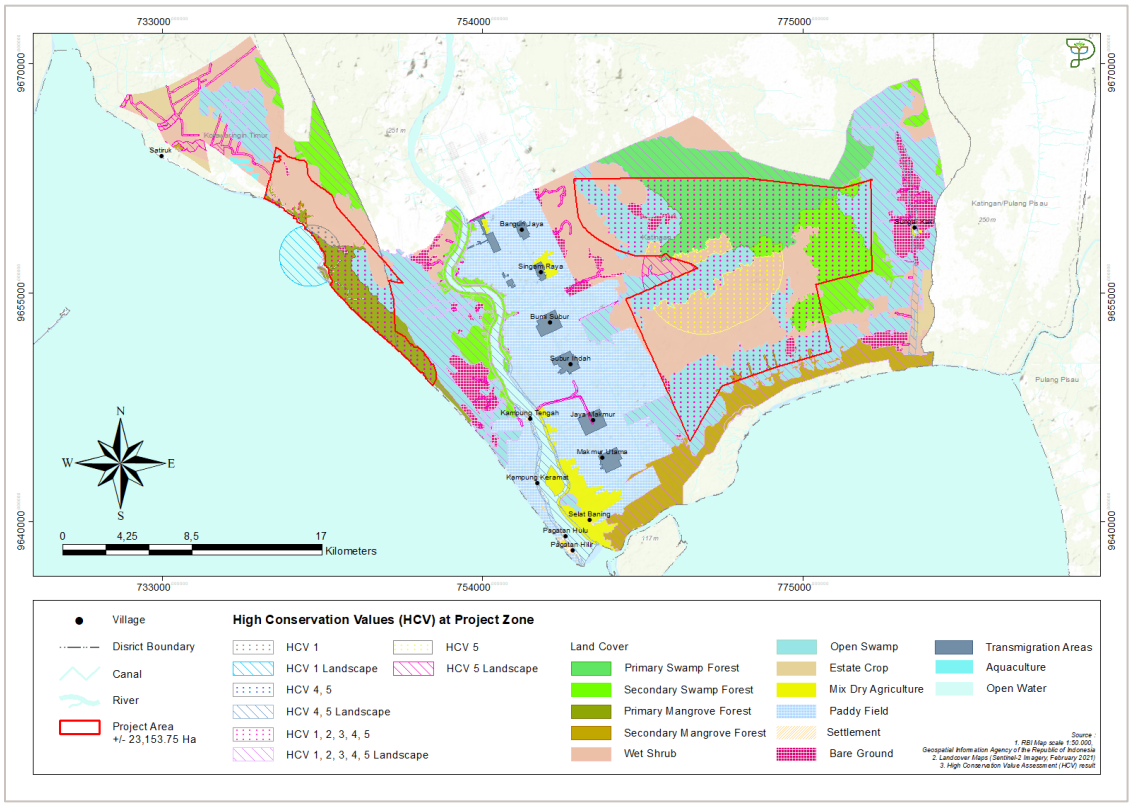


Map 2-7. Project area (red polygon) and project zone (purple polygon) of the PLUM Project

[27] The final license document refers to 23,665 ha. However, conservatively the area of 23,631.51 ha is used which refers to the approved coordinates for the principal license. The project area is 23,153.75 ha excluding 467.68 ha of SIMURP rice area and approximately 10 ha of rice area in the western part of the project.



Map 2-8. Land status in the project area



Map 2-9. Identified High Conservation Value (HCV) areas in the project zone

2.1.8 Stakeholder Identification (G1.5)

Stakeholders identified for the project include the project's communities and other stakeholders. The project's communities are defined as the communities in the villages of the project zone; other stakeholders are defined as the persons or institutions or groups of communities that impact or influence the project activities.

The identification of stakeholders was based on the following criteria:

1. Economic activities: communities that implement or intend to implement economic activities related to the use of land in the project area, including agriculture and fisheries.
2. Geographic location: communities that live in the surroundings of the project area.
3. Use of natural resources within the project area and customary use rights: communities who depend on forest-related activities, such as fishermen looking for fish in canals located in the project site or other extractive livelihoods such as forest honey or rattan seekers.
4. Other relevant stakeholders with interest in or influence over the project.

The identification process was conducted through participatory meetings and interviews with key contact persons in the villages, such as heads of village and local public figures. The stakeholder analysis was conducted through internal discussion and confirmation with key contact persons. The aim of the stakeholder identification and analysis was to identify the key stakeholders in the villages, including in relation to the decision-making process. A detailed stakeholder list and description is provided in the following section.

2.1.9 Stakeholder Descriptions (G1.6, G1.13)

Identified stakeholders are classified into three main groups, namely communities, community groups, and other stakeholders. The table below shows the stakeholders. Stakeholders were identified as per the process outlined in Section 2.1.8.

Table 2-7. Identified stakeholders within three main groups.

Stakeholder	Description	Role in the Project
Communities		
Village's residents	All groups of people who live in the villages located adjacent to the project area, and derive income, livelihood or cultural value	Project beneficiaries, engaged in project implementation
Community Groups		
Head of Village / Head of Urban Village	The Head of the Village Government who leads the implementation of Village Government	Decision-maker
Village Representative Body	Institution that carries out government functions whose members are representatives of the Village population based on regional representation and are determined democratically	Decision-maker
Mantir Adat	Mantir adat main task is to manage land and matters related to the related culture activities. Moreover, the land certificate must be checked by the Mantir before submitting to BPN (National Land Agency).	Decision-maker

Stakeholder	Description	Role in the Project
Religious leaders	Religious leaders are prominent and respected people as well as non-formal leaders in the community	Influencer
Youth Figures	Youth representatives	Influencer
Woman Figures	Women's groups representatives	Influencer
Village Owned Enterprises (BUMDes)	BUMDes are legal entities established by the village and/or with villages to manage businesses, utilize assets, develop investment and productivity, provide services, and/or provide other types of businesses for the greatest welfare of the village community	Business
Family Welfare Groups	A community organization that empowers women to participate in Indonesia's development	Influencer
Village Apparatus	Village apparatus consists of staff that assist the Village Head in policy formulation and implementation	Support to Village Head in managing the village administration business
Informal Community Leaders	Informal Community leaders (*Tokoh Masyarakat*) are people who have influence in the community, both formally elected community leaders and those obtained informally	Influencer and decision maker
Traditional Figures	A traditional figure is someone who has a traditional position in an order of peoples in an area	Decision-maker
Damang (community leader for sub-district area)	Damang Customary Heads are supervisors for Mantir at the sub-district level. They are also customary leaders who are appointed or elected based on the results of elections from several villages and sub-districts.	Decision-maker
Hunters	Residents who have hunting activities for a living, using simple hunting tools/snares	Affected livelihood group
Tatah/canal holder	Individuals/residents who first opened a canal (approximately 1.5 meters wide) that is used for transportation to the forest and fishing	Affected livelihood group
Civilian neighbourhood guards (Hansip)	The apparatus of village in maintaining peace and public order and enforcing Regional Regulations	Support to Village Head
Farmers	Residents who manage farmland cultivates land or crops or raises animals	Affected livelihood group
Head of Farmer Association	Farmer group is a group of farmers formed on the basis of similarity in environmental conditions and familiarity to increase business development. Farmer groups are the main actors become one of the agricultural institutions that spearhead agricultural development.	Influencer
Fishermen	Resident who engages in fishing (sea and/or river) as an occupation	Affected livelihood group
Honey Collectors	Residents who have a livelihood by looking for forest honey	Affected livelihood group
Other Stakeholders		
Provincial Government of Central Kalimantan Province	Government of Central Kalimantan Province, having authority in provincial-level policies and regulations	Regulator

Stakeholder	Description	Role in the Project
Regency Government – Kotawaringin Timur	Government of Kotawaringin Timur Regency, having authority in district-level policies and regulations	Regulator
Regency Government – Katingan	Government of Katingan Regency, having authority in district-level policies and regulations	Regulator
Sub-district Government	Government agency having authority in sub-district-level policies and regulations	Regulator
Sebangau National Park	National Park located adjacent to the project area	Forest Management Institution
Forestry Agency - Central Kalimantan Province/Dinas Kehutanan Provinsi Kalimantan Tengah	Government agency having authority in provincial-level policies and regulations related to Forestry	Regulator
Environmental Agency - Central Kalimantan Province/Dinas Lingkungan Hidup Provinsi Kalimantan Tengah	Government agency having authority in provincial-level policies and regulations related to Environmental	Regulator
Balai Besar Wilayah Sungai Kalimantan II	Under the Ministry of Public Works and Public Housing – responsible for carrying out the management of water resources in the river basin.	Regulator
Environmental Agency - Katingan Regency	Government agency having authority in district-level policies and regulations related to Environment in Katingan Regency	Regulator
Environmental Agency - Kotawaringin Timur Regency	Government agency having authority in district-level policies and regulations related to Environment in Kotawaringin Regency	Regulator
PT Rimba Makmur Utama (PT RMU)	Company implementing the Katingan Peatland Restoration and Conservation Project in Central Kalimantan that contributes to reducing carbon emissions through environmental-based initiatives	Business
Mendawai Village Forest Management Institution/Lembaga Pengelola Hutan Desa (LPHD) Mendawai	Social institutions established by Village Regulation (PERDES) whose job is to manage Village Forests which are functionally within the village organization and are responsible to the Village Head of Mendawai	Forest Management Institution
Sei Hambawang Village Forest Management Institution/Lembaga Pengelola Hutan Desa (LPHD) Sei Hambawang	Social institutions established by Village Regulation (PERDES) whose job is to manage Village Forests which are functionally within the village organization and are responsible to the Village Head of Sei Hambawang	Forest Management Institution
Kesatuan Pengelolaan Hutan Produksi (KPHP)	Production forest management organization whose territory mostly consists of production	Forest Management Institution

Stakeholder	Description	Role in the Project
Katingan Hulu Unit XVII	forest areas or is dominated by production forest areas.	
Bogor Agricultural University (IPB)	State-owned agricultural university based in Bogor, Indonesia	Support – as academic institution
Palangkaraya University	State-owned university located in Palangkaraya, Central Kalimantan	Support – as academic institution
Borneo Nature Foundation	Not-for-profit wildlife and biodiversity conservation and research organization that protects and safeguards tropical rainforests and the environment in Borneo.	Support – as non-profit conservation organization
Dompet Dhuafa	Health focused NGO	Support – as non-profit organization
PT Best Agro	Oil palm company	Business
PT Katingan Mujur Sejahtera	Oil palm company	Business
PT Katingan Sawit Bersama	Oil palm company	Business
PT Persada Era Agro Kencana	Oil palm company	Business
PT Pulang Pisau Antang Perkasa	Oil palm company	Business
PT Trubus Bumi Sejahtera	Oil palm company	Business

2.1.10 Sectoral Scope and Project Type

This project belongs to Sectoral Scope 14 for 'Agriculture, Forestry, and Other Land-Use (AFOLU)'. The project comprises REDD (APD) and ARR activities on peatland and tidal wetland as defined in VM0007 (Version 1.6). PLUM Project activities covered by the VM0007 include (1) Avoiding Planned Deforestation (APD), (2) Afforestation, Reforestation and Revegetation (ARR), (3) Restoration of Wetlands Ecosystems (RWE) on Peatland and Tidal Wetlands, and (4) Avoiding Planned Wetland Degradation (APWD) on Peatland and Tidal Wetlands.

The project is not a grouped project.

2.1.11 Project Activities and Theory of Change (G1.8)

The project aims to reduce emissions from planned deforestation and forest degradation while providing tangible climate, community, and biodiversity benefits. The area is directly threatened by the potential conversion to commercial oil palm plantation, which was successfully halted by the project. A portion of the project area is in a degraded condition due to historical logging, peatland drainage, and forest fires. Low community welfare surrounding the project area due to various causes, such as limited livelihood opportunities and low land productivity, have also indirectly threatened the integrity of the area through community agriculture expansion and illegal logging.

In the baseline scenario, the existence of commercial oil palm plantation in the area may provide some livelihood opportunities for the communities. However, it will not address the other issues currently faced by the communities, such as the limited access to health care services and education, limited livelihood opportunities and marketing of agricultural products, climate change, land degradation, and low water

quality and sanitation. The project was therefore established with the goal to conserve the remaining forest, restore ecosystem function, protect biodiversity, and improve the well-being of communities to become resilient to climate change. In addition to improving the livelihoods, the project also aims to improve communities' health and education.

The problem root analysis in the areas of community, climate and biodiversity is shown below:

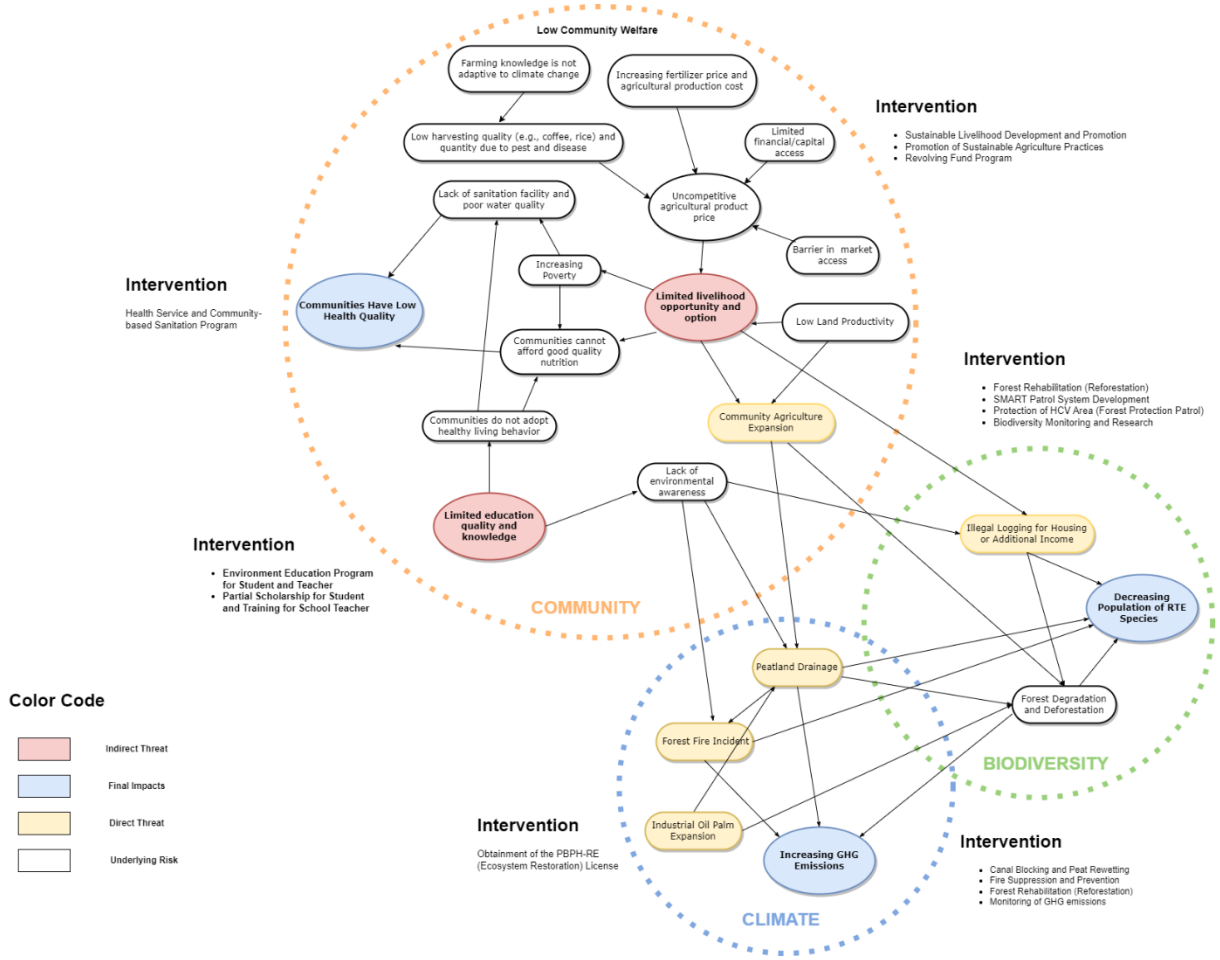


Figure 2-2. Schematic diagram of problem root analysis

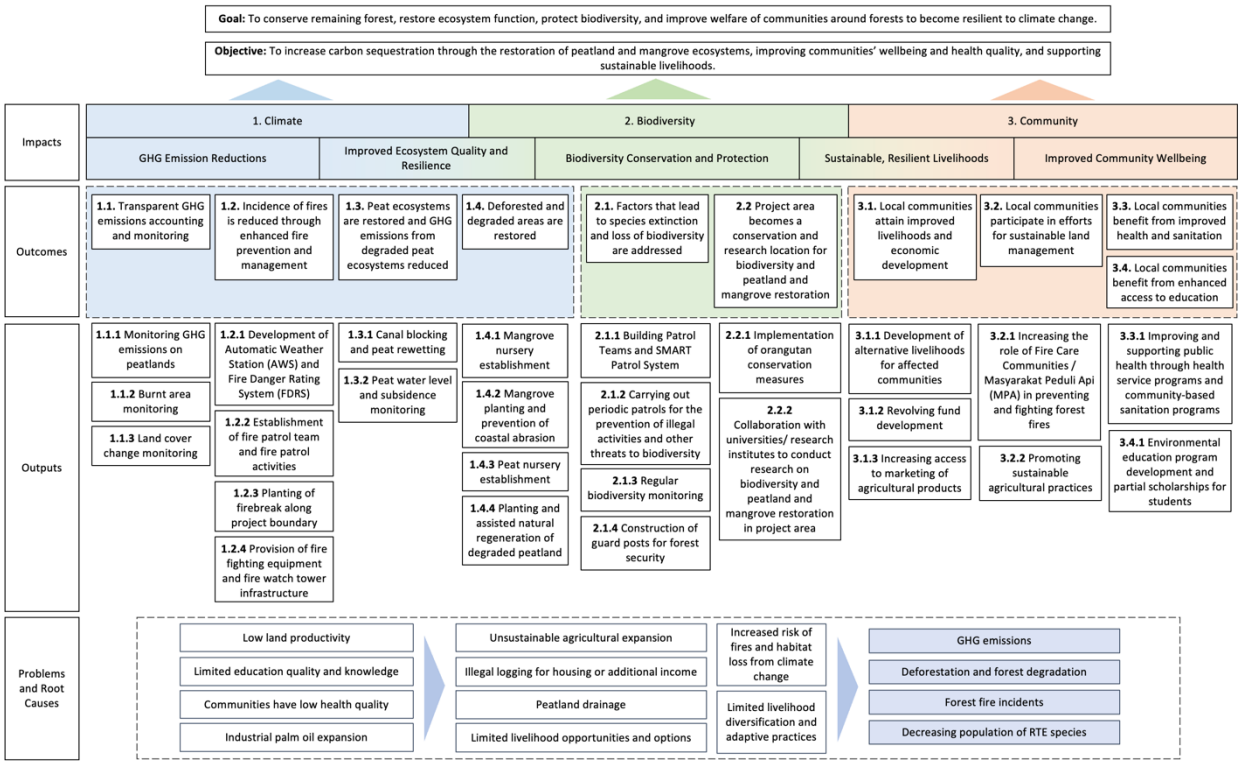


Figure 2-3. Theory of Change

The Theory of Change of the project is illustrated in the figure above. The overarching goal is supported through five specific impacts which will generate net benefits in the area of Climate, Community and Biodiversity, namely: (1) GHG emission reductions, (2) Improved ecosystem quality and resilience, (3) Biodiversity conservation and protection, (4) Sustainable, resilient livelihoods, and (5) Improved community well-being. These impacts are expected to be achieved through the outcomes, outputs and activities outlined below. It is anticipated that these outputs and outcomes will address the identified problems and root causes and lead to reduced GHG emissions, reduced deforestation and forest degradation, reduced biodiversity loss, increased resilience to climate change impacts, and improved local livelihoods and well-being. Obtaining the Forest Utilization Business License (PBPH) for the project area is considered a prerequisite for this Theory of Change.[28]

The project activities will be implemented with the close involvement of local leaders, local communities, and local government. The PLUM Project will also work closely with organizations such as the Borneo Nature Foundation and Dompet Dhuafa in the implementation of the activities on the ground (refer to Section 2.4.4). The project is not located within the jurisdiction of a REDD+ programme.

Outcome 1.1. Transparent GHG emissions accounting and monitoring

The project will establish a transparent GHG emissions accounting and monitoring system to ensure that the GHG emission reductions or removals are accurately quantified. This will enable the project to generate

[28] The Project succeeded in diverting the oil palm plantation license application process into Forest Utilization Business License (PBPH). The Project received the PBPH principal license from the Government of Indonesia in August 2022 and the definitive license in November 2023.

Verified Carbon Units (VCUs) and leverage financing for the project. Under the GHG emissions accounting and monitoring, the project will implement the following outputs.

Output 1.1.1 *Monitoring GHG emissions on peatlands*

GHG emissions on peatlands will be monitored. GHG measurement equipment will be installed, and long-term data on GHG flux on peatlands (CO_2, CH_4, etc.) be made available.

Output 1.1.2 *Burnt area monitoring*

The project will set up a system to monitor data on burnt area using drone photos or satellite images, remote sensing analysis and ground truthing. The data will allow the project to evaluate the fire prevention and restoration interventions and calculate the biomass and accumulated carbon in the area.

Output 1.1.3 *Land cover change monitoring*

In parallel, the project will establish a system for land cover change monitoring. This will enable the project team to monitor total area deforested and degraded as well as forest cover change, in particular the increase of forest cover from restoration activities.

Outcome 1.2. Incidence of fires is reduced through enhanced fire prevention and management

Along with climate change, wildfires are a serious threat to forest conservation efforts. Degraded or drained peatlands are more prone to fires and therefore may cause setbacks to restoration. Therefore, the project will invest systematic efforts to reduce and prevent forest fires in the project area and its surroundings. The development of a fire early warning system will be achieved by implementing a number of processes that enable the early detection of fires, including the socialization of fire protection, provision of facilities and infrastructure for fire prevention and extinguishment, periodic patrols and monitoring of hot spots.

Output 1.2.1 *Development of Automatic Weather Station (AWS) and Fire Danger Rating System (FDRS)*

An Automatic Weather Station (AWS) will be set up to collect weather data such as air temperature, precipitation, soil moisture, and water table depth. This data is critical to predicting fire risk, which is imperative to effective fire management. A Fire Danger Rating System (FDRS) will be put in place to systematically assess current fire danger and evaluate the factors influencing fire danger. The AWS and FDRS are important early warning tools in preventing peat fires. The information provided by these tools will be published for the community to increase their awareness of climate change issues.

Output 1.2.2 *Establishment of fire patrol team and fire patrol activities*

A fire patrol team will be established in parallel with the forest protection patrol under Output 2.1.1. It will carry out regular fire patrol activities depending on the fire danger rating, mostly in the dry season. The fire patrol will collaborate closely with the community firefighting team under Output 3.2.1. This effort aims to increase community participation in forest and land fire prevention.

Output 1.2.3 *Planting of firebreak along project boundary*

To prevent fire from spreading into the concession land, the project will plant firebreaks in vulnerable areas along the boundary of the concession. With this firebreak, it is expected that the risk of fire from outside the concession can be avoided. The firebreak species will be selected based on characteristic of their resistance to fire and the availability in the project area, such as but not limited to Galam (*Melaleuca leucadendron*), Tumih (*Combretocarpus rotundatus*), and Jelutung (*Dyera costulata*). Furthermore, they are adaptive to flood and stagnant water.

Output 1.2.4 *Provision of fire-fighting equipment and fire watch tower infrastructure*

The project will provide forest fire equipment to the fire patrol team, such as personal protective equipment, water pumps and hoses, as well as drones for monitoring. It will also build two forest fire watch towers in the project area, with a height of approximately 15 meters.

Outcome 1.3. Peat ecosystems are restored and GHG emissions from degraded peat ecosystems reduced

Output 1.3.1 *Canal blocking and peat rewetting*

A number of canals previously used for the transportation of logs and for fishing have resulted in the peat swamp forest being partially drained. For this reason, it is necessary to restore the peatland ecosystem by blocking canals. This will be done with the close involvement of the tatah/canal holders. Canal blocking activities will also involve local community as a way to provide alternative/additional income. Canal blocks will be made of wood and built manually. The design should allow fishermen with motorized canoe to pass to the fishing ground inside the concession.

Output 1.3.2 *Peat water level and subsidence monitoring*

The project will monitor the peat water level (through installation of dip wells) and subsidence (through subsidence poles) on a regular basis. Peat water level monitoring will be conducted daily, while the subsidence monitoring is scheduled every three months at sampling points.

Outcome 1.4. Deforested and degraded areas are restored

Output 1.4.1 *Mangrove nursery establishment*

A nursery will be established where seedlings will be raised and handled until they are ready for planting. The aim is to produce high-quality seedlings to increase the survival rate. It is anticipated that the following mangrove species will be grown in the nursery: Api api (*A. marina*, *A. lanata*, and *A. alba*), Bakau (*Rhizophora apiculata, Rhizophora stylosa*), Tancang (*Bruguiera* sp.), and Rambay (*Sonneratia caseolaris*). The project will only use native tree species and will prioritize species that are adapted to climate change (e.g., less vulnerable to temperature and salinity increase).

Output 1.4.2 *Mangrove planting and prevention of coastal abrasion*

Mangrove restoration activities will involve both planting and Assisted Natural Regeneration (ANR). In addition to planting activities, the project will ensure the maintenance of existing and newly planted mangroves. Maintenance will be carried out based on conditions found in the field, including controlling pest and diseases, and protecting the mangroves from attacks by crabs (*Crustacea* sp.), leaf and stem caterpillars, root fungus, barnacles/teritip and weeds (usually mosses).

Furthermore, the project will establish sediment traps to prevent coastal abrasion in the mangrove area. The sediment traps will consist of fences made of wood/bamboo stakes along eroded land. Soil will be deposited as sediment and the land will become suitable for mangrove planting. The sediment traps will also prevent mangrove seedlings from being washed away by sea waves.

Output 1.4.3 *Peat nursery establishment*

For the restoration activities in the peatland area, the project will establish a peat plant nursery. Seeds will be obtained in two ways: 1) seedlings; and 2) wildings. The species will be selected based on the adaptability to flood, their uses for the community and growth rate. Only local species will be used. The selected species include but are not limited to: Balangeran (*Shorea balangeran*), Jelutung (*Dyera costulata*), Ramin (*Gonystilus bancanus*), Bintaro (*Cerbera manghas*), Punak (*Tetramerysta glabra*), and Resak (*Cotylelobium lanceolatum*). The project will prioritize species that are adapted to climate change (e.g., that are resistant to floods and droughts).[29]

The target density for planting is 500 trees/ha in mature stage (20 cm DBH). Seedlings will be planted after they reach 30-50 cm in height or 5-6 months old from seeding time. Wildings will be collected from the remaining primary forest in the concession by involving the local community.

Output 1.4.4 *Planting and assisted natural regeneration of degraded peatland*

Historical illegal logging activities have caused serious damage to nearly two-thirds of the forest in the project area. This situation is exacerbated by fires occurring due to the deterioration of the peat ecosystem. The project will carry out reforestation and ANR activities to restore damaged and lost forests, using native species that are ecologically adapted to the conditions of the peat and mangrove ecosystems. Extreme weather events such as heavy rains, floods and droughts will be taken into account when determining the timing of the planting. Communities who rely on the forests for wood will be involved, for example, through planting schemes for alternative, sustainable sources of wood and/or alternative income sources.

[29] For example, the Balangeran tree (*Shorea balangeran*) has been found to have relatively high survival rates and tolerance to saturated conditions, indicating a degree of resilience to environmental stressors such as flooding. Tata HL, *et al.* (2022). Flooding tolerance of four tropical peatland tree species in a nursery trial. PLOS ONE 17(4): e0262375. https://doi.org/10.1371/journal.pone.0262375

Outcome 2.1. Factors that lead to species extinction and loss of biodiversity are addressed

Output 2.1.1 *Building Patrol Teams and SMART Patrol System*

Forest protection patrol teams will be established, consisting of permanent staff and involving local communities. The patrol teams will address preventive issues including illegal logging, forest fire, and other threats.

The project will adopt the Spatial Monitoring and Reporting Tool[30] (SMART) Patrol System, a system that allows data to be collected and stored digitally into a centralized database. This system will help provide standard, accountable and transparent data. The system will serve as a tool to monitor natural and human-induced threats, as well as trigger species, and biodiversity in general.

Output 2.1.2 *Carrying out periodic patrols for the prevention of illegal activities and other threats to biodiversity*

The protection of remaining forests and biodiversity will be ensured through regular patrols. The forest protection patrol teams will regularly patrol the forest using the SMART Patrol System on foot or using motorized canoe depending on the condition. Additionally, the project team will conduct regular joint patrols at least once a year together with local stakeholders.

Output 2.1.3 *Regular biodiversity monitoring*

The project will regularly monitor the three trigger species as well as other threatened species (species listed as CR, EN, VU in the IUCN Red List) in the project area using a standardized monitoring protocol. Permanent transect plots for flora and fauna monitoring will be established within the project area and field staff will be trained for flora/fauna identification, monitoring protocols, and data analysis.

Output 2.1.4 *Construction of guard posts for forest security*

Forest protection infrastructure in the form of guard stations and shelters will be built to create favorable conditions for forest protection. Sign boards will be installed along the boundary of the concession with the surrounding villages. The sign boards will contain information on the project area boundary and on fire prevention.

Outcome 2.2. Project area becomes a conservation and research location for biodiversity and peatland and mangrove restoration

Output 2.2.1 *Implementation of orangutan conservation measures*

The project will implement orangutan conservation measures, to be identified in collaboration with local conservation organizations and relevant government agencies. The project area may serve as an orangutan release location for rescued/displaced orangutans.

[30] https://smartconservationtools.org/

Output 2.2.2 *Collaboration with universities/ research institutes to conduct research on biodiversity and peatland and mangrove restoration in project area.*

The project will develop collaboration with universities/research institutes and students to conduct research on biodiversity (including climate change impacts on biodiversity), and peatland and mangrove restoration in the project area.

Outcome 3.1. Local communities attain improved livelihoods and economic development

Output 3.1.1 *Development of alternative, resilient livelihoods for affected communities*

The low economic and educational level of the community means that people often rely on forest resources for their livelihoods. Therefore, the project aims to create sustainable alternative livelihoods to increase incomes of local communities and reduce the pressure on forests, while increasing adaptive capacity of local communities to climate change. Initial options for sustainable livelihood development have been identified in consultation with local communities and include agroforestry, mangrove honey, local coffee, duck and chicken rearing, and small-scale fishponds. These activities are intended for the impacted communities such as fishermen, former loggers and others. The activities cover the training, start-up capital, and technical assistance. As part of the project's livelihood activities, the project will regularly discuss climate change impacts with local communities and identify additional measures that can be integrated into the project activities to ensure that they are adaptive to climate change. When selecting agroforestry crops in consultation with local communities, the project will take into account climate change considerations building on both scientific and local knowledge. For example, tree species will be selected that are resistant to flood and drought.

Output 3.1.2 *Revolving fund development*

Limited access to financial infrastructure makes it difficult for communities to develop alternative livelihoods that have the potential to enhance their well-being. The project will enhance access to financial resources through a revolving fund mechanism that helps households, especially vulnerable groups, develop sustainable alternative livelihoods and income sources. A revolving fund will be made available to local livelihood groups, including women's groups, and/or micro, small, and medium enterprises (MSMEs). The targeted groups of the program are low-income households, women's groups, and villagers in general. It is expected that these activities will contribute to strengthening the resilience of local communities to climate change, in particular for vulnerable groups including women and poorer households.

Output 3.1.3 *Increasing access to marketing of agricultural products*

In parallel with alternative livelihood development and access to financial resources, the project will support enhanced marketing and market access for agricultural products such as honey and coffee. This will enable local communities to increase and diversify their income sources.

Outcome 3.2. Local communities participate in efforts for sustainable land management

Output 3.2.1 *Increasing the role of Fire Care Communities / Masyarakat Peduli Api (MPA) in preventing and fighting forest fires*

Cooperation with the local community is considered critical to prevent forest fires. The project will establish Fire Care Communities (*Masyarakat Peduli Api*, MPA) in the villages surrounding the project area. These community groups will be trained on how to handle forest fires. The project also plans to distribute forest fire prevention posters, awareness raising on the negative impacts of burning, among others. This effort aims to increase community participation in forest and land fire prevention.

Output 3.2.2 *Promoting sustainable, resilient agricultural practices*

Low agricultural land productivity is one of the root causes of low incomes and poverty and can put more pressure on the project area. To increase the productivity of existing community lands, address land degradation and increase resilience to climate change, the project will develop a Sustainable Agriculture Program for farmers. This will include training and assistance on good agricultural practices (e.g., sustainable agriculture, organic farming, home gardens, etc.). Best practices will be introduced such as crop rotation, integrated pest management, agroforestry, and tillage management. In designing and implementing these activities, the project will take into account climate change considerations building on both scientific and local knowledge.

Outcome 3.3. Local communities benefit from improved health and sanitation

Output 3.3.1 *Improving and supporting public health through health service programs and community-based sanitation programs*

Limited access to health services and sanitation facilities is one of the contributing factors to poor health outcomes in the project zone. A program of health services and community-based sanitation development will be implemented to improve the quality of public health in the project area. In particular, the project aims to reduce the prevalence of stunting among children in the target villages.

The project will provide the local community health centres with needed equipment such as infant scales and will cooperate with local NGOs working in the health sector to provide health services and health education for the local communities.

In addition, the project will implement activities to improve sanitation in the target villages. It will assist households in adopting Clean and Healthy Behavior (*Perilaku Hidup Bersih dan Sehat* or PHBS), will develop clean water facilities as well as toilets and septic tanks.

Outcome 3.4. Local communities' benefit from enhanced access to education

Output 3.4.1 *Environmental education program development and partial scholarships for students*

Limited education quality and knowledge of the communities on the local environment is one of the existing root causes of low levels of development and land and forest degradation. This lack of

knowledge has resulted in environmentally damaging activities (opening lands by burning, draining peatlands, etc.). To improve this condition, the project will implement an Environmental Education Program for students and teachers. Furthermore, the project will provide partial scholarships for students and will provide local senior high school students with internship opportunities.

2.1.12 Sustainable Development

The project activities are expected to contribute to the United Nations Sustainable Development Goals (SDGs), especially goals number 1, 3, 5, 6, 12, 13, 14, and 15. The relevant SDG targets and indicators are included in Appendix 13: Monitoring Plan. These priorities are aligned with Indonesia's national sustainable development indicators as outlined in Indonesia's Medium Term Development Plan (RPJMN) 2020-2024[31], including in the areas of reducing poverty, ensuring environmental sustainability, gender mainstreaming, low-carbon development, and land and forest restoration[32].

Table 2-8. Project contribution to SDGs

Sustainable Development Goals	Application in the Project
	The project contributes to the achievement of SDG 1 on ending poverty. The project aims to provide sustainable alternative livelihoods as well as employment opportunities to surrounding communities. Initial options for sustainable livelihood development have been identified in consultation with local communities. For example, the development of agroforestry and ecologically compatible agriculture with the peat/mangrove ecosystem will be implemented together with the community. In addition, economic development based on natural solutions will be achieved based on existing potentials, such as mangrove honey, local coffee, and other products. Support will be provided to increase market access for these products. A revolving fund will also be implemented with local livelihood groups to improve access to financial resources.
	The project contributes to the achievement of SDG 3 on good health and well-being. Sub-districts in Indonesia, specifically in remote area, generally have one auxiliary community health center (Pustu), with one nurse and midwife. The provided facilities are basic and generally provide the community with limited health services. The project will support the Pustu with additional equipment and health services for communities, as well as introduce healthier habits related to sanitation such as avoiding or reducing open defecation practice. Through these interventions, the project aims to reduce the prevalence of stunting among children in the target villages.

[31] https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/migrasi-data-publikasi/file/RP_RKP/Narasi-RPJMN-2020-2024-versi-Bahasa-Inggris.pdf
[32] The RPJMN 2020-2024 has mainstreamed 118 SDG targets.

Sustainable Development Goals	Application in the Project
	The project contributes to the achievement of SDG 5 on gender equality. All project activities will encourage the participation of all residents of the villages, especially women, youth, and marginalized people. The project is committed to implementing Gender and Social Inclusion (GESI) in all its activities. The project will provide equal opportunities to women, vulnerable, and other groups to be involved and participate in all activities, including the hiring process for employment opportunities in the project. Additionally, the project will support the establishment of women's groups in the target villages to promote economic opportunities for women.
	The project contributes to the achievement of SDG 6 on clean water and sanitation. Clean water and sanitation is one of the major issues in the project zone. The project will provide sanitation facilities for communities and will support the adoption of Clean and Healthy Behavior (*Perilaku Hidup Sehat dan Bersih* or PHBS) in the target villages. It will also help increase access to clean water. Additionally, through the conservation and rewetting of peatlands, the project supports the protection and restoration of wetland ecosystems, contributing to securing water quality and availability in the project zone.
	The project contributes to the achievement of SDG 12 on responsible consumption and production. Through actions that encourage the sustainable management of natural resources, sustainable agriculture and the recovery of degraded areas, the project promotes the conservation of natural resources, coupled with socioeconomic development. The project will support the development of sustainable value chains for marketing of local agricultural products, generating income and well-being for local communities while promoting the sustainable use of natural resources. Finally, the project will increase awareness for sustainable development by implementing an Environmental Education Program.
	The project contributes to the achievement of SDG 13 on climate action. All activities undertaken by the project aim to take action to combat climate change and its impacts by reducing deforestation and forest degradation in the project area and consequently reducing greenhouse gases emissions. It will also address climate change by restoring mangrove and peatland areas. Furthermore, the project will contribute to climate change adaptation by increasing the resilience and adaptive capacity of local communities and ecosystems to climate change.
	The project contributes to the achievement of SDG 14 on life below water through the conservation and restoration of mangrove ecosystems. Mangroves serve as a natural filter leading to improved water quality and a reduction in erosion, which enhances the health of surrounding ecosystems. Mangroves also provide habitat for marine species populations through their contribution as a spawning ground and by providing shelter from predators.

Sustainable Development Goals	Application in the Project
	The project contributes to the achievement of SDG 15 on life on land. It supports the conservation and restoration of forests and wetlands by reducing deforestation and restoring degraded ecosystems. The project also supports the conservation of 31 species that are classified as Critically Endangered, Endangered, and Vulnerable in the IUCN Red List in the project area. The conservation program aims to protect the diversity of plants and animals and their ecosystems.

2.1.13 Implementation Schedule (G1.9)

Key dates and milestones in the project's development and implementation are presented in table below. The start and end dates for the GHG accounting period are 01 August 2022 – 31 July 2082. Monitoring and verification schedule is from 01 August – 31 July each year. The first monitoring report is planned to be prepared for the period 01 August 2022 – 31 July 2024, and verification is currently envisioned for August 2024.

Table 2-9. Project implementation and milestone

Date	Milestone(s) in the Project's Development and Implementation
Jan – Jul 2022	Project Preparation. Some activities in this milestone: (1) Introductory meetings, FPIC process and livelihood assessment (2) Social and biodiversity baseline assessments (3) Initial recruitment of project staff
Aug – Dec 2022	Initiation of project activities. Some activities in this milestone: Protection Activities: (1) Establish Forest Protection and Fire Patrol Teams (2) Develop SMART patrol system (3) Patrol implementation (4) Provision of forest fire handling equipment (5) Installation of sign board along the boundary of concession and village Community Development: (1) Community consultations and alternative livelihood identification (2) Health Services for villages
Jan 2023 – Jul 2026	Short-term period of project activities Protection Activities: (1) Forest protection and fire patrol implementation (2) Provision of forest fire handling equipment (3) Forest fire monitoring tower construction (4) Installation of Automatic Weather Stations (AWS) and establishment of online Fire Danger Rating System (FDRS) (5) Installation of sign board along the boundary of concession and village (6) Construction of guard posts

Date	Milestone(s) in the Project's Development and Implementation
	(7) Canal blocking and regular maintenance of canal blocks (8) Establishing peat water level and subsidence monitoring locations (9) Peat water level and subsidence monitoring (10) Establishing permanent biodiversity monitoring plots/transects (11) Biodiversity monitoring Reforestation Activities (intensive planting and Assisted Natural Regeneration for mangrove & peat ecosystems): (1) Planting of deforested/degraded mangrove areas and maintenance (2) Planting of degraded peat areas and maintenance (3) Construction of sediment traps to prevent shoreline abrasion and maintenance Community Development: (1) Development of alternative livelihoods for affected communities (2) Revolving Fund Development (3) Health and Sanitation (4) Education (5) Climate smart agriculture
Aug 2026 – Jul 2030	Medium-term period of project activities Protection Activities: (1) Forest protection and fire patrol implementation (2) Provision of forest fire handling equipment (3) Climate parameters monitoring (AWS) (4) Peat water level and subsidence monitoring (5) Canal blocking and regular maintenance of canal blocks (6) Maintenance of sign board along the boundary of concession and village (7) Biodiversity monitoring Reforestation Activities (intensive planting and Assisted Natural Regeneration for mangrove & peat ecosystems): (1) Planting of deforested/degraded mangrove areas and maintenance Planting of deforested/degraded peat areas and maintenance (2) Construction of sediment traps to prevent shoreline abrasion and maintenance Community Development: (1) Development of alternative livelihoods for affected communities (2) Revolving Fund (3) Health and Sanitation (4) Education
Aug 2030 – Jul 2082	Long-term period of project activities Protection Activities:

Date	Milestone(s) in the Project's Development and Implementation
	(1) Forest protection and fire patrol implementation (2) Provision of forest fire handling equipment (3) Installation of GHG flux tower (4) Monitoring greenhouse gas emissions on peatlands (5) Maintenance of canal blocks (6) Climate parameters monitoring (AWS) (7) Peat water level and subsidence monitoring (8) Maintenance of sign board along the boundary of concession and village (9) Biodiversity monitoring Reforestation Activities (intensive planting and Assisted Natural Regeneration for mangrove & peat ecosystems): (1) Planting of deforested/degraded mangrove areas and maintenance (2) Planting of deforested/degraded peat areas and maintenance (3) Maintenance of sediment traps Community Development: (1) Development of alternative livelihoods for affected communities (2) Revolving Fund (3) Health and Sanitation (4) Education

2.1.14 Project Start Date

The project start date was set on 1st August 2022, which is when the project received the principal approval from the Government of Indonesia for PBPH[33]. First field staff had already been recruited and established prior to August 2022, but regular project activities on the ground that lead to GHG reduction/removal (forest protection patrols, installment of sign boards, fire prevention and management, etc.) started since August 2022.

2.1.15 Benefits Assessment and Crediting Period (G1.9)

The start date of the project crediting period is August 1st, 2022. The end date is July 31st, 2082 for a total period of 60 years. There will be continuous monitoring of the benefits to the climate, communities and biodiversity throughout the duration of the project.

2.1.16 Differences in Assessment/Project Crediting Periods (G1.9)

There will be no differences between the assessment period and the crediting period of the Project.

[33] The principal license for PBPH was granted to PT PUM by the Ministry of Investment on August 1st 2022 (Decision of the Head of Investment Coordination No.01082211116206001). This was followed by the definitive license for PBPH granted to PT PUM by the Ministry of Investment on November 27th, 2023 (Decision of the Head of Investment Coordination No.02200084122050002).

2.1.17 Estimated GHG Emission Reductions or Removals

The total VCUs from all project activities for the 60 years project crediting period is 69,999,940 tCO_2e or 1,166,666 tCO_2e per annum (Table 2-10).

Table 2-10. The total estimated ex-ante Verified Carbon Units (VCUs) from all project activities

Year	Estimated GHG emission reductions or removals (tCO_2e)
1	954,128
2	951,917
3	922,545
4	930,769
5	942,582
6	970,060
7	1,003,745
8	1,026,477
9	1,038,384
10	1,085,850
11	948,534
12	855,850
13	892,451
14	942,425
15	957,082
16	1,146,548
17	1,066,931
18	1,134,835
19	1,297,736
20	1,313,033
21	1,368,274
22	1,506,047
23	1,341,710
24	1,148,260
25	1,169,583
26	1,193,633
27	1,212,529
28	1,221,930
29	1,237,816
30	1,251,729

Year	Estimated GHG emission reductions or removals (tCO_2e)
31	1,247,195
32	1,234,258
33	1,230,837
34	1,219,611
35	1,207,035
36	1,201,786
37	1,195,444
38	1,195,189
39	1,336,393
40	1,325,058
41	1,192,112
42	1,189,851
43	1,191,380
44	1,193,013
45	1,194,843
46	1,195,529
47	1,196,781
48	1,200,937
49	1,198,972
50	1,201,039
51	1,211,214
52	1,209,270
53	1,219,024
54	1,222,856
55	1,323,658
56	1,245,189
57	1,345,657
58	1,271,404
59	1,281,543
60	1,289,468
Total estimated ERs	69,999,940
Total number of crediting years	60
Average annual ERs	1,166,666

2.1.18 Risks to the Project (G1.10)

The project used the AFOLU Non-Permanence Risk Report Excel Calculation Tool, v4.2 (Appendix 7: AFOLU Non-permanence Risk Report) where the overall risk rating of 17% was determined. The risk factors were classified into three categories: internal risks, external risks and natural risks, and into subcategories such as project management, financial viability and community engagement. The project was evaluated considering each of the risk factors suggested by the tool. A description was made of the applicability of the risk factor and a score was assigned to each factor by category and subcategory. A summary of the main risks and mitigation actions identified is provided below. A more detailed risk report can be found in Appendix 7: AFOLU Non-permanence Risk Report.

Table 2-11. Main risks identified in the AFOLU Non-Permanence Risk Report.

No	Risk	Mitigation Measures
1	**Internal Risk:** Opportunity Cost: Net Present Value (NPV) from the most profitable alternative land use activity is expected to be between 50% and up to 100% more than from project activities.	1) Based on the NPV calculation (Appendix 4: NPV Calculation), the estimated NPV of the baseline scenario is USD 72.3 million, while the NPV of the PLUM Project was estimated at USD 37.8 million. The project proponent potentially holds about 50% opportunity cost compared to the baseline NPV. This risk is mitigated through the project proponent's legally binding agreement (license) to continue management practices that protect the credited carbon stocks over the duration of the project crediting period.
2	**External Risk**: Land Tenure and Resource Access or Impacts: Local communities access the project area for fishing, timber collection, and non-timber forest products (NTFPs).	1) Project area is protected by a legally binding commitment (i.e., the license) to continue management practices that protect carbon stocks for the duration of the project crediting period for 60 years (Decision of the Head of Investment Coordination No.02200084122050002). 2) The project has undertaken due process to identify any customary rights and access to the project area. Please refer to Sections 2.3.3 (stakeholder meetings), 2.5.3 (FPIC) and Appendix 5: FPIC Consultation Report. The project will not restrict the customary rights of local communities and will continue to allow access for fishing, NTFP collection, and access to tatah/canals. Logging and wood collection will no longer be permissible (by law); the project will work closely with affected individuals to provide alternatives.
3	**Natural Risk**:	Anthropogenic fires that occur in the project area are considered an external risk. The project has

No	Risk	Mitigation Measures
	Fire. Fires do not naturally occur in undisturbed tropical peatland and mangrove areas since this type of ecosystem is naturally waterlogged. Fires that occur in tropical peatland areas are anthropogenic and occur mainly on degraded peatlands[34]. Pest and disease outbreaks. Extreme Weather events such as heavy rains, floods, and droughts.	designed mitigation activities to prevent future fires in the project area (e.g., fire prevention patrols, canal blocking/peat rewetting, etc.) as described in Section 2.1.11. It is not anticipated that there will be pest and disease outbreak in the natural forest ecosystem, although climate change may increase this risk. By protecting and restoring the forest ecosystem, the project proponent will increase the resilience of forests to pest and disease outbreaks. Any occurrence of pest and disease will be monitored by the project. Please refer to Section 2.1.11. The project proponent develops an extreme weather protocol to mitigate risk to the project area. An Automatic Weather Station (AWS) is installed to collect weather data such as air temperature, precipitation, soil moisture, and water table depth. The project will use drought-resistant species and will adjust timing of planting in the case of extreme weather events such as floods and droughts. Please refer to Section 2.1.11.

Other risks to the expected climate, community, and biodiversity benefits identified by the project and mitigation measures to address them are summarized below.

Table 2-12. Identified Risks and Mitigation Measures.

Identified Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
1. Stakeholder risk: Lack of support from local stakeholder groups	Activities that generate climate, community, and biodiversity benefits are not supported by local stakeholders.	The project will work closely with local leaders and local communities to co-design and co-implement project interventions. This approach ensures that local stakeholders are involved in the decision-making process and that the project aligns with local needs and priorities.

[34] Page, S. *et al.* (2009). Tropical peatland fires in Southeast Asia. In: Tropical Fire Ecology. Springer Praxis Books. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-77381-8_9

Identified Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk
2. Market/financial risk: demand and/or prices decrease in the voluntary carbon market	The project's financial resources may decline if demand and/or prices for VCUs decrease.	The project will diversify its marketing strategy to mitigate this risk.
3. Implementation risk: Travel restrictions due COVID-19 or similar future pandemic	The project's activities and generation of benefits may be delayed or otherwise affected in case of a future pandemic.	The project will implement adaptive management and will use virtual means of communication if it becomes necessary.
4. Technical risk: Restoration failure in mangrove and peat restoration activities	Restoration failure would impact the climate benefits of the ARR activities.	The project will work closely with local experts and local stakeholders to ensure the restoration activities are planned and implemented in the most effective way that is resilient to climate change impacts. This approach will involve conducting thorough assessments of the site, selecting appropriate restoration techniques, and monitoring the progress of the restoration activities. By working closely with local experts and stakeholders, the project ensures that the restoration activities are effective and sustainable.

2.1.19 Benefit Permanence (G1.11)

The project is designed to be sustained for at least 60 years as per the license granted. The license can be extended by up to 90 years as per Indonesian regulations[35] to enhance the climate, community and biodiversity benefits beyond the project's lifetime.

The project's community development activities are designed to increase the quality of life of local communities and community groups. They are designed to build the capacity of the local communities in the long term and benefits are expected to endure beyond the lifetime of the project. The project will support alternative livelihoods by providing training and initial seed capital through a revolving fund, and by enhancing market access. It will also implement activities to improve health and sanitation and will improve access to higher education for local youth.

Regarding maintaining the project's climate benefits, the project will rewet the peatlands by building canal blocks, which is a recognized method of restoring the hydrology of this degraded area. This will lower the risk of fire in the landscape and enable the restoration of natural vegetation over the course of the project. In addition, the project will also increase the forest cover in the area by protecting remaining forests and

[35] Government Regulation (Peraturan Pemerintah) No. 23/2021 (clause 150) and MoEF Regulation (PermenLHK) No. 8/2021 (clause 75).

performing ARR activities. The restoration and conservation of peat and mangrove forests will increase the resilience of ecosystems to future climate impacts. Furthermore, the project also helps build long-term adaptive capacity of the local communities.

In terms of biodiversity benefits, the project will conduct forest protection patrols and biodiversity monitoring. Protecting the remaining forest from conversion to oil palm plantation and restoring deforested areas in the project area will provide a habitat extension and enhance connectivity to the larger forest areas in the project zone (e.g., Sebangau National Park to the north of project area) which will be beneficial for the long-term viability of key species population. Adaptive management will be undertaken, and local communities will be closely involved to ensure long-term benefits for biodiversity. The project's activities are described in more detail in Section 2.1.11.

2.1.20 Financial Sustainability (G1.12)

The project proponent is a visionary conservation company, led by an experienced CEO with support from long-term partners and investors. The project proponent has been demonstrating the commitment to the project by developing an integrated long-term plan which covers conservation, restoration, and community development. The financial projections of the company are classified as commercially sensitive information and will be shared with the audit team on a confidential basis.

2.1.21 Grouped Projects

Not Applicable

2.2 Without-project Land Use Scenario and Additionality

2.2.1 Land Use Scenarios without the Project (G2.1)

The PLUM Project is located in Katingan and Kotawaringin regencies, Central Kalimantan Province. The project area is under the management of PT PUM, who holds the forest utilization business license (PBPH) for 60 years in a total area of ±23,665 ha since 27th November 2023 (Decision of the Head of Investment Coordination No.02200084122050002). This PBPH is the definitive license to the earlier principal license that was granted to PT PUM by the Ministry of Investment since 1 August 2022 (Decision of the Head of Investment Coordination No.01082211116206001).

Prior to PT PUM receiving its principal PBPH license, the project area was designated to become hybrid coconut oil plantation in 2009 (Katingan Regent Decree No.335/2009) and oil palm plantation in 2011 (Katingan Regent Decree No.525/229/KPTS/VIII/2011). An environmental permit for oil palm plantation was granted to PT PUM in 2013[36], followed by other administrative steps and approvals. PT PUM's area was planned to be developed as an oil palm plantation along with two other companies adjacent to the area (PT Katingan Mujur Sejahtera or PT KMS to the east and PT Trubus Bumi Sejahtera or PT TBS to the south). All three companies were owned by a company group named PT Agro Inti Semesta (PT AIS)[37]. Additionally, in 2022, an approval to convert forest land into oil palm plantation was given to another oil palm company (PT Katingan Sawit Bersama or PT KSB[38]) not associated with PT AIS located along the western boundary

[36] Decree of Environmental Permit for Development of Oil Palm Plantation PT PUM (No.525.21/172/KPTS/IV/2013)
[37] Previously Agro Investama Group (AIG).
[38] Not affiliated with PT AIS.

of PT PUM, reflecting that the project zone was envisioned as an oil palm production area (Map 3-2). These oil palm plantations are/were on Convertible Production Forest (*Hutan Produksi Konversi*, HPK) land[39]. PT KMS already started its operation since 2013. Without the PLUM Project, it is highly likely that PT PUM's area would have continued to be developed into an oil palm plantation by PT AIS.

Prior to the project initiation, the area was already in degraded condition due to historical logging activities and forest fires. In 2015, about 1,079 ha of the remaining peat swamp forest was burnt by forest fires which was likely the result of small-scale communities' activities (e.g., illegal logging, fishing, hunting) and exacerbated by the El Niño event. At the time, PT PUM was not yet operating as an oil palm plantation as it was still in the process of obtaining all the necessary approvals. This situation demonstrates that, prior to the project initiation, activities were not implemented to generate GHG emissions for the purpose of their subsequent reduction.

Hence, in the absence of the project, the land use of the project area would in the most likely scenario have become oil palm plantation with no activities to reduce and remove the GHG emissions. Oil palm plantation becomes the baseline scenario for the project, and the rate of deforestation is further explained in Section 3.1.4 with the associated appendix (Appendix 3: Proxy Deforestation Report). Other alternative land use scenarios in the absence of the project are described in Section 3.1.4, including conservation project (without being registered as a VCS AFOLU project), industrial acacia plantation, logging concession, smallholder agriculture/farming, unprotected forest, and protected forest.

2.2.2 Most-Likely Scenario Justification (G2.1)

The most-likely scenario that would happen in the project area is that the area would be converted to oil palm plantation. In 2009, the project area was designated to become hybrid coconut oil plantation (Katingan Regent Decree No.335/2009). In 2011, the project area was designated to become oil palm plantation and had obtained a Plantation Business Permit (*Izin Usaha Perkebunan* or IUP) (Katingan Regent Decree No.525/229/KPTS/VIII/2011). As explained above, an environmental permit for oil palm plantation was granted to PT PUM in 2013, followed by other administrative steps and approvals. PT PUM was planned to be developed as an oil palm plantation along with two other companies adjacent to the area (PT KMS to the east and PT TBS to the south), owned by the same group, PT AIS. In 2013, PT KMS started operating at the east-side of PT PUM's concession (Map 3-2). In 2015, PT TBS obtained a Plantation Business Permit. In 2022, an approval to convert forest land into oil palm plantation was given to another oil palm company (PT KSB) not associated with PT AIS located to the west of PT PUM. Hence, even though the project area is on state-forest land, the government has regulated and allows the conversion of state-forest land into non-state-forest land. Considering that, prior to the project initiation, the project area had been granted an oil palm license and that the adjacent areas to the project area have and will become oil palm plantations (i.e., PT KMS, PT TBS, PT KSB), it is very likely that in the absence of the project, the project area would have become oil palm plantation.

2.2.3 Community and Biodiversity Additionality (G2.2)

In the absence of the project, the community and biodiversity benefits of the project would not occur. The project benefits for community include improved access to health services through village health service

[39] Except for PT TBS and partial area of PT KMS, which is on non-state forest land (*Areal Penggunaan Lain*, APL). For PT PUM, 82.56% of the area was on HPK (convertible production forest) and 17.44% on HP (production forest) land.

improvement program, higher education for children through scholarship assistance programs and collaboration with universities, income generation as company's workers and from livelihood development activities, increased access to clean water through village water supply programs (i.e., drilled wells), and hydrology system improvement to prevent fires and floods in residential and farm areas (see Section 4.5). The project benefits for biodiversity include the conservation of critically endangered species (i.e., Bornean orangutan) through habitat patrols and monitoring activities, restoration of peat and mangrove ecosystems through replanting of native tree species and water table management and assisting in natural regeneration (see Section 5.5).

Regarding the community's economic situation, six villages that are directly adjacent to PT PUM's concession are categorized as underdeveloped villages (see Section 4.1.1.3) and over 50% of villagers in the project zone are below the national poverty line of IDR 2,120,371/month per household[40]. Based on the livelihoods assessment conducted by the project, the average income in the villages of the project zone ranges from IDR 266,667/month to IDR 2,900,862/month per household, with an average of 1,886,397/month per household[41]. In terms of education, there has been an increase in the number of public schools in the villages but access to schools remains a challenge. From the 13 villages in the project zone, only four have a junior high school and two have a senior high school[42]. Regarding access to the nearest healthcare facility, each village has at least one healthcare facility supported by healthcare professionals. However, this facility is usually not open 24 hours and only two villages (Jaya Makmur and Pagatan Hulu) have a doctor (general practitioner).[43] Furthermore, the nearest hospitals are in Sampit, Kasongan and Banjarmasin, and it takes 5-7 hours of travel by river to reach them.

Regarding biodiversity conservation, the project will provide protection to the high biodiversity in the area and improve the habitat quality by restoring deforested and degraded areas. Since the project area is situated less than 2 km south of Sebangau National Park, the third largest national park in Kalimantan, the project will serve as a habitat extension and thus enhance habitat connectivity to the national park. This will be beneficial for the long-term viability of biodiversity within the landscape. The project will also address the threats of repeated fires in the project area and high human-disturbance (i.e., canals, logging, poaching) that lower the natural habitat quality.

Under existing laws, regulations, and governance arrangements, the project area would have likely become an oil palm plantation as demonstrated by the granted licensed in 2011 (Katingan Regent Decree No.525/229/KPTS/VIII/2011), followed by other administrative steps and approvals, as well as the development of the adjacent oil palm concessions. There are no laws or regulations that require the project activities to be implemented, nor that prevent the project area from being converted into oil palm plantation.

In conclusion, the project activities to conserve the critically endangered species and improve community livelihoods would not occur under the without-project scenario, as the project area (i.e., forest, peat and

[40] In 2021, the national poverty line was set at a per capita expenditure of Rp 450,185/month (approx. USD 28/month) or Rp 2,120,371 (USD 132)/month per household (4.71 members per household).
Poverty Line (Rupiah/Kapita/Month) By Province and Area - BPS-Statistics Indonesia and Indonesia Poverty Profile - BPS-Statistics Indonesia (accessed Jan 30, 2024)
[41] Yayasan Puter (2022). Preparation of Empowerment Program in Affected Livelihood Groups Ecosystem Restoration Project PT. Pagatan Usaha Makmur (PT. PUM) (in Bahasa Indonesia)
[42] Jaya Makmur and Pagatan Hulu each have a senior and a junior high school. Subur Indah and Satiruk have a junior high school. Source: internal identification data by PUM's team.
[43] Please refer to Sections 2.1.6.5 and 4.1.1.1 for more information on healthcare facilities in the project zone.

mangrove ecosystems) would have been converted to oil palm plantation. If the project activities are not implemented, there will be no improvement in economy, education, health, and biodiversity conservation.

Based on the NPV analysis by PT PUM (Appendix 4: NPV Calculation), the oil palm plantation's NPV (USD 72.3 million) is almost twice as high as the ecosystem restoration concession's NPV (USD 37.8 million). With oil palm plantation being a common business in Indonesia, many financial institutions and government policies support the business and provide ease of access to financing. This situation is in contrast with an ecosystem restoration business that mainly relies on carbon finance as the main revenue. With limited access to finance (i.e., investment, loan), it is difficult for the project to access financial support to develop and implement the project activities in the absence of the carbon project. Hence, financial support to implement the project activities remains a significant barrier under the without-project scenario.

2.2.4 Benefits to be used as Offsets (G2.2)

This project does not currently intend to use any community and biodiversity benefits described above (see Section 2.2.3) as offsets. The project might, in the future, apply for certification under the SD Vista Nature or another relevant biodiversity credit framework. The additionality for community and biodiversity benefits is demonstrated in the section above.

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

The project provides stakeholders with access to documents and other project information in oral, written, and virtual form, as described below:

1. Regular coordination. Regular coordination will be undertaken by PT PUM for government at different levels (i.e., national, provincial, regency, and village governments). For community stakeholders, the coordination will be undertaken through village meetings. Furthermore, PT PUM staff will be permanently based in the field office and at the head office in Jakarta.
2. Printed version of project documents. The project description document (PD), monitoring reports, validation and verification reports and project activities reports will be available in English and in Bahasa Indonesia for consultation both at the project's head office in Jakarta and in the field office. Information and news related to the project will also be conveyed through village information boards.
3. Online access. Documents related to the project are available through virtual means on Verra and the project website (www.plumproject.id).

2.3.2 Dissemination of Summary Project Documents (G3.1)

There are three types of stakeholders involved in this project, namely government, local communities, and business entities. Summary project information has been disseminated to local stakeholders during the introductory meetings and FPIC process as described in Section 2.3.3. For all stakeholders, the summary of project documents will be shared and given access to through regular coordination, printed documents at the project offices and village information boards, and online resources through Verra and the project website (www.plumproject.id).

Specifically for communities, the project documents and monitoring reports will be shared through village meetings and village information boards. Regular communication will occur during the project lifetime, as the project will closely involve the community in the project activities. Furthermore, the project will have a dedicated team to engage with community to ensure that the project is benefiting the community and obtains consent from community prior to implementing project activities. Hence, the communication will be continuous. Formally, at least two village meetings will be conducted annually to disseminate project activities updates and reports.

2.3.3 Informational Meetings with Stakeholders (G3.1)

Community meetings were conducted in all villages prior to the implementation of project activities. The meetings were publicized through the village leaders and were attended by the heads of village, community group representatives, and the project representatives. The meetings had two objectives: first, as an introductory meeting to the project, and second, to gather initial opinions of the communities about the project. These introductory meetings were followed by the FPIC process in each of the villages.

A total of 13 villages are included as the target for community beneficiaries in this project. Eight out of these 13 villages have granted their consent and have signed an agreement with the project. The FPIC process is still ongoing in the remaining five villages. Main issues highlighted by communities are to make a distinct boundary between PT PUM and communities' lands, and ensure benefits from the project to the community. A summary of informational meetings with stakeholders (as part of the FPIC activities) is provided in Table 2-13 below (refer to Appendix 5: FPIC Consultation Report for more detail on FPIC process including evidence of consent). Meetings and consultations with local communities will be continued throughout the life of the project.

Table 2-13. Summary of conducted stakeholder meetings.

No	Village	Date	Notes
1.	Kelurahan Pagatan Hulu	8 February 2022	Focus group discussion (FGD) and FPIC Socialization.
		14 February 2022	The FGD activities took place at the Pagatan Hulu Village Head Office, with continuing agenda from the previous meeting.
2.	Kelurahan Pagatan Hilir	8 February 2022	FGD and FPIC Socialization
		14 February 2022	The FGD activities took place at the Pagatan Hilir Village Head Office, with continuing agenda from the previous meeting.
3.	Jaya Makmur	12 February 2022	FGD and FPIC Socialization
		17 February 2022	• The Village Team was formed and ratified simultaneously through a community deliberation process that was present in the FGD activity. • The signing of the Memorandum of Understanding (MoU) or agreement reached by both parties between Jaya Makmur Village and PT PUM.

No	Village	Date	Notes
4.	Subur Indah	11 February 2022	The FGD activities took place at the Subur Indah Village Multipurpose Hall.
		16 February 2022	Continuing previous FGD's agenda
		12 March 2022	The signing of the MoU or agreement reached by both parties between Subur Indah Village and PT PUM.
5.	Kampung Keramat	8 February 2022	The FGD activities took place at the Kampung Keramat Village Hall.
		14 February 2022	The signing of the MoU or agreement reached by both parties between Kampung Keramat Village and PT PUM.
6.	Singam Raya	11 February 2022	The FGD activities took place at the Singam Raya Village Hall.
		16 February 2022	Continuing previous FGD's agenda
		19 February 2022	Discussions were held with the Head of Singam Raya Village to gather opinions and directions for the continuation of the FPIC process.
7.	Bangun Jaya	11 February 2022	The Village Team was formed and ratified simultaneously through a community deliberation process that was present in the FGD activity.
		16 February 2022	The signing of the MoU or agreement reached by both parties between Bangun Jaya Village and PT PUM.
8.	Kampung Tengah	8 February 2022	The FGD activities took place at the Kampung Tengah Village Hall, with FPIC socialization as the agenda.
		16 February 2022	The FGD activities took place at the Kampung Tengah Village Hall, with continuing FPIC socialization as the agenda.
		18 February 2022	Meeting with the Kampung Tengah Village Team at the Kampung Tengah Village Office to discuss plans to check the concession boundaries.
		20 February 2022	The process of checking the boundaries of project proponent's concession area with Kampung Tengah Village.
9.	Sungai Kaki	9 February 2022	The FGD activities took place at Sungai Kaki Elementary School.
		10 February 2022	Continuing previous FGD's agenda
10.	Selat Baning	13 February 2022	The FGD activities took place at the Selat Baning Village Hall.
		17 February 2022	Continuing previous FGD's agenda
		14 March 2022	The signing of the MoU or agreement reached by both parties between Selat Baning Village and PT PUM.
11.	Makmur Utama	12 February 2022	The FGD activities took place at the Makmur Utama Village Hall.
		17 February 2022	The signing of the MoU or agreement reached by both parties between Makmur Utama Village and PT PUM.

No	Village	Date	Notes
12.	Bumi Subur	11 February 2022	The FGD activities took place at the Bumi Subur Village Hall.
		16 February 2022	Continuing previous FGD's agenda
		14 March 2022	The signing of the MoU or agreement reached by both parties between Bumi Subur Village and PT PUM.
13.	Satiruk	12 February 2022	The FGD activities took place at the Satiruk Village Hall.
		28 May 2022	The signing of the MoU or agreement reached by both parties between Satiruk Village and PT PUM.

2.3.4 Community Costs, Risks, and Benefits (G3.2)

One of the initial activities carried out by PT PUM was to conduct socialization and provide explanations to the surrounding community about the impacts that may be caused by the project's ecosystem restoration activities, including the costs, risks and benefits from the project. From the FPIC process, the possible negative impacts from the project to the communities relate to the rights, livelihoods and cultures of the local communities, such as restrictions on customary land and resource rights, increased centralization of forest management and fairness of benefit sharing.

The project has provided initial information to communities regarding the costs, risks, and benefits of the project as reflected in the FPIC report (see Appendix 5: FPIC Consultation Report). As FPIC is an iterative and continuous process, the project expects that some adjustments related to communities' benefits will be undertaken as community expectations from the project evolve over the project lifetime. So far, the project has learned that communities expect benefits on livelihoods, education, and health (refer to Section 4.2.1). The project will maintain active community participation as a prerequisite for the realization of community benefits and will regularly discuss expectations from the carbon project with the community. Along the project lifetime, more detailed and clear benefits will be defined in the project. So far, however, the community has understood and provided consent on the potential costs, risks and benefits that they will receive because of the project.

2.3.5 Information to Stakeholders on Validation and Verification Process (G3.3)

Participating communities in the project will be informed about the CCB and VCS validation and verification schedule by the project's site team. They will also be informed if any participation is required from their community and residents. Prior to the validation and verification, the project team will conduct a site visit to provide information to the villages through the village leaders.

2.3.6 Site Visit Information and Opportunities to Communicate with Auditor (G3.3)

The project team will inform the communities in the engaged villages about CCB and VCS validation and verification activities approximately three weeks prior to the site visit. The preparation process will cover the following activities:

- The project team will prepare validation and verification materials, such as the PD document and all supporting documents, as well as the summary validation and verification information for the communities.
- The project team will approach and explain the activities to the engaged villages' leaders.
- Meetings with community beneficiaries of project activities will be arranged in consultation with the auditor. The arrangement can be adjusted to the needs of the auditor to ensure direct and independent communication between the communities and the auditor.
- The project team will create a visiting route considering the distance, time, and transportation between one village to another village, and the forest area within the project area.

2.3.7 Stakeholder Consultations (G3.4)

Stakeholder consultations are being conducted as part of the FPIC process. The first phase of consultations was undertaken in 2022 to introduce the project in general, consult on the project activities, and obtain the communities' consent, as described in the FPIC report (see Appendix 5: FPIC Consultation Report). Within the communities, several community groups were identified and consulted who influenced the project design, including wood loggers, farmers, fishermen, women's groups, and village communities in general. These groups provided input to the project as part of the risk mitigation strategy for minimizing potential negative impacts on their livelihoods. For community groups who engage in activities that are not legally permissible (i.e., wood loggers), the project proposed alternative solutions to mitigate the illegal activities while maintaining community participation through livelihood activities (e.g., agroforestry).

Furthermore, consultations were held regarding the SIMURP project, which constructed irrigation canals for paddy fields that partially overlap with PT PUM concession. The SIMURP project supports around 13,000 ha of existing paddy fields in the project zone. A 10-km stretch of the irrigation canals is located inside the PUM concession. Based on communities' input, the irrigation and community farms located inside PT PUM have been excluded from the project area.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

The project proponent will maintain regular and frequent communication and consultation with communities. The communication and consultation processes are part of the project's adaptive management, an iterative process to identify the most effective management actions in achieving the project's goal.

The project proponent will implement an adaptive management approach, which involves relevant communities. The project proponent will use regular meetings as the channel for this communication. The meetings will provide an opportunity to gather inputs, suggestions, and opinions from communities. The inputs will be noted and considered in improving the project actions, as described in Figure 2-4 below.

As part of the adaptive management approach, the project will regularly discuss climate change impacts with local communities and identify additional measures that can be integrated into the project activities to ensure that they are adaptive to climate change.

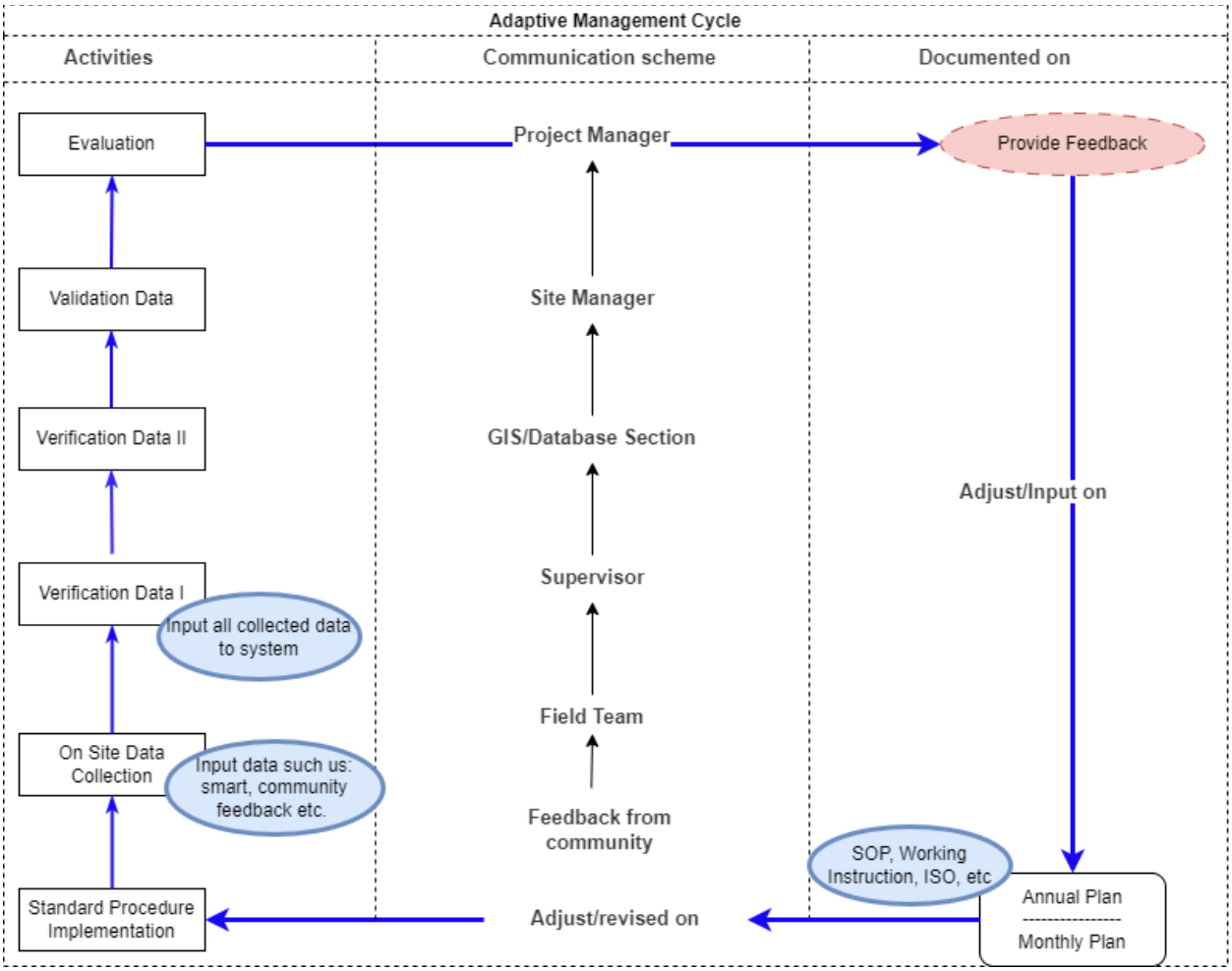


Figure 2-4. Schematic diagram of adaptive project management.

2.3.9 Stakeholder Consultation Channels (G3.5)

As described in Section 2.3.4, several meetings have been held between the communities and the project proponent. This communication and accessibility for discussion on the progress of project activities between stakeholders and proponents will occur continuously throughout the duration of the project through various channels:

- Information board in each village
- Direct communication with the heads of village and relevant local stakeholders
- Formal letter to the heads of village and other stakeholder institutions

2.3.10 Stakeholder Participation in Decision-Making and Implementation (G3.6)

Local communities will be engaged in the activity planning and the implementation process, especially for activities that influence or require the involvement of local communities, such as livelihood-related activities. Meetings related to the project activities implementation will be open to all community members and will be arranged through the village leaders in line with local customs. The project proponent will encourage women's groups to participate in the meetings. The project has activities that are specifically intended for

women's groups, including providing revolving fund. Furthermore, the project will encourage women to participate in field activities such as nursery, mangrove planting, and other community development activities.

2.3.11 Anti-Discrimination Assurance (G3.7)

The project operates under the constitution, laws and regulations of Indonesia. With regard to discrimination, the project will comply with the constitution and relevant laws, among others:

- Constitution 1945 (UUD 1945) especially section 27
- Law No. No. 40/2008 on the elimination of racial and ethnic discrimination
- Law No. 1/2023 concerning the criminal law code

In addition, the project will comply with any regulations on manpower and safety of workers, among others Law No. 1/1970 on the Occupational Safety (Occupational Safety Law). All employees will receive an induction on work safety, employment and be provided with an employee pocketbook when they join the company.

The company will implement best practices in recruiting employees, including implementing a policy of zero tolerance for sexual harassment and no discrimination to gender, religion, ethnicity, and sexual orientation while taking into account job availability, educational background and workforce skills.

2.3.12 Feedback and Grievance Redress Procedure (G3.8)

The project's grievance procedure includes grievance registration, verification, identification of possible solutions with the complainant, taking action to resolve grievances, reporting and monitoring the result. All grievances will be processed within a specific timeframe (generally within 15 working days), in a transparent and accountable manner.

The complainant should submit the grievance verbally or in writing to the project office. After receiving the grievance, the project will response through formal letter to the complainant. Based on the grievance, the project team will develop a necessary action plan, implement, monitor, evaluate and communicate the action and result to the complainant. Figure 2-5 depicts the grievance process involving several parties.

Moreover, in the FPIC process, there was an agreement between the project proponent and the community on a conflict resolution mechanism consisting of:

1. Project proponent and community will conduct an investigation regarding the related dispute.
2. Project proponent and community will discuss to reach deliberations and consensus.
3. If deliberation and consensus do not produce a meeting point, then a third party will be appointed as a mediator agreed by both parties.
4. If all efforts to reach a consensus have not been able to resolve the dispute, then both parties agree to bring it to the level of law in force in Indonesia.

The grievance procedure lays out the ways in which complainants submit or deliver grievances, as well as the ways in which the project handles the grievances. Unless the complainant requests anonymity, the complainant should provide clear identity (name, address, ID number, phone) and description of the grievance as well as the background, expectation, and evidence.

The project and the project proponent have zero tolerance for threats, intimidation, violence, or reprisals towards any complainants or their representative(s). The principles of protection of Human Rights, Complainants, and Community Spokespersons will be adhered to, including:

- Peaceful Resolution of Disputes
- Confidentiality
- Anonymity if requested
- Participation and Informed Consent
- Conflict of Interest
- Equality and non-discrimination
- Prevention
- Protection

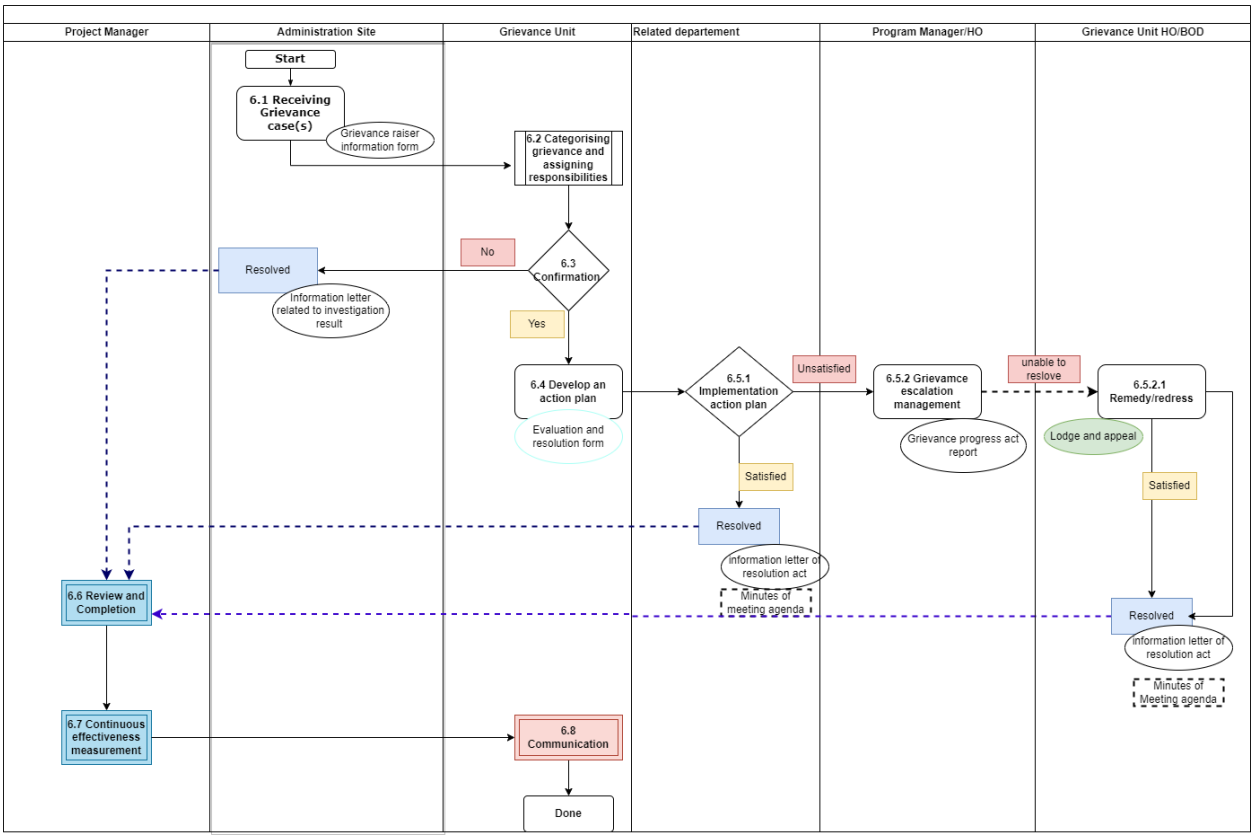


Figure 2-5. The schematic diagram of the project's grievance process

2.3.13 Accessibility of the Feedback and Grievance Redress Procedure (G3.8)

The feedback and grievance redress procedure will be communicated to the local communities through community meetings and village boards and will be accessible to all villagers. Complainants can submit grievances verbally or in writing to the project office. The grievances and project responses will be documented and reported every six months by the project team and, unless confidential, made available for stakeholders to view at the project office upon request.

2.3.14 Worker Training (G3.9)

The qualification and empowerment of local stakeholders are essential to ensure quality in implementation of the proposed actions, as well as to ensure the permanence of results and positive long-term impacts. The following worker training will be implemented by the project to ensure that local capacity is built. The project will document all training materials and processes to ensure that the expertise and skills of local staff are captured and preserved.

Table 2-14. The project's workers training.

Training	Description	Participant
Carbon MRV	Field and classroom-based training on installing equipment and conducting monitoring of biomass, water level and peat depth	Project employees
SMART Patrol	Field and classroom-based training on conducting patrol based on digital system to reduce threats to the forest. Training includes setup of desktop database, collecting patrol data using smartphone/tablet and storing data	Communities and project employees
Biodiversity Survey Methods	Field and classroom-based training on conducting monitoring on biodiversity including flagship and key species such as orangutan, gibbon and proboscis monkey	Communities and project employees
Good Agricultural Practice	Field and classroom-based training regarding coffee planting, agroforestry and sustainable paddy farming	Communities
New Potential Livelihoods	Field and classroom-based training to increase quality of existing livelihoods such as financial planning and create alternative new livelihoods especially for woman and youth	Communities
Data and Information management	Classroom-based training regarding data collection procedure, storing and distribution.	Project employees
Forest Fire Prevention and Suppression	Field and classroom-based training on fire suppression including fire suppression strategy, equipment,	Communities and project employees

Training	Description	Participant
	mitigating fire risk and safety procedures	
Peat hydrology/rewetting	Field and classroom-based training on water management and canal blocking	Communities and project employees
Restoration methods and techniques	Field and classroom-based training regarding forest rehabilitation includes selecting appropriate species, silviculture, nursery management, assisted natural regeneration, and tree planting.	Communities and project employees
Working Safety	Field and classroom-based training regarding safety procedures to be implemented while working in the forest and water bodies	Project employees

2.3.15 Community Employment Opportunities (G3.10)

All community members will have equal opportunity to apply for employment opportunities offered by the project. Workers will be selected based on a competitive recruitment process implemented by the project proponent. Women and vulnerable groups will be encouraged and given equal opportunity to apply for all positions, including management positions, if the requirements for the vacancy are fulfilled.

2.3.16 Relevant Laws and Regulations Related to Worker's Rights (G3.11)

Indonesian employment law is governed by Law No. 13/2003, dated 15 March 2003, regarding Manpower (Labour Law), as amended by Law No. 11/2020, dated 2 November 2020, and as amended by Perpu (Government Regulation in lieu of Law) No. 2 year 2022 dated 30 December 2022 regarding Job Creation (Job Creation Law) (Labour Law, as amended). The government has issued the following regulations to implement the Labour Law:

- Government Regulation No. 35/2021, dated 2 February 2021, regarding Fixed-Term Employment Agreement, Outsourcing, Working Hours and Rest Hours, and Termination of Employment (GR 35/2021); and
- Government Regulation No. 36/2021, dated 2 February 2021, regarding Wages (GR 36/2021)

The other main statutes are:

- Law No. 2/2004, dated 14 January 2004, regarding Industrial Relations Dispute Settlement; and
- Law No. 21/2000, dated 4 August 2000, regarding Labour Unions.

In addition to the above laws and regulations, employers and employees are also subject to the relevant company regulations (or work rules) or collective labour agreement (CLA), as applicable, as well as the provisions of the employment agreement between the employer and employee. Workers will be informed about their rights during the recruitment and induction process.

2.3.17 Occupational Safety Assessment (G3.12)

Within the proposed project activities, there are certain risks associated with the activities that can generate a negative impact on the health and safety of the participants due to the project's nature in peat and mangrove ecosystems. Potential risks include:

- Accidents due to improper handling of tools
- Insect and spider bites
- Snake bites
- Wildlife attacks (bears, wild boars)
- Falls, which can lead to contusions, fractures, sprains, etc.
- Overturning of boats
- Drowning
- Exposure to fire and smoke during fire management activities
- Getting lost in the field during patrolling activities

To reduce the risks associated with each activity, the project will hold meetings and trainings prior to the implementation of the activity where, in addition to discussing technical issues, the risks and measures to mitigate them are discussed. The measures proposed to minimize risks are designed in such a way that they are aligned with the cultural practices of the community, so that these safety measures are easily accepted and complied with by the communities involved. For example, the project will provide navigation tools and markings on clothing, work in a buddy system, require the use of personal protective equipment (PPE), and provide anti-snake venom serum. A Manual on Safety and Health at Work including SOPs will be provided with the aim to achieve zero incidents. Incident reporting forms and an emergency plan to ensure occupational safety during activities carried out within the framework of the project are also presented, in accordance with legal requirements.

2.4 Management Capacity

2.4.1 Project Governance Structures (G4.1)

PT Pagatan Usaha Makmur is the project proponent and main entity to lead project design and implementation. PT PUM was and will be supported by other entities in the project design and implementation, as described in Sections 2.1.4 and 2.4.4.

The project will be managed by the project proponent. The organization structure of the project team is shown in Figure 2-6 below.

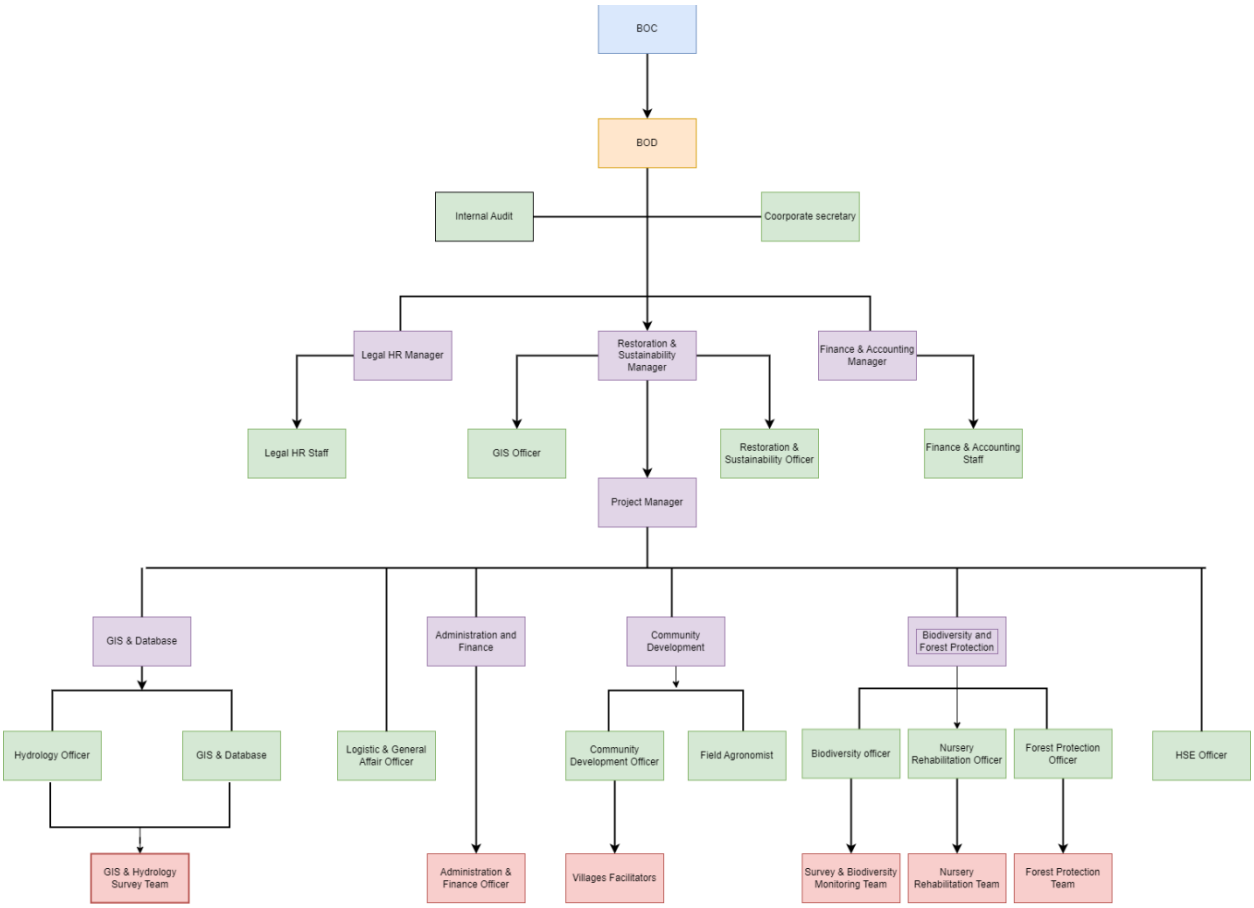


Figure 2-6. The schematic diagram of the project structure.[44]

2.4.2 Required Technical Skills (G4.2)

The key technical skills required to implement the project are knowledge about development and management of forest conservation projects, which covers carbon measurement and accounting, ecosystem restoration, forest protection, biodiversity conservation and monitoring, community engagement and livelihood development, research and development, and community adaptation and resilience. The detailed technical skills are shown Table 2-15 below.

Table 2-15. Required technical skills for the project

Project Activity	Sub activity	Skill required
Carbon accounting and reporting	Carbon measurement, monitoring, and accounting	Forest carbon modelling and quantification

[44] BOC = Board of Commissioners, BOD = Board of Directors, HSE = Health, Safety and Environment.

Project Activity	Sub activity	Skill required
Ecosystem restoration	Hydrology management, forest rehabilitation, Peat management, Biomass monitoring, MRV	HCV identification and monitoring, GIS and mapping, peat hydrology, forest rehabilitation technique, silviculture, nursery management
Forest Protection and Biodiversity Conservation	Forest Fire Prevention and Suppression, Forest Patrol, and biodiversity survey	GIS, habitat and species management, biodiversity management
Community Engagement and Alternative Livelihood Development	Agroforestry, non-timber forest products	Community organizing, conflict resolution and grievance handling, aquaculture, silviculture, Good Agricultural Practices
Research and Development	Biodiversity monitoring, rehabilitation, Peat management, MRV	Biodiversity inventory technique, peatland silviculture, IT management
Community adaptation and resilience	Micro financing, community-based health and sanitation, environmental education	Business development, public health management, community organizing

2.4.3 Management Team Experience (G4.2)

Dr. Handoko Limaho is the Chief Executive Officer (CEO) of Hutan Kencana Group, the parent company of PT Pagatan Usaha Makmur (PT PUM). He is one of the main decision makers of the project proponent.

In 2021, Dr. Limaho obtained his Research Doctorate in Management specialized in sustainability issues at Universitas Pelita Harapan. Prior to that, he had obtained a bachelor's degree (BSc.) in Cell Biology from the University of Manchester and a master's degree (MSc.) in Management from the University of Salford. In 2008, he began his career as an Account Manager at Carphone Warehouse, and later as a Director at PT Wangijaya Sejahtera, a marketing company, where he was in charge of the marketing strategy of several Fast-Moving Consumer Goods (FMCG) companies.

Subsequently, he worked for Agro Investama Group (AIG) for nearly ten years. His last position before leaving the company was COO, where he led the operational team to drive and increase performance. He also conducted collaborative actions between stakeholders such as NGOs, government bodies, and others to create a more sustainable organization. In 2021, Dr. Limaho's family decided to exit the oil palm business and instead develop ecosystem restoration projects. In his current position as CEO of Hutan Kencana Group, he is leading a nature-based solutions company that specializes in ecosystem restoration from the ground up.

Dr. Rio Christiawan, S.H., M.Hum., M.Kn. is the Human Resource and Legal Director. Dr. Christiawan is the Co-Founder of Hutan Kencana Group, and one of the key decision makers at PT PUM. He completed his doctoral degree in Law at Parahyangan Catholic University in 2012. He started his career as a writer and columnist and then became an advocate in 2006 until now. He has also worked as a Director of Legal, HR & corporate affairs at several private companies operating in the natural resources sector. The

professional education he has received includes Advocates, Mediators, PPAT and ISPO auditors. Currently, Dr. Christiawan is still active as a lecturer for undergraduate, masters and doctoral degrees at Prasetiya Mulya University, University of 17 August 1945, Pelita Harapan University, and others. As co-founder of Hutan Kencana Group, he is responsible for creating a nature-based solutions company specializing in bottom-up environmental restoration.

Imanuddin Utoro, is the Restoration Sustainability Manager. Imanuddin received his Bachelor of Science (BSc) and Master of Science (MSc) degrees in 2000 and 2009, respectively, from Bogor Agricultural University. Prior to joining PT Pagatan Usaha Makmur, he worked for a number of organizations, including Menjangan Jungle and Beach Resort as conservation manager for a year beginning in 2009, the Zoological Society of London as Field Manager in 2010, PT Astra Agro Lestari Tbk as Conservation Specialist for four years beginning in 2010, PT SMART Tbk as Section Head of Forest Conservation Policy for another four years beginning in 2014, Orangutan Foundation UK and Yayasan Kehati as Program Manager. He authored and co-authored several scientific publications, the most recent being a practical toolkit for identifying and monitoring biodiversity in oil palm landscapes published in 2011. He has received several trainings, the most recent of which were the GCF Project Concept Note Writing Workshop in 2021 and the Exit Strategy for the TFCA Project in 2020.

Michael Agung Kuncoro, S.H. is the Legal, HR & General Affair Manager. Michael Agung Kuncoro completed his law degree at the Faculty of Law, Gadjah Mada University. Currently, he is the Legal, Human Resources & General Affair Manager at PT PUM, with the main task being the supervision of all legal processes/aspects of the company (legality and permits and other matters related to legal aspects), in addition to being responsible for supervising matters related to human resources and general affairs of PT PUM and affiliated companies. Prior to working at PT PUM, M Agung Kuncoro had worked and attended training/management training in several companies engaged in banking and manufacturing. During 2012 to 2021, he was part of Agro Investama Group, a palm plantations and palm oil mills company. He was involved in the ISPO and RSPO audit and certification processes in several companies under the Agro Investama Group.

Larissa D. Salaki, B.S., M.Si is the Biodiversity and Forestry Specialist. Larissa has over eight years of experience in biodiversity research, conservation area management, and environmental assessments. She is presently a Senior Restoration and Sustainability Officer at PT PUM, where she is responsible for initiating, planning, and implementing AFOLU carbon projects in Hutan Kencana Group's concessions. In 2010, she obtained a Bachelor of Science in Environmental and Resource Science from the University of California at Davis, and in 2016, she earned a Master of Science in Conservation Biology from the University of Indonesia. She began her career in 2012 as a Junior Environmental Scientist at PT DHI Water & Environment Indonesia. Throughout her career, she has been involved in and responsible for numerous projects for conservation NGOs (Borneo Nature Foundation, Borneo Orangutan Survival Foundation, Zoological Society of London) in Kalimantan and Sumatra, where she was given the responsibility of 1) conducting biodiversity assessments; 2) planning and managing the orangutan release and monitoring activities; 3) planning and managing several conservation programs and budgets within the project's sustainable landscape management framework and liaising with local governments. Prior to joining PT PUM, she was Forestry and Biodiversity Specialist at Hatfield Consultants responsible for managing and implementing environmental consultancy projects for private sector and development organizations using international standards (e.g. IFC Performance Standards, Verra VCS-CCBS, and HCS-HCVA).

Andreina Triyantari, S.hut is the Restoration Sustainability Officer at PLUM Project. Andreina received her bachelor's degree in forestry with a major in Forestry Management from Bogor Agricultural University (IPB University). She is the co-author of a published paper related to financial analysis of women farmers group. During her university years, she was active as a teaching assistant in the forest ecology subject and PIC of research team for forest management expedition in Kerinci, Jambi of social and economics aspect. She has received several training courses, the most recent one being the blue carbon and SMART Patrol training 2022 also the GHG validation and verification in FOLU and energy sector in 2023.

Indra Purnama Bahri, M.Si is the Community Development Coordinator. Indra has a degree in Forestry from IPB University and a master's degree in Science from Sriwijaya University. He has published several articles and research on forestry, one of which is 'Participation of Forest Encroachers in Participatory Ecosystem Restoration Program in Dangku Wildlife Reserve,' published in 2021. Indra started his working experiences as a project staff on a Global Environment Facility project related to forest protection management. Subsequently, he moved to the Zoological Society of London as a restoration unit team leader and later got promoted to restoration coordinator. Indra also attended several training activities related to forestry restoration and community development. After spending four years in the Zoological Society of London, he pursued his master's degree in Science from Sriwijaya University.

Soni Setia Budiawan, S.Hut is the Project Manager. Soni received his bachelor's degree in forest science from Bogor Agricultural University. He studied forest management and participated in several trainings and projects. He is now in charge of coordinating the project's ecosystem restoration activities at the site. He began his career in 2016 as a conservation assistant at PT. Royal Lestari Utama, where he was in charge of patrolling and protecting conservation areas, mitigating human-wildlife conflict, and reforestation. In addition, in 2018 and 2020, he worked as a sustainability officer at PT SMART and as a Program Coordinator at Belantara Foundation. Since 2013, he has also been involved in projects at several institutions, including BIOREF IPB, Mott MacDonald, The Forest Trust (TFT), Fauna & Flora International (FFI), and the Consortium of IPB UNIPA TFF. Furthermore, he received several related trainings such as surface carbon stock calculation, drone mapping, project cycle management, and in-house training at PT SMART regarding HCV Assessor ALS, FPIC, LTS, SIA, HCV, and HCS.

Panji Ahmad Fauzan, S.Hut is the project's Biodiversity and Forest Protection Coordinator. In 2010, he received his bachelor's degree in forestry from Bogor Agricultural University (IPB). After graduating, he worked as a field assistant for a German Primate Center and then as a scientific assistant before joining PT Environmental Resource Management Indonesia in 2012 as a Biodiversity Specialist (Technical Staff). Furthermore, prior to working as an Animal Curator at Bandung Zoological Garden, Panji spent two years at Burung Indonesia as a Junior Ecologist in 2014 and a Biodiversity Officer in 2015. He also participated in several biodiversity, conservation, and behavioral studies, including Ecosystem Restoration Concessions for Tropical Rainforest Conservation in Indonesia in 2016, and Biological Surveys of Threatened Bird Species on the Islands of Sangihe and Talaud in 2015. He also spoke at several national seminars, including the 2016 Second National Conference of Bird Researchers and Observants in Indonesia. He co-authored a 2015 study on Androgen correlates of male reproductive effort in wild male long-tailed macaques (*Macaca fascicularis*): A multi-level test of the challenge hypothesis, which was published in the Physiology and Behavioral Journal.

Vanny Milenia, S.T is the project's GIS Specialist. Vanny received her Bachelor's degree in Geodetic Engineering from Gadjah Mada University (UGM). She has experience in Geographic Information Systems (GIS), notably serving as GIS staff at the National Land Agency of Central Jakarta and the Spatial Planning

Agency of the Special Region of Yogyakarta. During her university years, she was a teaching assistant in the Adjustment Computation subject of Survey Measurement and participated in GIS-related project. She expanded her knowledge through online courses about Environmental Science from Dartmouth College and Tropical Forest Landscape Conservation and Restoration from Yale University.

Siti Nadia Nurul Azizah, M.Si is the Restoration and Sustainability Officer at PLUM Project. She has a bachelor's degree in Applied Meteorology and completed her master's degree in Applied Climatology at Bogor Agricultural University (IPB University). Throughout her college years, she participated in and led a campaign on sustainability and the climate crisis for the Youth Leadership Camp for Climate Crisis projects, which were held by The Climate Reality Project and UNFCCC in 2020. She actively served as a teaching assistant in the subject of Micrometeorology in 2021. She is the co-author of Land Use Change Impact on Normalized Difference Vegetation Index, Surface Albedo, and Heat Fluxes in Jambi Province: Implications to Rainfall, published in the Agromet Journal in 2022. In 2023, she underwent training, including SMART Patrol and validation and verification training for greenhouse gases in forestry (FOLU) and the energy sector.

2.4.4 Project Management Partnerships/Team Development (G4.2)

The project proponent recognizes that human resources skills will significantly influence the success of the project implementation. As mentioned in the previous section, the project proponent's team consists of highly capable staff with appropriate and diverse educational background and experience. In addition, in order to strengthen and complement the capacity of the team, the project proponent will cooperate with other institutions that master required skills. The table below shows a list of institutions and respective subjects of cooperation.

Table 2-16. Institutions and cooperation

Institution	Cooperation	Status
Borneo Nature Foundation	The Borneo Nature Foundation will support biodiversity monitoring and conservation activities of PT PUM and capacity building in biodiversity monitoring of PT PUM's field staff	MoU
Dompet Dhuafa	Dompet Dhuafa will support health activities of the project, such as providing mobile health services and health education	MoU
LPPM[45] Palangkaraya University	Palangkaraya University will support community development and circular economy activities	MoU
IPB University	IPB University will support the development of the Fire Danger Rating System (FDRS)	Contract
Yayasan Puter	Yayasan Puter developed the livelihood assessment of the project and provided recommendations for livelihood activities	Contract
Remark Asia	Remark Asia led the FPIC Process of the project. Remark Asia also developed the baseline biodiversity and HCV assessment for PT PUM.	Contract

[45] Institute for Research and Community Service

2.4.5 Financial Health of Implementing Organization(s) (G4.3)

The project proponent is led by an experienced CEO with support from long-term partners and investors. The project proponent has been demonstrating the commitment to the project by developing an integrated long-term plan which covers conservation, restoration, and community development. The supporting document of the financial health of the company is classified as commercially sensitive information (refer to Section 2.4.7) and will be shared with the VVB and Verra team on a confidential basis.

2.4.6 Avoidance of Corruption and Other Unethical Behavior (G4.3)

As a private company engaged in Ecosystem Restoration services, the project proponent strives to constantly improve its performance quality and carry out work in accordance with applicable laws and regulations. The project proponent established an anti-corruption policy[46] and culture in the workplace by preventing, anticipating, and eliminating bribery or illegal levies and gratuities in all work operations when performing services to foster cooperation and long-term partnerships. The following are the specifics of the anti-bribery framework that has been put in place:

1. Reducing the potential for bribes and extortion in all lines of work operations that affect them.
2. Avoiding giving and receiving gratuities in all areas of work.
3. Providing assurance to service users that there is no bribery, extortion, or gratification in any construction work service provided.
4. Increasing partners' (goods/services providers) confidence that there is no bribery, extortion, and gratification practice in every procurement process.
5. Ensuring the integrity of the project proponent's employees.

2.4.7 Commercially Sensitive Information (*Rules* 3.5.13 – 3.5.14)

Some information that must be disclosed by the project proponent in order to comply with the VCS and/or CCB standards is deemed confidential or commercially sensitive. This information is not included in the public version; however, these details were fully provided to the VVB during the validation process attached to this PD document. The information that was only made available to VVB is listed below:

1. The Project Financial Performance Worksheet and any other relevant financial documents.
2. Contracts and agreements among the parties.
3. Records of legal status and property rights.
4. Financial Statements of the project proponent.
5. Project proponent's Operating and Environmental Procedures.

[46] PT PUM Anti Bribery Policy KM-SMAP-PUM-001-00 (14 September 2022)

2.5 Legal Status and Property Rights

2.5.1 Statutory and Customary Property Rights (G5.1)

There are no outside statutory claims in the project area as the project has officially received all statutory rights to manage the area under the license as described in Section 2.5.8. However as described in Section 2.1.6, the villages surrounding the project area have been engaged in a FPIC process to identify any customary rights and access to the project area. As described previously, some villagers hold informal management rights over tatah/canals in the project area that are used for fishing and transportation.

2.5.2 Recognition of Property Rights (G5.1)

The project proponent is committed to recognizing, respecting, and supporting all property rights of communities and other stakeholders. The assessments undertaken during the FPIC process, village profiles, and livelihood assessment identified that there is no community property in the project area such as people living permanently in the area.

2.5.3 Free, Prior and Informed Consent (G5.2)

The FPIC process ensures that community rights are respected when activities of reducing emissions from deforestation and forest degradation and enhancing forest carbon stocks (REDD+) are implemented. The project proponent designed and conducted an FPIC process to obtain the consent of the communities living in the project zone for the project implementation. As described in the previous Section 2.5.2, there is no community property in the project area. Nonetheless, the project proponent conducted an FPIC process, as the project plan may affect communities' practices, such as fishing, hunting, harvesting non-timber forest products, or timber removal for house construction, and may influence the communities' income or livelihood cycle.

The FPIC process was conducted as the initial participatory process of community involvement in project implementation. The FPIC process is described below:

1. Project introduction to 17 villages surrounding the project area. The project proponent introduced the project and the team to the villages. The meetings were conducted in each village and attended by the heads of the villages and representatives of communities.

2. Village consultations. After the introduction, the project proponent conducted village consultations. In these meetings, the project proponent explained the project objectives, plan, and activities in detail and showed the project area map. The consultation was a two-way communication, where the project proponent described the project in detail and listened to the responses, comments, and concerns of the community. The communities' concerns were discussed and addressed (see Appendix 5: FPIC Consultation Report). The detailed agenda of consultation was as follows:

    a) Explanation of the project: objectives, plan, legal basis, and project area map in large size.

    b) Community's activities or interactions with the project area.

    c) Community's responses, comments, questions, and concerns.

    d) Agreed points as the discussion results and meeting notes.

The final project zone area and engaged villages were determined in this process based on the stakeholder inputs.

3. Obtaining consent. After the consultation process, the project team documented the consultation note which was signed by the parties. The note covered information: date, day, attendees, discussed concerns, agreed points, and signature of parties.

4. Negotiation process. The consultation was conducted in 17 villages, and each village consultation had a different obtained consent process. Based on the consultation process, 13 villages were included in the project zone; the other four villages were determined to have limited interactions with the project area. The results and status of the FPIC process in the 13 engaged villages can be found in Appendix 5: FPIC Consultation Report. Eight out of the 13 villages have granted their consent and have signed an agreement with the project. The FPIC process is still ongoing in the remaining five villages. The FPIC process is an iterative process that will be continued throughout the life of the project.

5. Monitoring plan and team. The meeting participants discussed a participatory monitoring plan where parties – the project team and community – together will monitor the project implementation. For the joint monitoring activities, the project team and communities agreed to establish monitoring teams composed of the project team and representatives of community.

6. The signing parties. The meeting notes/results were signed by the heads of villages, community representatives, and a representative of the project.

2.5.4 Property Rights Protection (G5.3)

The project activities do not lead to involuntary removal or relocation of property rights holders from their lands or territories and does not force rights holders to relocate activities important to their culture or livelihood. For example, the river fishermen group uses the canals inside the forest in the project area as fishing ground. The project team will not prevent these fishermen from fishing in the forest after the start of the project activities but will educate them to apply environmentally friendly fishing techniques.

2.5.5 Illegal Activity Identification (G5.4)

Based on the biodiversity and livelihood assessment and discussion with the communities, there were some identified small-scale illegal activities as follows:

- Illegal logging. Although the volume of removed timber is small and mostly used for house construction, it has the potential to cause harm to the environment in the project area.
- Illegal hunting. The villagers hunt using traditional traps.
- Destructive fishing methods including electrofishing and fish poisoning.

The project team has identified the drivers and developed activities to mitigate them. The activities are as follows:

- Conduct patrol and include illegal logging and hunting into the monitored activities list.
- Provide alternative livelihoods for loggers and hunters. The project includes livelihood training, revolving fund, and other supporting activities to empower these community groups.

2.5.6 Ongoing Disputes (G5.5)

There are no ongoing or unresolved disputes over rights to lands, territories and resources in the project area. During the FPIC process, it was identified that some small-scale illegal logging, fishing and rice farming activities are conducted within the project area. Also, some community members have customary management rights over tatah (trenches/canals where logs were transported in the past) in PT PUM concession. Before the project started, these tatah were still partially used for transportation of wood, but were mostly used for fishing. The project will not restrict the customary rights of local communities and will continue to allow access for fishing, NTFP collection, and access to tatah/canals. During the FPIC consultations, it was clarified that (i) PT PUM will not block these canals without the consent of the tatah holders, and the design will be discussed with them; (ii) fishing activities will continue to be allowed; (iii) as logging and wood collection will no longer be permissible (by law), PT PUM will work closely with affected individuals to provide alternatives.

Some communities were concerned that the boundaries between their rice paddy fields and PT PUM were not clear, and that it could affect their rice farming activities. To address these concerns, the FPIC team conducted participatory mapping exercises in each village to clarify the boundaries. It also followed up with related parties (including the SIMURP program) to clarify the boundaries and any future plans for expansion[47]. This helped address concerns in the affected villages and FPIC agreement was reached with them. Any potential additional concerns will be addressed through regular communication with the concerned villages. It is noted that 182 hectares of paddy fields (since 2014) are located inside PT PUM, to which an additional 286 hectares were added under SIMURP. These areas, located along the boundary of the concession, have been excluded from the project area, and farmers will be allowed to continue cultivating these fields.

The project aims to bring exceptional benefits to the community (refer to Section 4.5) and biodiversity (Section 5.5), while restoring the land for reducing and removing emissions through forest protection and ecosystem rehabilitation.

2.5.7 National and Local Laws (G5.6)

The project is designed to be fully compliant with national, regional and local laws of the Republic of Indonesia, especially laws regulating forest conservation projects. Necessary approvals are obtained by the project in line with these laws and regulations. Relevant laws and regulations include[48]:

1. Law No. 6/1994 on Ratification of the United Nations Framework Convention on Climate Change
2. Law No. 41/1999 on Forestry
3. Law No. 25/2004 on the National Development Planning System
4. Law No. 17/2007 on Long-Term Development Plan 2005 – 2025

[47] It was clarified that no expansion beyond the current areas (which have already been excluded from the project area) is foreseen. The construction of canals will be finalized in 2023-2024.
[48] http://ditjenppi.menlhk.go.id/peraturan-perundangan.html [accessed July 5, 2023]

5. Law No. 32/2009 on Environmental Protection and Management
6. Law No. 16/2016 concerning Ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change
7. Law No. 11/2020 on Job Creation amended by Perpu (Government Regulation in lieu of Law) No. 2/2022 dated 30 December 2022 regarding Job Creation (Job Creation Law)
8. Government Regulation No. 46/2017 concerning Environmental Economic Instruments
9. Government Regulation No. 22/2021 on Environmental Protection and Management
10. Government Regulation No. 23/2021 concerning Forestry Management
11. Presidential Regulation No. 98/2021 on Carbon Pricing
12. Minister of Environment and Forestry Regulation No. P.32/Menlhk/Setjen/Kum.1/3/2016 concerning Forest and Land Fire Control
13. Minister of Environment and Forestry Regulation No. P.33/Menlhk/Setjen/Kum.1/3/2016 concerning Guidelines for Formulating Climate Change Adaptation Actions
14. Minister of Environment and Forestry Regulation No. P.70/Menlhk/Setjen/Kum.1/12/2017 concerning Procedures for Implementing Reducing Emissions from Deforestation and Forest Degradation, Role of Conservation, Sustainable management of forest and enhancement of forest carbon stocks
15. Minister of Environment and Forestry Regulation No. P.71/Menlhk/Setjen/Kum.1/12/2017 concerning Implementation of a national registration system for climate change control
16. Minister of Environment and Forestry Regulation No. P.72/Menlhk/Setjen/Kum.1/12/2017 concerning Guidelines for the Implementation of Measurement, Reporting and Verification of Climate Change Controlling Actions and Resources
17. Minister of Environment and Forestry Regulation No. P.73/Menlhk/Setjen/Kum.1/12/2017 concerning Guidelines for the Implementation and Reporting of the National Greenhouse Gases Inventory
18. Minister of Environment and Forestry Regulation No. P.7/Menlhk/Setjen/Kum.1/2/2018 concerning Guidelines for the Study of Vulnerability, Risk, and Impact of Climate Change
19. Minister of Environment and Forestry Regulation No. P.8/Menlhk/Setjen/Kum.1/2/2018 concerning Technical Criteria for Alert and Emergency Status of Forest and Land Fires
20. Minister of Environment and Forestry Regulation No. P.9/Menlhk/Setjen/Kum.1/2/2018 concerning Fixed Procedures for Field Checking Hotspot Information and/or Forest and Land Fire Information
21. Decree of the Minister of Environment and Forestry No. SK.679/Menlhk/Setjen/Kum.1/12/2015 concerning Monitoring the Implementation of Nationally Determined Contribution (NDC)
22. Minister of Environment and Forestry Regulation No. 8 year 2021 regarding Forest Governance and Preparation of Forest Management and Utilization Plans in Protection Forest and Production Forest
23. Minister of Environment and Forestry Regulation No. 21 year 2022 regarding The Guidance for Implementation of Carbon Economic Value

24. Minister of Environment and Forestry No. 7 year 2023 regarding Carbon Trading Procedures in the Forestry Sector

2.5.8 Approvals (G5.7)

The project proponent has obtained recognition and approvals of the project implementation from Government. The following is the list of approval documents.

Table 2-17. Documented approval for the project implementation.

No	Document Title	Document Number	Issuing Institution	Issued Date
1	Request for Technical Consideration	570/142/BII/DPMPTSP-2021	One Stop Investment and Services Office, Central Kalimantan Province	09-Aug-21
2	Technical Considerations for Forest Utilization Business Licensing (PBPH) for PT PUM	522/2127/II.2/Dishut	Forestry agency of Central Kalimantan Province	02-Sep-21
3	PT PUM's PBPH application	570/3/IUPHHK-RE/IX/DPMPTSP-2021	One Stop Investment and Services Office, Central Kalimantan Province	23-Sep-21
4	Memorandum of the Office of Directions for the Utilization of the PBPH Application Area	ND.604/KPHP/PKPHP/HPL.0/12/ 2021	Sustainable Forest Management, Ministry of Environment and Forestry	28-Dec-21
5	Directions for Utilization of PT PUM's PBPH Application Area	5.655/PHPL/KPHP/HPL.0/12/2021	Sustainable Forest Management, Ministry of Environment and Forestry	30-Dec-21
6	PBPH Commitment Principal Approval on PT PUM's Production Forest	1082211116206000	Ministry of Investment	01-Aug-22
8	Event Record of Application Review for Making Geographical Coordinates for PT PUM's PBPH Commitment Approval	S.328/BPHPX-2/2022	Sustainable Forest Management, Ministry of Environment and Forestry	10-Aug-22
9	Results of the automatic screening of environmental document information system Amdalnet PBPH in PT PUM's production forest	634d0ff34b96e	Ministry of Environment and Forestry (through Amdalnet)	17-Oct-22

No	Document Title	Document Number	Issuing Institution	Issued Date
10	PT PUM's Air Emission Pertek Directive	S.600/PPU/PSPU/PKL .3/12/2022	Directorate of Air Pollution Control, Directorate General of Pollution Control and Environmental Damage, Ministry of Environment and Forestry	09-Dec-22
11	Approval of the statement of capability for environmental management of PBPH activities by PT PUM	SK. 4859/MENLHK.PKTL/ PDLUK/PLK.4/4/2023	Directorate of Environmental Impact Prevention for Businesses and Activities, Director General of Forestry Planning and Environmental Management, Ministry of Environment and Forestry	18-Apr-23
12	Event Record of Discussion on the substance of the technical standard documents for compliance with quality standards for the utilization of wastewater for application to the ground as watering for PT PUM	84/PPA/II/2023	Directorate of Water Pollution Control, Director General of Pollution Control and Environmental Damage, Ministry of Environment and Forestry	21-Feb-23
13	Definitive PBPH license for PT PUM for 60 years in a total area of ±23,665 ha	02200084122050002	Ministry of Investment	27-Nov-23

2.5.9 Project Ownership (G5.8)

PT Pagatan Usaha Makmur is the legitimate owner of the project for the establishment of responsibility and rights over the project. The regulatory approvals establishing such rights are available for the VVB to view.

2.5.10 Management of Double Counting Risk (G5.9)

The project generates benefits to the climate, communities and biodiversity. However, only net reductions and removals of greenhouse gases will be marketed. The project is not part of any other public or private sector programs that account for emission related benefits.

2.5.11 Emissions Trading Programs and Other Binding Limits

This project does not participate or is included in any emission trading schemes other than VCS and other binding limits. However, approvals are obtained from Indonesia's National Registry System (SRN)[49] which is the Indonesian GHG emission registry.

2.5.12 Other Forms of Environmental Credit

The project is not intended to generate any other form of environmental credits related to the reductions and removals of GHG emissions claimed under the VCS Program.

2.5.13 Participation under Other GHG Programs

The project is not participating under other GHG Programs. In compliance with Indonesian regulations, the project has been listed under Indonesia's SRN with identification number 005-V-2023-4005.

2.5.14 Projects Rejected by Other GHG Programs

The project has not undergone validation/verification of any other GHG program and is therefore not rejected by any other GHG program.

2.5.15 Double Counting (G5.9)

As referred to in Section 2.5.11 of this document, this VCS project is submitted for approval under the VCS Program and SRN in Indonesia. Hence, there will be no double counting.

[49] *Sistem Registri Nasional Pengendalian Perubahan Iklim* (SRN PPI) or National Registry System for Climate Change Control.

3 CLIMATE

3.1 Application of Methodology

3.1.1 Title and Reference of Methodology

The methodology title and reference are the approved VCS Methodology VM0007 REDD+ Methodology Framework (REDD+ MF), v.1.6, 8 September 2020.

The tools applied by the project are: 1) the VT0001 Tool for the Demonstration and Assessment of Additionality in AFOLU Project Activities, v.3.0, 1 February 2012 (T-ADD); 2) the Agriculture, Forestry, and Other Land Use (AFOLU) Non-Permanence Risk Tool (NPRT), v.4.2, 12 October 2023 (T-BAR); 3) Tool for testing significance of GHG emissions in A/R CDM project activities (T-SIG) v.0.1.

3.1.2 Applicability of Methodology

The project applies the latest version of VCS Methodology VM0007 (Version 1.6 dated 08 September 2020) also called 'REDD+ MF' together with applicable pre-framed modules and tools. The modules were selected based on the PLUM Project activities covered by the VM0007 including (1) Avoiding Planned Deforestation (APD), (2) Afforestation, Reforestation and Revegetation (ARR), (3) Restoration of Wetlands Ecosystems (RWE) on Peatland and Tidal Wetlands, and (4) Avoiding Planned Wetland Degradation (APWD) on Peatland and Tidal Wetlands. All applicability conditions of the VM0007 (REDD+ MF) and its associated modules/tools are met by the project.

Table 3-1. Analysis of applicability conditions for the VM0007 methodology.

No	Module	Applicability Condition	Comment
1	REDD+ MF Version 1.6, Section 4.2, All Project Activities	All land areas registered under the CDM or under any other GHG program (both voluntary and compliance oriented) must be transparently reported and excluded from the project area. The exclusion of land in the project area from any other GHG program must be monitored over time and reported in the monitoring reports.	Condition met, no part of the project area is under any CDM or any other GHG program (either voluntary or compliance oriented).
2	REDD+ MF Version 1.6, Section 4.3.1, All REDD Activity Types	Land in the project area has qualified as forest (following the definition used by VCS) for at least the 10 years prior to the project start date.	Condition met. Land use records indicate that all land subject to REDD project activities in the project area is covered by tropical forest on peatland and has qualified as such under the applicable definition for at least 10 years.
3	REDD+ MF Version 1.6, Section 4.3.1, All REDD Activity Types	If land within the project area is peatland or tidal wetlands and emissions from the SOC pool is deemed significant, the relevant WRC modules (see Table 3) must be applied alongside other relevant modules.	Condition met. All relevant WRC modules have been applied to estimate emissions from peat soils.

No	Module	Applicability Condition	Comment
4	REDD+ MF Version 1.6, Section 4.3.1, All REDD Activity Types	Baseline deforestation and forest degradation in the project area fall within one or more of the following categories: Unplanned deforestation (VCS category AUDD), Planned Deforestation/ degradation (VCS category APD), Degradation through extraction of wood for fuel (fuelwood and charcoal production) (VCS category AUDD)	Condition met. Baseline deforestation falls in the category of APD. The project area does not include any significant unplanned deforestation or forest degradation and is not modelled in either the baseline of the project scenario.
5	REDD+ MF Version 1.6, Section 4.3.1, All REDD Activity Types	Leakage avoidance activities must not include: Agricultural lands that are flooded to increase production (e.g., rice paddy) Intensifying livestock production through use of feed lots 10 and/or manure lagoons.	Condition met. The project does not promote either establishment of agriculture on flooded land or intensification of livestock production.
6	REDD+ MF Version 1.6, Section 4.3.3, Avoiding Planned Deforestation/ Degradation	Avoiding planned deforestation/degradation activities are applicable under the following condition: Where conversion of forest lands to a deforested condition must be legally permitted.	Condition met. See baseline scenario
7	REDD+ MF Version 1.6, Section 4.4, ARR	The project area is non-forest land or land with degraded forest.	Condition met. See baseline scenario
8	REDD+ MF Version, Section 4.4, ARR	In strata with drained organic soil, ARR activities must be combined with rewetting.	Condition met. The project scenario includes rewetting activities.
9	REDD+ MF Version 1.6, Section 4.4, ARR	ARR activities are not eligible if the project scenario involves the application of nitrogen fertilizers.	Condition met. The project does not involve the application of any fertilizers.
10	REDD+ MF Version 1.6, Section 4.4, ARR	Where project activities on wetlands are excluded by the applicability conditions of applied modules or tools, these can be disregarded for the purpose of their use within this methodology, as quantification procedures for the peat soil are provided in modules BL-PEAT and M-PEAT.	Condition met. The project applies modules BL-PEAT and M-PEAT alongside all modules related to ARR.
11	REDD+ MF Version 1.6, Section 4.5.1, All WRC Activity Types	WRC activities are not eligible under the following conditions: > Project activities lower the water table, unless the project converts open water to tidal wetlands, or improves the hydrological connection to impounded waters. > Changes in hydrology do not result in the accumulation or maintenance of	Condition met. The project activities do not lower the water table, hydrological connection of the peatland does not lead to increase of emissions outside of the project area and do not include burning of organic soil, and does not include the use of fertilizers.

No	Module	Applicability Condition	Comment
		SOC stock, noting that a) this pertains to projects that intend to sequester carbon through sedimentation and/or vegetation development and b) this does not pertain to projects that increase salinity to reduce CH_4 emissions. > Projects that aim to decrease CH_4 emissions through increased salinity must account for any changes in SOC stocks. > Hydrological connectivity of the project area with adjacent areas leads to a significant increase in GHG emissions outside the project area. > Project activities include the burning of organic soil. Nitrogen fertilizer(s), such as chemical fertilizer or manure, are applied in the project area during the project crediting period.	
12	REDD+ MF Version 1.6, Section 4.5.2, RWE Project Activities General	For RWE project activities, prior to the project start date, the project area must meet the following conditions: The area is free of any land use that could be displaced outside the project area, as demonstrated by at least one of the following, where relevant: • The project area has been abandoned for two or more years prior to the project start date; or • Use of the project area for commercial purposes (i.e., trade) is not profitable as a result of salinity intrusion, market forces, or other factors. In addition, timber harvesting in the baseline scenario within the project area does not occur; or • Degradation of additional wetlands for new agricultural/aquacultural sites within the country will not occur or is prohibited by enforced law. OR b) The area is under a land use that could be displaced outside the project area, although in such case, baseline emissions from this land use must not be accounted for, and where degradation of additional wetlands for new agricultural/aquacultural sites within the country will not occur or is prohibited by enforced law. OR	Condition met. The project will continue at a similar or greater level of service or production during the project crediting period as the concession is under a Forest Utilization Business License (PBPH). The license is valid until the end of the project crediting period. In line with the granted license, the project will develop a long-term and annual management plan (RKU/RKT) which will include restoration of wetland ecosystem in the project area.

No	Module	Applicability Condition	Comment
		c) The area is under a land use that will continue at a similar or greater level of service or production during the project crediting period (e.g., reed or hay harvesting, collection of fuelwood, subsistence harvesting, commercial fishing).	
13	REDD+ MF Version 1.6, Section 4.5.2, RWE Project Activities Peatland Rewetting	This methodology is applicable to rewetting drained peatland (RDP) activities on project area that meet the VCS definition for peatland (see VCS Program Definitions)	Condition met. The project will conduct rewetting drained peatland (RDP) activities on project areas that meet the VCS definition for peatland
14	REDD+ MF Version 1.6, Section 4.5.2, RWE Project Activities Tidal Wetland Restoration	Project activities restoring tidal wetlands may include any of the following, or combinations of the following: > Creating, restoring and/or managing hydrological conditions (e.g., removing tidal barriers, improving hydrological connectivity, restoring tidal flow to wetlands or lowering water levels on impounded wetlands) > Altering sediment supply (e.g., beneficial use of dredge material or diverting river sediments to sediment-starved areas) > Changing salinity characteristics (e.g., restoring tidal flow to tidally-restricted areas) > Improving water quality (e.g., reducing nutrient loads leading to improved water clarity to expand seagrass meadows, recovering tidal and other hydrologic flushing and exchange or reducing nutrient residence time) > (Re-)introducing native plant communities (e.g., reseeding or replanting) > Improving management practice(s) (e.g., removing invasive species, reduced grazing) > In RWE-ARR project activities, the prescribed burning of herbaceous and shrub aboveground biomass (cover burns) may occur	Condition met. The project will: i. (Re-)introduce native plant communities (e.g., reseeding or replanting) ii. Improve management practices(s)
15	REDD+ MF Version 1.6, Section 4.5.3, CIW Project Activities	This methodology is applicable to conservation of undrained and partially drained peatland (CUPP) activities on project areas that meet the VCS definition for peatland (see VCS Program Definitions).	Condition met. The module is applicable because the project has both undrained peatlands and partially drained peatlands that meet the VCS definition.

No	Module	Applicability Condition	Comment
		Project activities conserving tidal wetlands may include: 1. Protecting at risk wetlands (e.g., establishing conservation easements, establishing community supported management agreements, establishing protective government regulations, and preventing disruption of water and/ or sediment supply to wetland areas) 2. Improving water management on drained wetlands 3. Maintaining or improving water quality for seagrass meadows 4. Recharging sediment to avoid drowning of coastal wetlands 5. Creating accommodation space for wetlands migrating with sea level rise	Furthermore, the project will conserve tidal wetlands by: 1. Protecting at risk wetlands 2. Improving water management on drained wetlands
16	REDD+ MF Version 1.6, Section 4.5.3, CIW Project Activities Avoiding Planned Wetland Degradation (APWD)	Avoiding planned wetland degradation activities are eligible under the following condition: Conversion of intact or partially altered wetlands to a degraded condition must be legally permitted.	Condition met. Prior to the project scenario, the project area was allocated a legal permit to be converted into oil palm plantation. See baseline scenario.
17	VMD0001 Version 1.1, CP-AB	This module is applicable to all forest types and age classes. Inclusion of the above ground tree biomass pool as part of the project boundary is mandatory as per the framework module REDD+ MF.	Condition met. The project area includes a variety of forest types all of which are applicable to the module (i.e., all forest types and classes applicable). Further the project includes above ground biomass as a carbon pool.
18	VMD0001 Version 1.1, CP-AB	Non tree aboveground biomass must be included as part of the project boundary if the following applicability criteria are met (per framework module REDD+ MF: > Stocks of non-tree aboveground biomass are greater in the baseline than in the project scenario, and > Non tree aboveground biomass is determined to be significant (using the T SIG module). Belowground (tree and non-tree) biomass is not required for inclusion in the project boundary because omission is conservative.	Condition met. Non-tree above ground biomass is excluded because it is greater in the project scenario than in the baseline scenario, and non-tree biomass was not determined to be significant. The baseline scenario assumes that all-natural forest biomass will be cleared for the establishment of oil palm plantation, and this will logically reduce baseline biomass including non-tree above ground biomass to zero and significantly less than in the project scenario. Furthermore, the tier 2 emission factors (Krisnawati *et al.* (2015)) for understory are between 3.30% to

No	Module	Applicability Condition	Comment
			4.94% of AGB which is significantly less than the estimates of total tree biomass used in the baseline and project scenarios. Belowground tree biomass (organic soil) is included because it covers the entirety of the project area and is allowed.
19	VMD0006 Version 1.3, BL-PL	Peatland. Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/ forest degradation and planned wetland degradation (BL-PL). The module is applicable for estimating the baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land.	Conditions are met. The project activities include Avoiding Planned Wetland Deforestation on peatland. See baseline scenario.
20	VMD0006 Version 1.3, BL-PL	Where, pre project, unsustainable fuelwood collection is occurring within the project boundaries Modules BL DFW and LK DFW must be used to determine potential leakage.	Condition not applicable. There is no history of fuelwood collection in the project area and this activity is excluded from the baseline and project scenarios. The project does not avoid unsustainable fuelwood collection.
21	VMD0009 Version 1.3, LK-ASP	The module is applicable for estimating the leakage emissions due to activity shifting from forest lands that are legally authorized and documented to be converted to non-forest land, including activity shifting to forested peatland that is drained as a consequence of project implementation. Under these situations, displacement of baseline activities can be controlled and measured directly by monitoring the baseline deforestation agents or class of agents.	Conditions are met. See leakage monitoring.
22	VMD0009 Version 1.3, LK-ASP	This module must be used for projects in areas where planned deforestation happens on forested peatlands, regardless of the absence of peatland within the project boundaries. This module must be used for projects in areas where planned deforestation happens on forested peatlands, regardless of the absence of peatland within the project boundaries.	Condition met. The module is used because the project includes areas where planned deforestation is and has happened on forested peatlands directly adjacent to the project area. Additionally, the tool is justified because the project activity avoids the baseline scenario of planned deforestation in the project area.
22	VMD0009 Version 1.3, LK-ASP	The module is mandatory if module BL PL has been used to define the baseline, and the applicability	Condition met. The project has used module BL-PL and comply with BL-PL in full.

No	Module	Applicability Condition	Comment
		conditions in module BL PL must be complied with in full.	
23	VMD0013 Version 1.2, E-BPB	This module is applicable to avoiding unplanned deforestation or degradation (AUDD), avoiding planned deforestation (APD) and avoiding degradation project activities, whether or not situated on peatland.	Condition met. Project includes WRC activities.
24	VMD0015 Version 2.2, M-REDD	Strata as defined in the relevant baseline modules are fixed and may not be changed without baseline revision.	Condition met. Strata are fixed and may be revised upon baseline adjustment at year 10.
25	VMD0015 Version 2.2, M-REDD	The module is mandatory for REDD, CIW+REDD, RWE+REDD and standalone CIW project activities.	Condition met: The project has applied all relevant aspects of VMD0015 M-REDD in its monitoring approach as the project falls under three categories of RWE+REDD, CIW+REDD, and RWE+ARR project activities.
26	VMD0015 Version 2.2, M-REDD	Where selective logging is taking place in the project case: Emissions from logging may be omitted if it can be demonstrated the emissions are *de minimis* using Tool T SIG. If emissions from logging are not omitted as *de minimis*, logging may only take place within forest management areas that possess and maintain a Forest Stewardship Council (FSC) certificate for the years when the selective logging occurs. Logging operations may only conduct selective logging that maintains a land cover that meets the definition of forest within the project boundary. All trees cut for timber extraction during logging operations must have a DBH greater than 30 cm. During logging operations, only the bole/log of the felled tree may be removed. The top/crown of the tree must remain within the forested area. The logging practices cannot include the piling and/or burning of logging slash Volume of timber harvested must be measured and monitored.	Condition not applicable. The project does not involve selective logging or any timber harvesting.
27	VMD0016 Version 1.2, X-STR	In case of REDD, above ground biomass stratification is only used for pre deforestation forest class es, and strata are the same in the baseline and the project scenario. Post deforestation land uses are not stratified.	Condition met. Above ground biomass stratification is only used for pre deforestation forest classes, and strata are the same in the baseline and the project scenario. Post deforestation areas are classified simply as “oil palm plantation”.

No	Module	Applicability Condition	Comment
		Instead, average post deforestation stock values (e.g. simple or historical area weighted approaches are used, as per module BL UP).	
28	VMD0016 Version 1.2, X-STR	For peatland rewetting and conservation project activities this module must be used to delineate non peat versus peat and to stratify the peat according to peat depth and soil emission characteristics unless it can be demonstrated that the expect ed emissions from the soil organic carbon pool or change in the soil organic carbon pool in the project scenario are *de minimis*	Condition met.
29	VMD0016 Version 1.2, X-STR	In the case of WRC project activities, the project boundary must be designed such that the negative effect of drainage activities that occur outside the project area on the project GHG benefits are minimized.	Condition met. The project is taking significant steps to maintain the intactness of hydrology in the project area and to restore hydrology in areas which have been disturbed by existing drainage. The project is monitoring areas outside the project area[50] which could be under threat of disturbance in order to minimize potential impacts in terms of drainage.
30	VMD0017 Version 2.2, X-UNC	The module is mandatory when using VCS methodology VM0007. It is applicable for estimating the uncertainty of estimates of emissions and removals of CO_2e generated from REDD and WRC project activities. The module focuses on the following sources of uncertainty: > Determination of rates of deforestation and degradation > Uncertainty associated with estimation of stocks in carbon pools and changes in carbon stocks > Uncertainty associated with estimation of peat emissions. Uncertainty in assessment of project emissions	Condition met. X-UNC has been used throughout to estimate uncertainties associated with this project.
31	VMD0017 Version 2.2, X-UNC	Where an uncertainty value is not known or cannot be simply calculated, then a project must justify that it is using an indisputably conservative number and an uncertainty of 0% may be used for this component.	Condition met. In all cases where an uncertainty value is not known or cannot be simply calculated, the project provides a justification that the value used is an indisputably conservative number (or an IPCC default value as instructed by VM0007).

[50] Automatic Weather Station (AWS), water table monitoring, and monitoring of dikes along SIMURP canal.

No	Module	Applicability Condition	Comment
32	VMD0017 Version 2.2, X-UNC	Guidance on uncertainty a precision target of a 95% confidence interval half width equal to or less than 15% of the recorded value shall be targeted. This is especially important in terms of project planning for measurement of carbon stocks; enough measurement plots should be included to achieve this precision level across the measured stocks.	Condition met. Uncertainty requirements have been taken into account in project planning and carbon stock calculations.
33	VMD0041 Version 1.1, BL-ARR	Applicability conditions included in AR-ACM0003 Afforestation and reforestation of lands except wetlands and corresponding tools that exclude project activities on wetlands can be disregarded for the purpose of their use in this module, as accounting procedures for the peat soil are provided in module BL-PEAT	Condition met.
34	VMD0041 Version 1.1, BL-ARR	Where the ARR project activity is implemented on peatland, the peatland must be degraded in the baseline scenario as identified by the presence of drainage infrastructure (ditches, canals) and associated lowered water tables below the surface. In the case of forested peatland, degradation may be identified by the removal or degradation of the tree cover before the project start date.	Condition met. ARR project activities are only implemented on already degraded land which would be further degraded in the baseline scenario.
35	VMD0041 Version 1.1, BL-ARR	The project scenario does not involve the harvesting of trees. Therefore, procedures for the estimation of long-term average carbon stocks are not provided.	Condition met.
36	VMD0042 Version 1.1, BL-PEAT	This module is applicable to RDP and CUPP activities on project areas that meet the VCS definition for peatland. The scope of this module is limited to domed peatlands in the tropical climate zone.	Condition met.
37	VMD0042 Version 1.1, BL-PEAT	It must be demonstrated by using the latest version of the CDM A/R methodological tool: “Tool for testing significance of GHG emissions in A/R CDM project activities” (T- SIG) that N_2O emissions in the project scenario are not significant, or it must be demonstrated that N_2O emissions will not increase in the project scenario compared to the baseline scenario, and therefore N_2O emissions need not be accounted for	Condition met. The project does not cause an increase in N_2O emissions

No	Module	Applicability Condition	Comment
38	VMD0042 Version 1.1, BL-PEAT	In the baseline scenario the peatland must be (partially) drained. At project start the peatland may still be undrained.	Condition met. The baseline scenario is of oil palm plantation in peatland requires substantial water table management (i.e. lowering). At project start, the peatland is already partially drained.
39	VMD0043 Version 1.0, LK-ARR	This module is applicable under the following conditions: • Applicability conditions set out in AR-ACM0003 must be met. • Applicability conditions in AR-ACM003 that exclude project activities on wetlands can be disregarded in the context of this module Emissions due to the displacement of pre-project agricultural activities in ARR project activities are estimated using CDM tool Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity	Condition not met, as there will be no displacement of pre-project agricultural activities in ARR project activities.
40	VMD0044 Version 1.1, LK-ECO	This module is applicable under the following condition: Leakage caused by hydrological connectivity is avoided by project design and site selection, as outlined in Chapter 5 (Procedures).	Condition met. Project does not cause ecological leakage. See application of LK-ECO
41	VMD0045 Version 1.1, M-ARR	This module is applicable under the following conditions: • The applicability conditions provided in A/R CDM consolidated methodology AR- ACM0003 (Afforestation and reforestation of lands except wetlands) and associated tools. • Where exclusion of project activities on wetlands exists in the applicability conditions of methodologies and tools, these can be neglected for the purpose of their use in this module, as accounting procedures for the peat soil are provided in nodule M-PEAT	Condition met. See BL-ARR comments
42	VMD0046 Version 1.1, M-PEAT	This module is applicable to RDP and CUPP activities as defined in the VCS Standard.	Condition met: The project involves rewetting of peatlands, i.e., Restoration of Drained Peatlands (RDP) or Restoring Wetlands Ecosystems (RWE). The project also involves preservation of partially drained peatland, i.e., Conservation of Undrained and Partially Drained

No	Module	Applicability Condition	Comment
			Peatlands (CUPP) or Conservation of Intact Wetlands (CIW)
43	VMD0046 Version 1.1, M-PEAT	Furthermore, the following applicability conditions apply: It must be demonstrated using tool T-SIG that N_2O emissions in the project scenario are not significant, or it must be demonstrated that N_2O emissions will not increase in the project scenario compared to the baseline scenario, and therefore N_2O emissions need not be accounted for. In the baseline scenario the peatland must be drained or partially drained. At project start the peatland may still be undrained. It must be demonstrated using Module LK-ECO that ecological leakage must not occur	Condition met. The baseline and project scenarios exclude emissions from fire, so N_2O emissions from fire are not calculated. Project is partially drained at project start.
44	VMD0050 Version 1.0, BL-TW	This module applies to tidal wetland restoration and conservation project activities, as defined in REDD+ MF. This module is applicable under the same applicability conditions outlined in REDD+ MF for WRC project activities.	Condition met. One of the project activities is WRC.
45	VMD0051 Version 1.0, M-TW	This module applies to tidal wetland restoration and conservation project activities, as defined in REDD+ MF. This module is applicable under the same applicability conditions outlined in REDD+ MF for WRC project activities.	Condition met. One of the project activities is WRC.
46	VT0001 Version 3.0, T-ADD	For all project activities other than tidal wetland conservation and Restoration – this tool is applicable under the following conditions: > Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced. This tool is not applicable to small – scale afforestation and reforestation project activities.	Conditions are met. The project is designed to be fully compliant with national, regional and local laws of Republic of Indonesia, especially laws regulating forest conservation projects. Thus, additionality do not violate any applicable laws. In fact, adherence to these laws is required under the project scenario.
47	VMD0052 Version 2.0, ADD-AM	For all tidal wetlands conservation and restoration project activities. Project activities restoring tidal wetlands may include any of the following, or combinations of the following: • Creating, restoring and/or managing hydrological conditions	Conditions are met. The project activities of restoring tidal wetlands include: •(Re-)introducing native plant communities (e.g., reseeding or replanting) •Improving management practice(s)

No	Module	Applicability Condition	Comment
		(e.g., removing tidal barriers, improving hydrological connectivity, restoring tidal flow to wetlands or lowering water levels on impounded wetlands) • Altering sediment supply (e.g., beneficial use of dredge material or diverting river sediments to sediment-starved areas) • Changing salinity characteristics (e.g., restoring tidal flow to tidally-restricted areas) • Improving water quality (e.g., reducing nutrient loads leading to improved water clarity to expand seagrass meadows, recovering tidal and other hydrologic flushing and exchange or reducing nutrient residence time) • (Re-)introducing native plant communities (e.g., reseeding or replanting) • Improving management practice(s) (e.g., removing invasive species, reduced grazing) • In RWE-ARR project activities, the prescribed burning of herbaceous and shrub aboveground biomass (cover burns) may occur	

3.1.3 Project Boundary

The table below shows the carbon stocks included in the project.

Table 3-2. Carbon stock included in the baseline and project scenarios of the PLUM project activities

Carbon Stocks	Included?	Justification
Above Ground Biomass	Included	Mandatory pool in ARR project, REDD and WRC project activities
Aboveground non-tree biomass	Excluded	The stocks of non-tree aboveground biomass are deemed insignificant and not greater in the baseline than in the project scenario
Belowground biomass	Excluded	Belowground biomass is part of soil pool in WRC procedures, and the omission is conservative

Carbon Stocks	Included?	Justification
Litter on mineral soil	Excluded	It is conservatively excluded. Litter carbon pools and their stock changes may be monitored in the future
Litter on peatland	Excluded	This is not mandatory for either mineral soil or peatland. The dead wood carbon pool is expected to increase in the project scenario compared to the baseline, so that it is conservatively omitted.
Dead wood	Excluded	Neither peatland nor mineral soil are required to have this pool. Since in the project scenario, the dead wood carbon pool is anticipated to rise relative to the baseline. It is conservatively omitted.
Mineral soil carbon pool	Excluded	Carbon stock in this pool is expected to increase more or decrease less due to the implementation of project activities relative to the baseline, and thus conservatively omitted
Peat carbon pool	Included	Carbon stock in this pool is expected to increase in the project scenario compared to the baseline
Organic carbon from the soil	Included	Carbon stock in this pool is expected to increase in the project scenario compared to the baseline
Wood product	Excluded	Only applied in cases where the process of deforestation includes the harvesting of timber for commercial markets

The GHG emission sources included or excluded from the project activities are shown in table below.
Table 3-3. The GHG sources included in the project area.

Source		Gas	Included?	Justification/Explanation
Baseline	Oxidation of drained peat	CO_2	Yes	Considered under carbon pools.
		CH_4	No	Conservatively omitted.
		N_2O	No	Excluded as per applicability condition in Module BL-PEAT.
	Water bodies	CO_2	Yes	Water bodies comprise 0.84% of the project area. IPCC DOC values for ‘drained’ and ‘natural’ peatlands will be used.

Source		Gas	Included?	Justification/Explanation
		CH_4	No	Conservatively assume that all DOC emissions are CO_2.
		N_2O	No	Conservatively omitted.
	Deforestation	CO_2	Yes	Above-ground biomass losses as a result of deforestation are included
	Forest Degradation	CO_2	Yes	If forest degradation occurs in the project scenario, it will be accounted for. Values will be calculated using forest degradation emission factors.
	Peat combustion	CO_2	Yes	Procedures provided in Module E-BPB. Make use of IPCC combustion factors
		CH_4	No	Conservatively omitted.
		N_2O	No	Conservatively omitted.
	Combustion of fossil fuels	CO_2	No	Deemed *de minimis* in VCS AFOLU Requirements
		CH_4	No	Deemed *de minimis* in VCS AFOLU Requirements
		N_2O	No	Deemed *de minimis* in VCS AFOLU Requirements
	Fertilizer application	CO_2	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit
		CH_4	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit
		N_2O	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit
Project	Oxidation of drained peat	CO_2	Yes	Considered under carbon pools.
		CH_4	No	Conservatively omitted.
		N_2O	No	Excluded as per applicability condition in Module BL-PEAT.
	Water bodies	CO_2	Yes	Water bodies comprise 0.029% (legacy canal) of the project area. IPCC DOC values for 'drained' and 'natural' peatlands will be used.
		CH_4	No	Conservatively assume that all DOC emissions are CO_2.
		N_2O	No	Conservatively omitted.
	Deforestation	CO_2	Yes	Above-ground biomass losses as a result of deforestation are included
	Forest Degradation	CO_2	Yes	If forest degradation occurs in the project scenario, it will be accounted for. Values will be calculated using forest degradation emission factors.
	Peat combustion	CO_2	Yes	Procedures provided in Module E-BPB. Make use of IPCC combustion factors
		CH_4	No	Conservatively omitted.
		N_2O	No	Conservatively omitted.
	Combustion of fossil fuels	CO_2	No	Deemed *de minimis* in VCS AFOLU Requirements
		CH_4	No	Deemed *de minimis* in VCS AFOLU Requirements
		N_2O	No	Deemed *de minimis* in VCS AFOLU Requirements

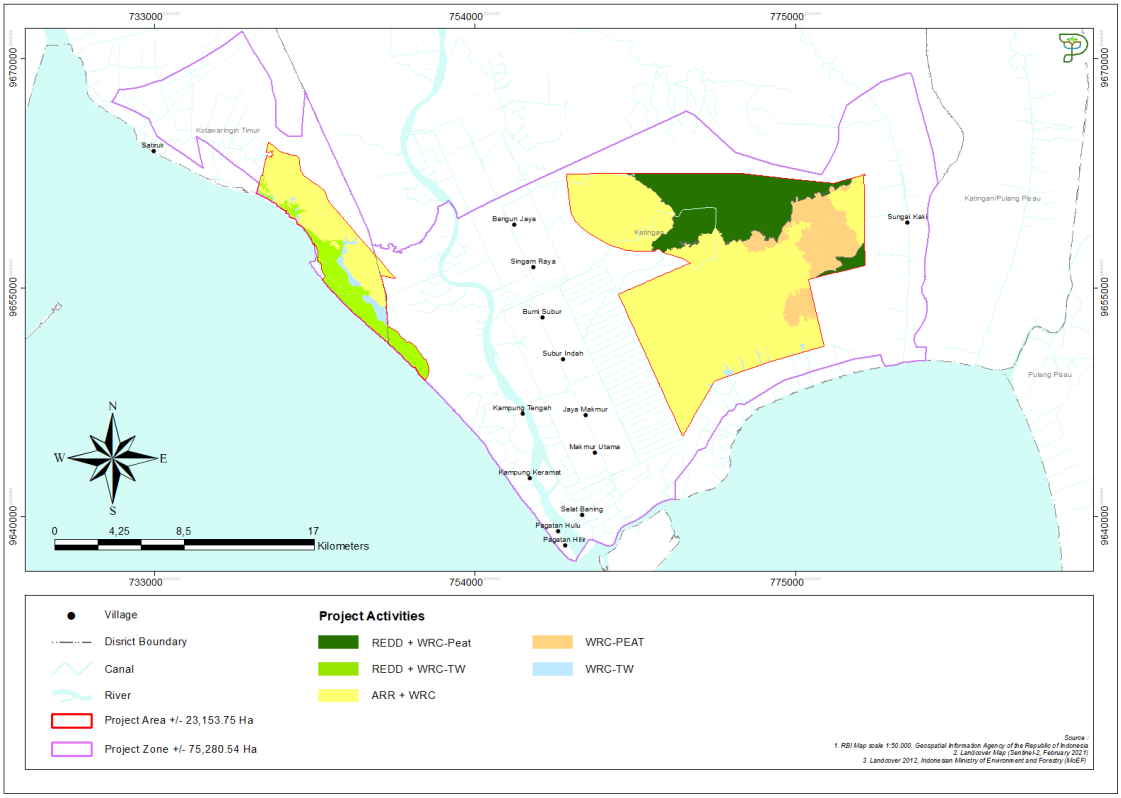
Source		Gas	Included?	Justification/Explanation
	Fertilizer application	CO_2	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit
		CH_4	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit
		N_2O	No	Fertilizer application is higher in the baseline than in the project scenario. As such it is conservative to omit

To define the project boundaries, the project team conducted a land cover assessment using the VCS Module X-STR. The maps below show the project boundary with physical locations of the various project activities, as well as the leakage belt. The leakage belt boundary corresponds to the project zone boundary as shown in Map 3-1 and explained in Section 3.2.3.

The PLUM project area is identified as eligible for various project activities under the VM0007 REDD+ Methodology Framework, including REDD (Reducing Emissions from Deforestation and Forest Degradation), WRC (Wetland Restoration and Conservation), and ARR (Afforestation, Reforestation and Revegetation). Specifically, the area eligible for REDD spans 5,523.14 hectares, constituting approximately 23.85% of the total project area. To qualify for REDD, the designated area must meet the requirement that the land within the project area has qualified as a forest for a minimum of 10 years before the project's commencement.

For Wetland Restoration and Conservation (WRC), the eligible area encompasses 21,009.91 hectares on Peat, representing 90.74% of the total project area, and an additional 2,143.84 hectares on Tidal Wetlands, accounting for 9.25% of the total project area. Meanwhile, for the Afforestation, Reforestation and Revegetation (ARR) activity, the eligible area is 15,087.59 hectares, constituting 65.12% of the overall project area. An essential criterion for an area to be considered eligible for ARR is that the project area should be non-forest land or land with degraded forest, and it must not have undergone clearance of native ecosystems to achieve greenhouse gas emissions reductions or removals. About 1,079 ha out of the 15,087.59 hectares of ARR area was still forest in 2012 but was burnt by forest fires in 2015. It is noted that PT PUM was not operating as an oil palm plantation during this period as it was still in the process of obtaining all the necessary approvals. The fire was likely the result of small-scale local activities (fires, fishing, illegal logging) and exacerbated by the El Niño event in 2015. This situation demonstrates that, prior to the project initiation, activities were not implemented to generate GHG emissions for the purpose of their subsequent reduction.

Please refer to Map 3-1 for the location of eligible areas.



Map 3-1. Project Boundary showing eligible areas of various project activities

3.1.4 Baseline Scenario

This section provides justification for the project's baseline and additionality using the "VT0001 Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities (version 3.0)" which was adapted from the "combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities: Version 2".

This tool is applicable to the project as the project fulfils the following conditions:

a) AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project do not lead to violation of any applicable law even if the law is not enforced;
b) The project used the tool to determine additionality as the tool provides a stepwise approach justifying the determination of the most plausible baseline scenario.

Step 1. Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity

A list of realistic and credible alternative land use scenarios that would have occurred in the project area in the absence of the project is provided in Table 3-4. These scenarios were identified by analysing the pre-project land use, the current land use across similar ecosystems and land use classifications in Central Kalimantan, the land use trends in other similar regions of Indonesia (i.e., Sumatra Island), and the

observed similar activities in the geographical area with similar socio-economic and ecological conditions to the proposed project activity.

All identified land use scenarios are deemed realistic and credible, as the land-uses within the boundary of the proposed project are currently existing or existed at some time in the period beginning ten years prior to the project start date but no longer exist.

Table 3-4. Identified land use scenarios in the absence of the project.

Land Use Scenario	Description
Conservation project without being registered as a VCS AFOLU project	The project concession could be acquired by a conservation organization with long-term philanthropic funding and converted into an ecosystem restoration project.
Industrial oil palm plantation	Oil palm is one of the most common non-forest commodity industrial land uses of lowland peatlands in Indonesia. The area of oil palm plantations in Indonesia has increased dramatically over the past decade. Oil palm cultivation requires maintaining the water table of the peat to below 70cm. In Central Kalimantan Province, the oil palm plantation area increased by 71% (1.5 million ha) between 2013 and 2018 alone (BPS, 2023) on non-state forest land (*Areal Penggunaan Lain*, APL) and convertible state forest land (*Hutan Produksi Konversi*, HPK). 82.56% of the project area is on HPK, and before PT PUM applied for the Forest Utilization Business License (PBPH), the area was designated to become hybrid coconut oil plantation in 2009 (PT PUM, Katingan Regent Decree No. 335/2009) and oil palm plantation in 2011 (PT PUM, Katingan Regent Decree No. 525/229/KPTS/VIII/2011). The environmental permit for oil palm plantation granted to PT PUM in 2013[51], followed by other administrative steps and approvals. Before 2021, PT PUM was part of the PT Agro Inti Semesta (PT AIS) group[52] who owns two other oil palm plantations in the area, namely PT Katingan Mujur Sejahtera (PT KMS) and PT Trubus Bumi Sejahtera (PT TBS). PT PUM was planned to be developed as an oil palm plantation along with PT KMS and PT TBS. PT KMS has already started conversion of the peat forest into oil palm plantation, made canals, and secured HGU[53]; PT TBS has obtained a Plantation Business Permit (*Izin Usaha Perkebunan* or IUP) from the Katingan Regent, and has secured funding. Without the PLUM Project, it is highly likely that PT PUM's area would have continued to be developed into an oil palm plantation by PT AIS.

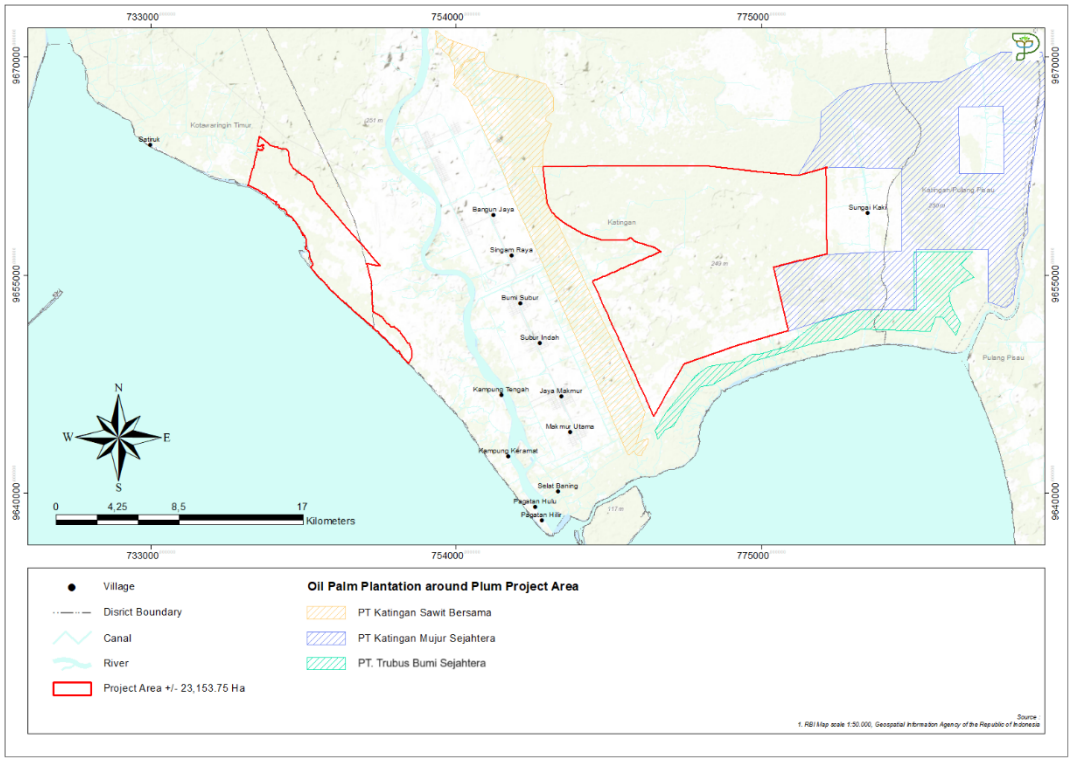
[51] Katingan Regent Decree of Environmental Permit for Development of Oil Palm Plantation PT PUM (No.525.21/172/KPTS/IV/2013)
[52] Previously Agro Investama Group (AIG).
[53] *Hak Guna Usaha* (Right to Cultivate).

Land Use Scenario	Description
	Furthermore, there is one more oil palm plantation (PT KSB – not in PT AIS group) that has been designated in the area surrounding the project and already secured the permit to convert the state-forest land into non state-forest land. This illustrates that the project zone was envisioned as an oil palm production area.
Industrial acacia plantation	Industrial acacia plantation is another common land use in lowland Indonesia, which also requires maintaining the water table of the peat to below 70cm. Acacia plantations have been expanding in Indonesia between 2011-2020, from 9.6 million ha in 2011 to 11.2 million ha in 2020, and more than 50% are located in peatland[54].
Logging concession	Since 1970 until late 1990s, most businesses on Kalimantan Island were logging concessions. In the last decade, only few logging concessions operated in Central Kalimantan Province, and none operates on wetlands in Central Kalimantan today. However, logging concession remains a legal possibility in the project area despite the unlikely practice mainly due to the low commercial timber availability. Most logging concessions in Central Kalimantan Province are on mineral soil (non-wetland) in the northern part of the province, while the southern part of the province is predominantly being developed for oil palm plantations (Map 3-2).
Smallholder agriculture/farming	Smallholder agricultural land occupies around 15% of the planted oil palm area in Central Kalimantan Province[55]. In the direct vicinity of the project area, there are over 13,000 ha of paddy fields from 13 villages, providing the main income and livelihood to the local communities in the area. Under the SIMURP project, the government has supported the smallholder farmers by constructing an irrigation system. This involved digging of a 4m x 4m canal directly adjacent to the project area. Although smallholder agriculture/farming is not seen as a likely land use for the project area, it remains considered as a plausible scenario given that it is one of the primary land uses in Indonesia and in the surroundings of the project area.
Unprotected Forest – Continuation of pre-project land use	In Indonesia, unprotected and unexploited forests are not uncommon, but they typically exist as a temporary state between phases of commercial or local exploitation. These neglected forest areas are often degraded, leading to a loss of their commercial value for timber. The vicinity of the project area has seen this pattern play out, with unprotected forests being replaced by oil palm plantations and smallholder agriculture.
Protected Forest	There are instances of logging concessions in Central Kalimantan Province that have been converted to protection forest, especially in areas with Production Forest (*Hutan Produksi*, HP) status on state-forest land. Some

[54] The State of Indonesia's Forests 2020 (MoEF).
[55] https://www.climatepolicyinitiative.org/id/publication/peluang-untuk-meningkatkan-produktivitas-dan-profitabilitas-petani-kecil-kelapa-sawit-di-kalimantan-tengah

Land Use Scenario	Description
	examples were former logging concessions that became Sebangau National Park and a number of areas of Protection Forest (*Hutan Lindung).* Although only 17.44% of the project area was Production Forest, the scenario to become protected forest is plausible.

Apart from the six major land use scenarios described above, several smaller land uses were analyzed, such as the development of fish ponds, infrastructure, and settlements. Nevertheless, these were not retained as they were not deemed sufficiently significant and credible.



Map 3-2. Location of the oil palm plantations around PT PUM Concession

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

The consistency of the six major land use scenarios identified under Sub-step 1a with mandatory laws and regulations in Indonesia was then considered. In particular, the analysis took into account the legal designation of the project area as 17.44% production forest (HP) and 82.56% convertible production forest (HPK).

Land Use Scenario	Legality
Conservation project without being registered as a VCS AFOLU project	This scenario may be implemented in accordance with applicable laws and regulations (including the Forestry Law No. 41/1999 and No. 19/2004 and the Ministry of Forestry Regulation No. 31/2014 and supporting regulations including the latest MoEF Regulation No. 7/2021). A PBPH license for

Land Use Scenario	Legality
	ecosystem restoration could potentially be obtained by a non-profit or for-profit organization that implements a conservation project without carbon finance.
Industrial oil palm plantation	This scenario is consistent with applicable laws and regulations. Oil palm can be legally established on land designated as HPK with a request to convert the area to become APL (as per the recent MoEF Regulation No. 7/2021). The application to convert HPK into APL had been submitted by the former license holder in the project area (before PT PUM) (Letter No.01/PUM/P.KS/VII/ 2013). In addition, there are 43 oil palm plantation permits granted on lands with Production Forest status within 100 km radius of PT PUM (Map 3-3).
Industrial acacia plantation	Acacia plantation is consistent with applicable laws and regulations, including the Forestry Law No. 41/1999 and No. 19/2004 and the Ministry of Forestry Regulation No. 31/2014 and supporting regulations including the latest MoEF Regulation No. 7/2021.
Logging concession	Logging concession is also legally a possibility in line with the Forestry Law No. 41/1999 and No. 19/2004 and the Ministry of Forestry Regulation No. 31/2014 and relevant regulations including the latest MoEF Regulation No. 7/2021.
Smallholder agriculture/farming	As production forest, the project area cannot be legally converted to smallholder agriculture. Nevertheless, smallholders often target forest land that is neglected and not subject to active concession licenses or commercial exploitation. In the absence of a commercial license, smallholders may seek to assert ownership of the occupied land.
Unprotected Forest – Continuation of pre-project land use	In the absence of an application for a concession license, the project area could continue to be classified as production forest in line with applicable forestry laws and regulations and remain unprotected.
Protected Forest	Forest land in the project area could undergo a legal process to be converted to protection forest or conservation forest. However, this is a complex legal process that is subject to a number of laws and regulations (MoEF Regulation No. 7/2021).

Sub-step 1c. Selection of the baseline scenario

In conclusion, all the plausible scenarios are retained for analysis in the following step. Although the smallholder agriculture scenario could be rejected due to the illegality, it was retained as it remains common across Indonesia and in the surroundings of the project area.

VT0001 provides the option to undertake either Step 2 (Investment analysis) or Step 3 (Barrier analysis). Step 3 was selected to be used to determine the baseline and additionality. Nevertheless, the project undertook an analysis of the Net Present Value (NPV) between baseline scenario and project scenario, which showed that oil palm plantation is the most profitable land use compared to the project scenario (Appendix 4: NPV Calculation). The barriers to the alternative scenarios and the project scenario are evaluated in the following section. As established in this section, the most likely and credible business-as-usual scenario is the conversion to oil palm plantation. Oil palm plantation becomes the baseline scenario for the project.

3.1.5 Additionality

Step 3. Barrier analysis

Sub-step 3a. *Identification of barriers that would prevent the implementation of the type of proposed project activity*

Land Use Scenario	Barriers
Conservation project without being registered as a VCS AFOLU project	There are investment barriers that would prevent the implementation of the project if it were not registered as a VCS AFOLU project. In the absence of carbon finance revenues, there would not be any revenues from this project undertaken by a private entity. As shown in Appendix 4: NPV Calculation, the only revenues of the PLUM project are from the sale of VCUs. Without the registration as a VCS AFOLU project, alternative sources of financing would be needed such as philanthropic funding for a conservation project. These sources of financing are not widely available for the scale and duration of the PLUM Project.

Sub-step 3b. *Demonstration that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios*

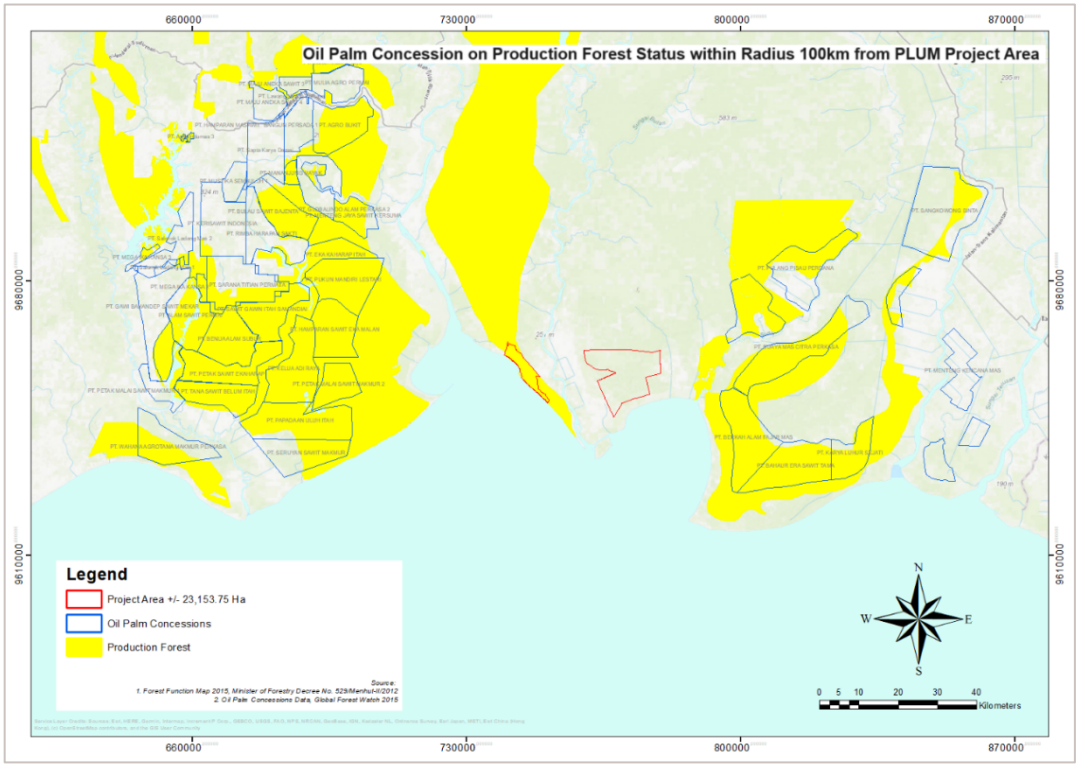
The investment barrier identified under Sub-step 3a above does not prevent the implementation of the four commercial alternative land use scenarios below, given that these projects have revenues from the commercialization of commodities. The same barrier would, however, prevent the implementation of the Unprotected Forest and Protected Forest scenarios. A summary of other barriers faced by the alternative land use scenarios is provided below.

Land Use Scenario	Barriers
Industrial oil palm plantation	This land use scenario does not face any significant barriers. When the project was initiated in 2021, the area was legally permissible for plantation establishment, and PT PUM (which was formerly part of PT AIS) had been granted a permit for the same purpose. After the acquisition of PT PUM by Hutan Kencana Group in 2021, PT AIS group still has two oil palm plantations adjacent to the project area, which have already started the process of conversion of the peat forest into oil palm plantation.
Industrial acacia plantation	This land use scenario faces barrier in transporting logs to a processing factory. The nearest factory is situated in South Kalimantan Province[56] (> 250km from the project area) and is only accessible by sea since there is no land routes available. With the high transport costs and the relatively small area size, it may not be financially feasible to develop an industrial acacia plantation in the area. There is also an institutional barrier for the establishment of industrial acacia plantation since the area has already obtained a government permit (from the Regent) for oil palm plantation development since 2011 and has been in the process of land status

[56] PT Hutan Rindang Banua (plywood factory)

Land Use Scenario	Barriers
	conversion from forest estate to non-forest estate. In addition, there are no existing acacia plantation concessions in the vicinity. The majority of acacia plantation concessions in Central Kalimantan Province are concentrated in the northern part of the province, which indicates that acacia plantation establishment is not a common practice in the area.
Logging concession	This scenario faces ecological and economic barriers. Logging activities took place in the project area since the early 1970s, which resulted in a reduction in commercially viable timber. Also, timber prices have decreased while costs and requirements for certification have increased.
Smallholder agriculture/farming	Barriers to the expansion of smallholder agriculture in the project area are both ecological and institutional. Peat soils are generally less suitable for agriculture, and smallholder agriculture is not legally permissible on production forest land.
Unprotected Forest – Continuation of pre-project land use	There are economic barriers to maintaining the area as unprotected forest, since the project area would not generate any state revenues nor benefits to local communities.
Protected Forest	Political and economic barriers exist for this scenario, since as a protected forest the project area would not generate any state revenues nor benefits to local communities and local government.

Based on the analysis above, oil palm plantation is the most credible land use scenario in the project area due to its financial, legal and technical viability and the significant barriers faced by the other options.



Map 3-3. Oil palm concessions on Production Forest (*Hutan Produksi*) status within 100km distance to the project areas

Step 4. Common practice analysis

In the absence of carbon finance revenues, there are few instances of this practice in Indonesia where intact forest on production forest land is protected. It is not common practice in the country to maintain intact forests on production forest land. Projects aiming to protect these forests would rely heavily on donor or corporate funding sources, which are often scarce. Other similar conservation and restoration projects in Central Kalimantan are either implemented by non-profit organizations and reliant on philanthropic funding or are VCS AFOLU projects that rely on carbon finance.

Conclusion

The project is considered additional, and the most likely and credible business-as-usual scenario is the conversion to oil palm plantation. By preventing this conversion, the project significantly contributes to carbon sequestration and biodiversity preservation, marking a vital step away from business-as-usual towards environmental sustainability.

Additional background on PT PUM's transformation to ecosystem restoration project

In 2021, PT PUM separated from PT AIS group and transformed its business from oil palm plantation into Forest Utilization Business License (PBPH). In 2021, Dr. Handoko Limaho's family, a shareholder of PT AIS, decided to exit the palm oil business and instead develop ecosystem restoration projects. The family had been in the palm oil business since 2009 and became increasingly aware of the urgency of the climate and biodiversity crisis and the importance of conservation. The decision was made in 2021 to divest from PT AIS and to acquire PT PUM from PT AIS to stop the planned deforestation of this high-biodiversity area. The family established Hutan Kencana Group with a mission to support ecosystem restoration efforts, protect biodiversity, and improve the wellbeing of communities around forests. Without the prospect of carbon revenues, the decision to convert PT PUM into an ecosystem restoration project would not have been viable.

Additionality of tidal wetland restoration and conservation project activities

The project also applied VCS module VMD0052 to demonstrate additionality of tidal wetland restoration and conservation project activities (ADD-AM).

Step 1: Regulatory surplus

The project activities related to tidal wetland restoration and conservation are not mandated by any law, statute, or other regulatory framework of Indonesia. The western part of the project area (where the tidal wetland activities take place) is on Production Forest (*Hutan Produksi*) land which mandates production rather than conservation use. As shown in Map 3-3 above, there are 43 oil palm plantation permits granted on lands with Production Forest status within 100 km radius of PT PUM.

Step 2: Positive list

As explained in Section 3.1.2, the project meets all applicability conditions of Section 4.5 of the VM0007 REDD+ Methodology Framework, and in so doing, it is deemed as complying with the positive list established for VMD0052.

3.1.6 Methodology Deviations

The project does not involve deviations from the VM0007 methodology or any of the related modules relating to the criteria and procedures for monitoring or measurement.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

3.2.1.1 General Procedures and Assumptions

The project has used VM0007 (REDD+ MF), VMD0006 (BL-PL), VMD0042 (BL-PEAT), VMD0050 (BL-TW), and VMD0041 (BL-ARR) to assess the project's baseline emissions.

VMD0006 (BL-PL)

Part 1: Calculating annual area of land deforested

Under the VMD0006 (BL-PL), four parts of procedures with several steps were analysed. As explained in Sections 3.1.4 and 3.1.5, the deforestation agent is the oil palm company group PT AIS, the former parent company of PT PUM, who received the permit to convert the land into oil palm plantation in 2011 (Katingan Regent Decree No.525/229/KPTS/ VIII/2011). However, in order to determine a more realistic and conservative deforestation rate compared to the plan indicated in PT PUM's Environmental Impact Assessment Report (AMDAL), the project conducted a deforestation rate analysis in proxy areas following the criteria for applicability of proxy areas laid out in VMD0006.

The project identified six companies for proxy areas deforested by the same 'class of deforestation agent' at least ten years previously. There is an immediate site-specific threat of deforestation (refer to Section 2.2) at a rate that was established by examining the proxy areas. VMD0006 BL-PL guides the reference or proxy area selection process. A sufficient number of parcels are required to be reflective of usual practice in both the proxy area and the project region since the proxy area will be used to estimate the average proportion of land that is cleared each year. Below are the overall project area criteria and the list of reference region requirements. All of the criteria have been fulfilled.

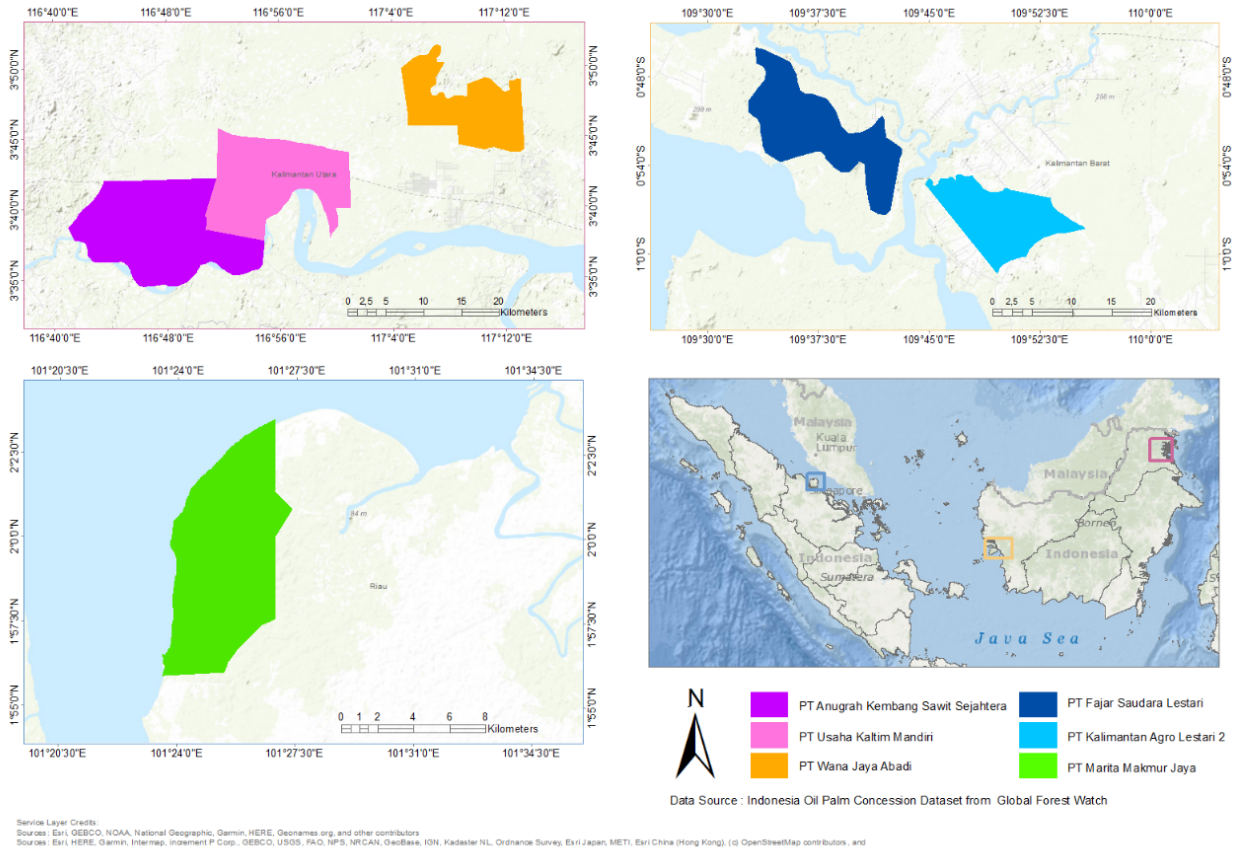
Table 3-5. Requirements for the reference areas of the PLUM Project.

No	Project Area Criteria	Reference Region Requirements
1	Forest type: 6.67% of mangrove forest	5.34-8% of mangrove forest
2	Soil type: 68.56% of peat land	54.85-82.27% of peat land
3	Slope: 98.52% of the area has "gentle" (slope <15%) slopes	At least 78.81% of the area must have "gentle" slope
4	Elevation: 100% of the area in the 0 – 500m class (lowland)	At least 80% of the area must fall in 0-500m class

Moreover, VM0007 REDD+ MF Version 1.6 also describes the historical reference period criteria for each activity. The historical reference period is the temporal domain from which information on historical deforestation is extracted, analyzed and projected into the future. For REDD activities (Non-Wetland Area)

the starting date of the historical reference period must be between 9 and 12 years in the past and the end date must be within two years before project start date. For the WRC activities (Wetland Area) the starting date of the historical reference must be at least 10 years in the past.

The project proponent conducted research to obtain reference areas. Several reference areas were selected based on its historical reference period (data collected from January 1st, 2012 to December 31st, 2022). Six reference areas were selected, which are areas owned by PT Anugrah Kembang Sawit Sejahtera, PT Usaha Kaltim Mandiri, PT Fajar Saudara Lestari, PT Kalimantan Agro Lestari 2, PT Wana Jaya Abadi, PT Marita Makmur Jaya, and PT Anugrah Kembang Sawit Sejahtera (refer to Appendix 3: Proxy Deforestation Report for details). The reference areas are shown in Map 3-4 below.



Map 3-4. The reference areas of the PLUM Project

1. PT Anugrah Kembang Sawit Sejahtera

PT Anugrah Kembang Sawit Sejahtera satisfies the reference region requirements (Table 3-6). The project analysed that this company has converted almost 100% of its forest within 10 years' time (Figure 3-1).

Table 3-6. Analysis on reference region requirements for PT Anugrah Kembang Sawit Sejahtera.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	6.62% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	72.75% of peat land
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

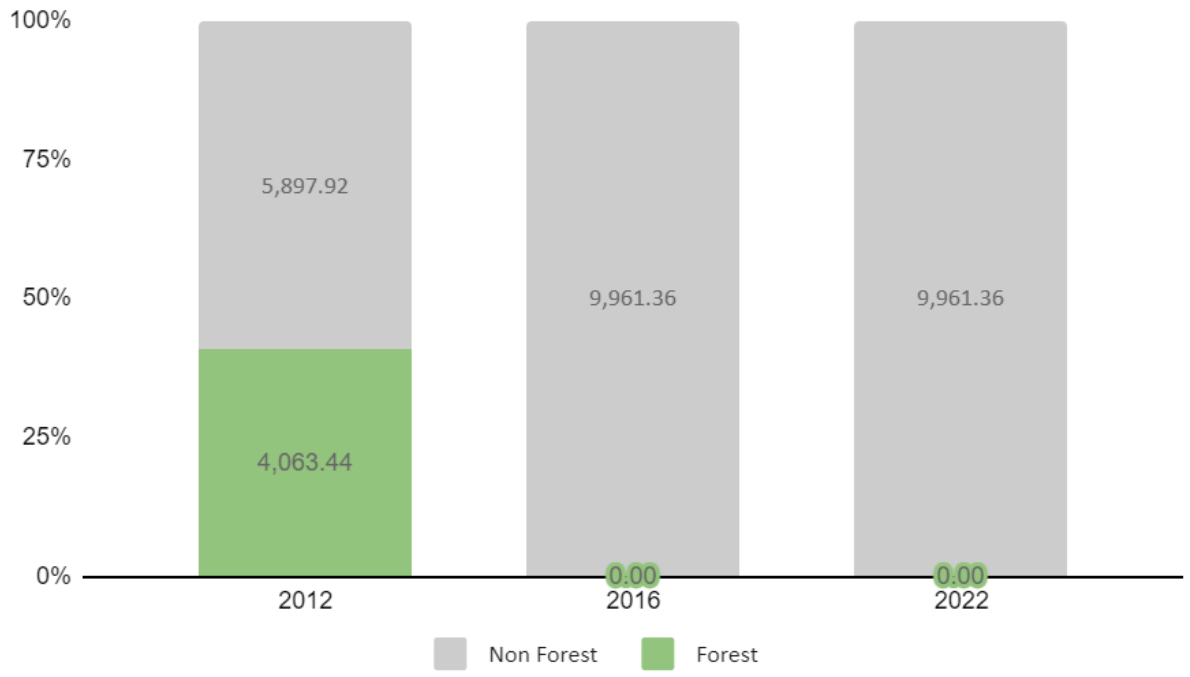


Figure 3-1. Land cover changes in PT Anugrah Kembang Sawit Sejahtera.

2. PT Usaha Kaltim – Mandiri

PT Usaha Kaltim – Mandiri satisfies the reference region requirements (Table 3-7). The project analysed that this company has converted most of its forest and only 4.37% forest cover area remains (Figure 3-2).

Table 3-7. Analysis on reference region requirements for PT Usaha Kaltim – Mandiri.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	6.62% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	72.75% of peat land

No	Reference Region Requirements	Requirements Evaluation	Notes
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

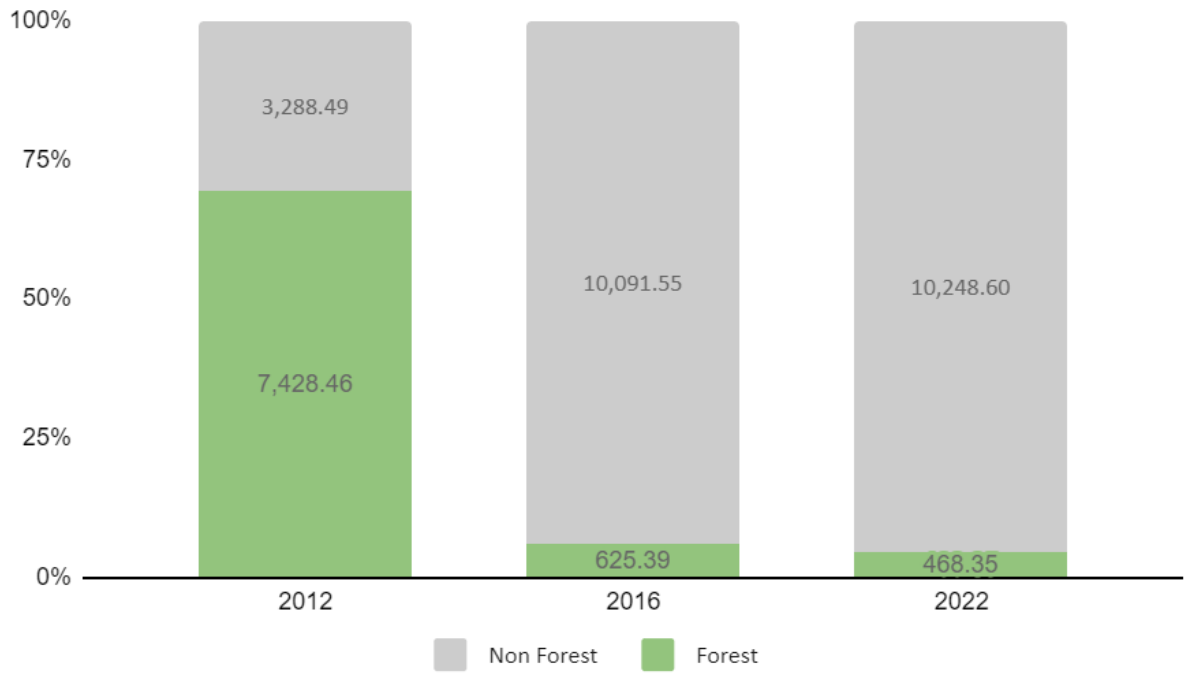


Figure 3-2. Land cover changes in PT Usaha Kaltim – Mandiri.

3. PT Fajar Saudara Lestari

PT Fajar Saudara Lestari satisfies the reference region requirements (Table 3-8). The project analysed that this company has converted most of its forest and only 7.52% forest cover area remains (Figure 3-3).

Table 3-8. Analysis on reference region requirements for PT Fajar Saudara Lestari.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	6.88% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	81.96% of peat land
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

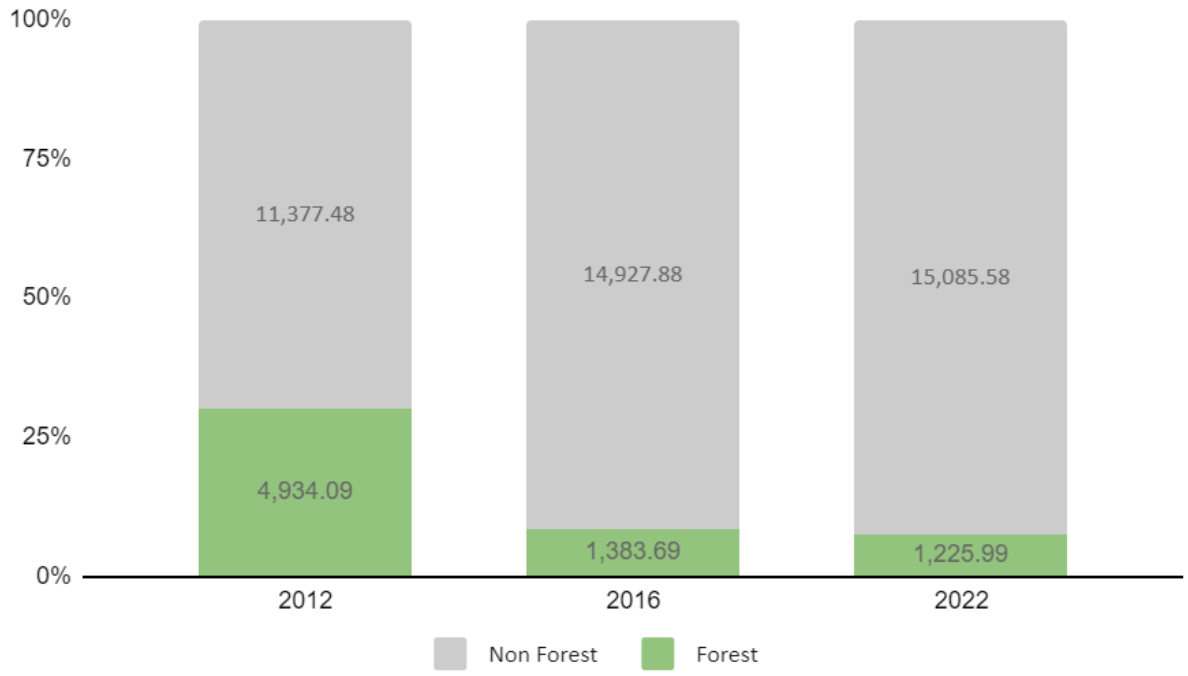


Figure 3-3. Land cover changes in PT Fajar Saudara Lestari

4. PT Kalimantan Agro Lestari 2

PT Kalimantan Agro Lestari 2 satisfies the reference region requirements (Table 3-9). The project analysed that this company has converted most of its forest and only 5.15% forest cover area remains (Figure 3-4).

Table 3-9 Analysis on reference region requirements for PT Kalimantan Agro Lestari 2.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	6.04% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	77.16% of peat land
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

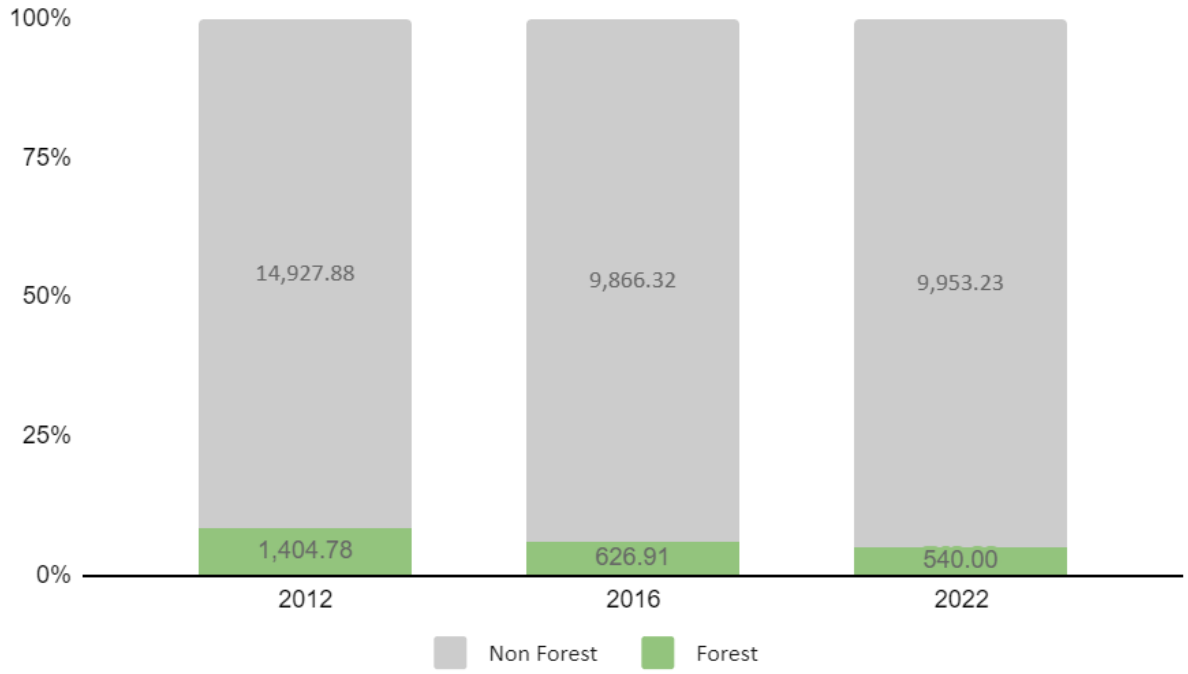


Figure 3-4. Land cover changes in PT Kalimantan Agro Lestari 2.

5. PT Wana Jaya Abadi

PT Wana Jaya Abadi satisfies the reference region requirements (Table 3-10). The project analysed that this company has converted most of its forest and only 27% forest cover area remains (Figure 3-5).

Table 3-10. Analysis on reference region requirements for PT Wana Jaya Abadi.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	7.34% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	65.07% of peat land
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

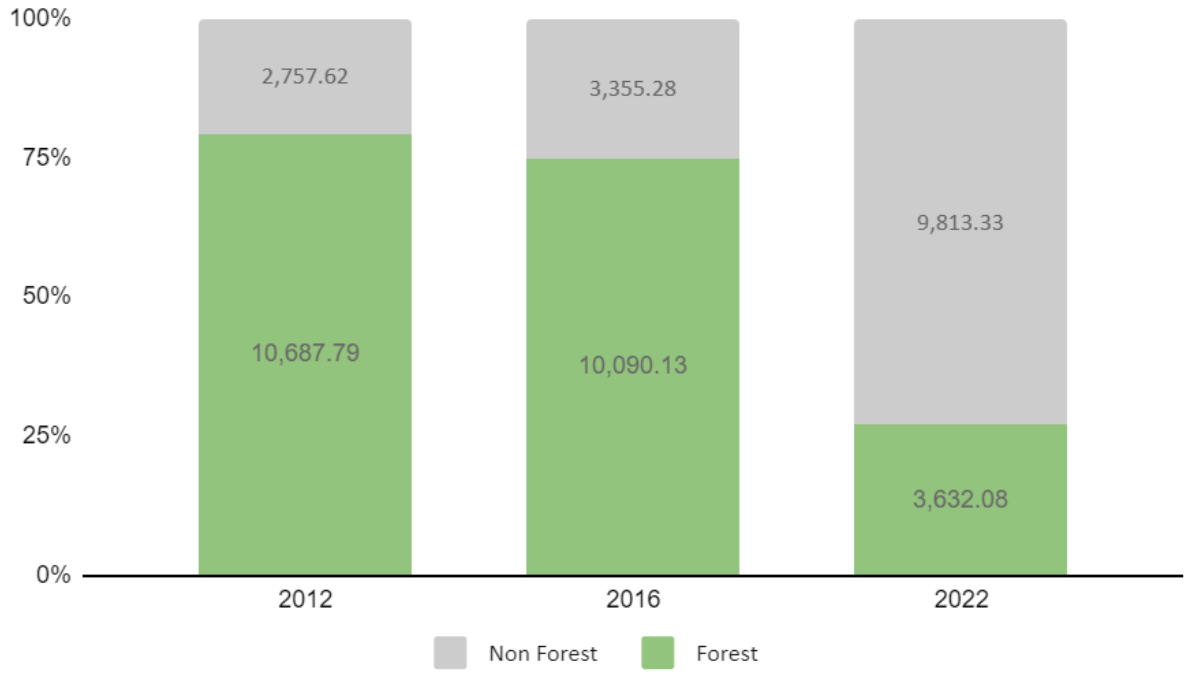


Figure 3-5. Land cover changes in PT Wana Jaya Abadi.

6. PT Marita Makmur Jaya

PT Marita Makmur Jaya satisfies the reference region requirements (Table 3-11). The project analysed that this company has converted most of its forest and only 4.48% forest cover area remains (Figure 3-6).

Table 3-11. Analysis on reference region requirements for PT Marita Makmur Jaya.

No	Reference Region Requirements	Requirements Evaluation	Notes
1	5.34% - 8.00% of mangrove forest	Yes	7.07% of mangrove forest
2	54.85% - 82.27% of peat land	Yes	82.14% of peat land
3	At least 78.81% of the area must have “gentle” slope	Yes	Majority (>90%) of the area has “gentle” (slope <15%) slopes
4	At least 80% of the area must fall in 0-500m class	Yes	Elevation: 100% of the area in the 0 – 500m class (lowland)

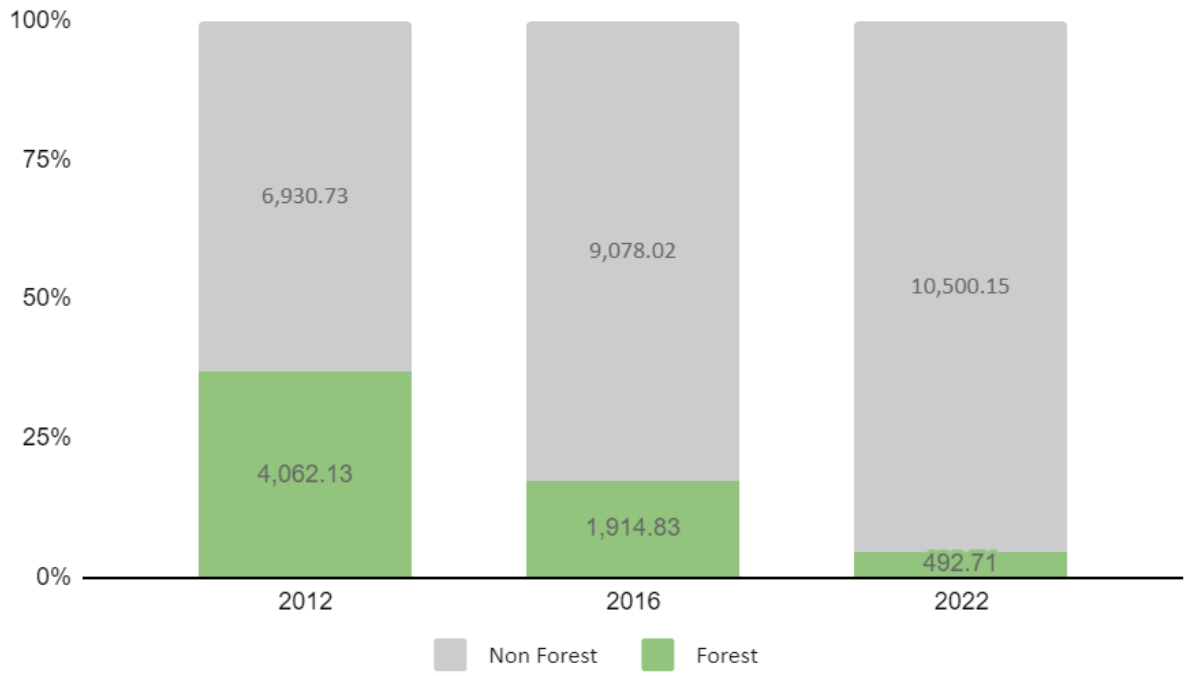


Figure 3-6. Land cover changes in PT Marita Makmur Jaya.

As the proxy areas were not both under government control and zoned for deforestation, the likelihood (L-Di) is equal to 100%. Furthermore, none of the proxy areas have been abandoned to forest regrowth (see Appendix 3: Proxy Deforestation Report).

The project calculated the rate of deforestation using **Equation 4** of the VMD0006 BL PL as below:

$$D\%_{planned\ ,i,t} = (\sum_{pn=1}^{n*} (D\%_{pn} \div Yrs_{pn}))/n$$

Where	Description	Unit
$D\%_{planned,i,t}$	CO2 emissions from the tidal wetland SOC pool in the baseline scenario in stratum i in year t	$tCO_{2\_}e$
$D\%_{pn}$	CO2 emissions from the tidal wetland SOC pool of in-situ soils in the baseline scenario in stratum i in year t	$tCO_{2\_}e$
Yrs_{pn}	CO2 emissions from the eroded tidal wetland SOC pool in the baseline scenario in stratum i in year t	$tCO_{2\_}e\ yr^{-1}$
n	Total number of land parcels examined	
pn	1, 2, 3 …n* land parcels examined in proxy area	
i	1, 2, 3 …M strata	

The project calculated the annual area of deforestation using **Equation 5** of the VMD0006 BL PL as below:

$$AA_{planned\ ,i,t} = A_{planned\ ,i} * D\%_{planned\ ,i,t} * L - D_i$$

Where	Description	Unit
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i at time t	ha
$A_{planned,i}$	Projected annual proportion of land that will be deforested in stratum i during year t. If actual annual proportion is known and documented (e.g. 25% per year for 4 years), set to proportion	%
$D\%_{planned,i,t}$	Total area of planned deforestation over the baseline period for stratum i	ha
$L - D_i$	Likelihood of deforestation for stratum i	%

Hence, the rate of deforestation following VMD0006 BL-PL is 6.79% (Table 3-12) and the annual rate of deforestation under the baseline scenario is 442.86 ha/year (Table 3-13). This rate of deforestation is considered conservative when compared to the deforestation rate indicated in PT PUM's Environmental Impact Assessment Report (AMDAL) of approximately 5,000 ha/year[57].

Table 3-12. Rate of deforestation following Equation 4 of the VMD0006 BL PL.

Strata	D%planned,i,t
Primary Mangrove Forest to Non Forest	3.76%
Secondary Mangrove Forest to Non Forest	4.36%
Primary Swamp Forest to Non Forest	9.41%
Secondary Swamp Forest to Non Forest	9.64%
Average	**6.79%**

Table 3-13. Annual area of deforestation following Equation 5 of the VMD0006 BL PL.

Strata	A planned,i (Ha)	L -Di (%)	AA planned,i,t (ha/yr)
Primary Mangrove Forest to Non Forest	1,371.43	1	51.58
Secondary Mangrove Forest to Non Forest	-	1	-
Primary Swamp Forest to Non Forest	3,895.72	1	366.61
Secondary Swamp Forest to Non Forest	255.99	1	24.67
Total			**442.86**

Part 2: Baseline carbon stock change

A total of 36 sampling plots (0.25 ha each) and 97 sampling plots were sampled for the above ground biomass and below ground biomass respectively[58]. The number of sampling plots were deemed sufficient to fulfil 10% error and 95% confidence interval. From the sampling plots, it was determined that around 1,822,430.64 tC is stored in the above ground biomass, around 20,302,995.97 tC in the peatland soil, around 1,002,137.80 tC in the tidal wetlands soil, and around 117,562.38 tC in the below ground biomass (mangrove roots) of the tidal wetlands, totalling 23,245,126.79 tC of carbon stock within the project area.

[57] Land clearing activities are planned to be implemented during the first four years in the AMDAL document.
[58] PT PUM Biomass Assessment Report (2022).

For APWD-REDD and stand-alone APWD project activities, GHG emissions from the soil organic carbon pool are quantified below:

1. The baseline includes no harvesting of long-lived wood products, thus the harvested wood products carbon pool is not used
2. Stock changes in all pools except soil is calculated using Equation 14 below. Under the VMD0001 CP-AB, the belowground biomass are not required because omission is conservative.
3. The soil organic carbon (SOC) in APWD-REDD is calculated using BL-PEAT and BL-TW.

As no harvest for wood product (Cwp100,i), and the below ground biomass (CBB), non-tree biomass (CABnon-tree), and litter (CLI,i) are omitted, then, **the Equation 14** becomes:

$$\Delta C_{BSL,i,t} = AA_{planned\ ,i,t} \times \left(\Delta C_{ABtree\ ,i}\right)$$

Where	Description	Unit
$\Delta C_{BSL,i,t}$	Sum of the baseline carbon stock change in all terrestrial pools in stratum i in year t	tCO_2_e
$AA_{planned,i,t}$	Annual area of baseline planned deforestation for stratum i in year t	ha
$\Delta C_{ABtree,i}$	Baseline carbon stock change in aboveground tree biomass in stratum i	$tCO_2\_e\ ha$
i	1, 2, 3 …M strata	
t	1, 2, 3, … t* years elapsed since the projected start of the project activity	

Table 3-14. The mean carbon stock in aboveground biomass for each stratum following VMD0001 CP-AB ($C_{AB\_tree,i}$)

Landover Classes	$C_{AB\_tree,i}$ (tCO2e/ha)	Source
Primary Swamp Forest	1,050.06	PT PUM's Biomass Assessment (2022)
Secondary Swamp Forest	326.41	PT PUM's Biomass Assessment (2022)
Primary Mangrove Forest	354.34	PT PUM's Biomass Assessment (2022)
Secondary Mangrove Forest	339.62	PT PUM's Biomass Assessment (2022)
Wet Shrub	126.12	PT PUM's Biomass Assessment (2022)
Paddy Field	17.23	Indonesia FREL (2022)
Bare Ground	4.14	Indonesia FREL (2022)
Open Water	-	-
Open Swamps	33.33	Indonesia FREL (2022) – wet shrub stratum

Table 3-15. Baseline carbon stock change in aboveground tree biomass in stratum i

Landover Classes	$\Delta C_{AB\_tree,i}$ (tCO2e/ha)
Primary Mangrove Forest to Non Forest	336.11
Secondary Mangrove Forest to Non Forest	321.38
Primary Swamp Forest to Non Forest	1,031.83

Landover Classes	$\Delta C_{AB\_tree,i}$ (tCO_2e/ha)
Secondary Swamp Forest to Non Forest	308.18

Part 3: Greenhouse gas emissions

The GHG emissions in the baseline within the project boundary were estimated as Equation 15 below.

1. According to VMD0006, the N_2Odirect-N,i,t must be calculated using the latest AA/R CDM tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Module E-NA). However, the tool is not applicable when A/R CDM project activities are implemented on wetlands which is the case in this project. Hence, the GHG emissions from fertilizer application is excluded in the baseline.
2. According to VMD0006, the eBiomassBurn,i,t must be calculated using Module E-BPB. Where used in the baseline, accounting must occur under both the baseline and project scenarios in both the project area and in the leakage belt. As this project assumes that the fire prevention program is successfully implemented by the project, it is assumed that no fires will occur after the project initiation in the project scenario. Hence, the GHG emissions from biomass burning (not the peat burn) in the baseline were conservatively omitted.
3. According to VMD0006, the EFC,I,t must be calculated using Module E-FFC. All fossil fuel combustion associated with a project may be accounted, including fossil fuel combustion of subcontractors that are conducting (parts of the) work to implement the project. Fossil fuel combustion in all situations is an optional emission source. This project assumes that the use of fossil fuel will be *de minimis* under the project scenario. Hence, the GHG emissions from combustion of fossil fuels in the baseline were conservatively omitted.

With the above description, hence the $GHG_{BSL,E,I,t}$ is equal with the $\Delta C_{BSL,I,t}$ as shown in **Equation 15** below:

$$GHG_{BSL,E,i,t} = E_{FC,i,t} + E_{BiomassBurn\ ,i,t} + N2O_{direct\ -N,i,t}$$

Where	Description	Unit
$GHG_{BSL,E,i,t}$	Greenhouse gas emissions as a result deforestation activities within the project boundary in the stratum i in year t	$tCO_{2-}e$
$E_{FC,i,t}$	Net CO2e emission from fossil fuel combustion in stratum i in year t	$tCO_{2-}e$
$E_{BiomassBurn,i,t}$	Non-CO2 emissions due to biomass burning in stratum i in year	$tCO_{2-}e$
$N2O_{direct-N,i,t}$	Direct N2O emission as a result of nitrogen application on the alternative land use within the project boundary in stratum i in year t;	$tCO_{2-}e$
i	1, 2, 3 …M strata	
t	1, 2, 3, … t* years elapsed since the projected start of the project activity	

Hence, the GHG emissions in the baseline scenario for 60 years from planned deforestation and wetland degradation are 4,559,546 tCO_2e (Table 3-16).

Table 3-16. The baseline emissions from planned deforestation and wetland degradation (BL-PL).

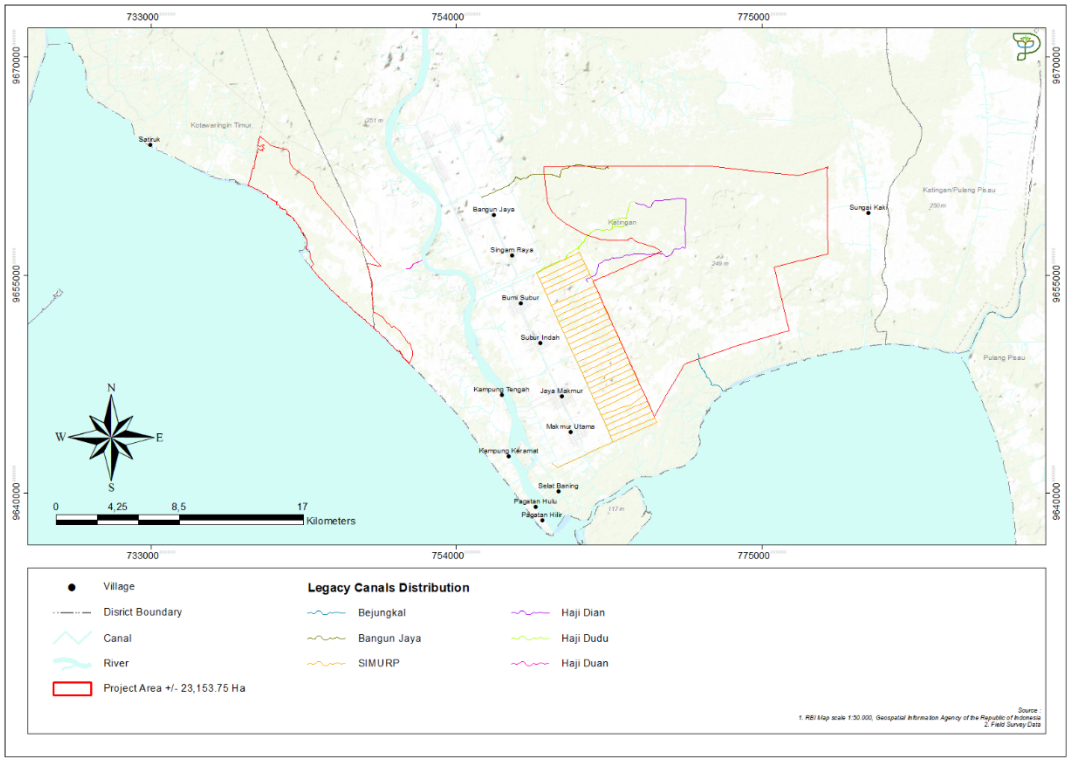
Year	$\Delta C_{BSL,l,t}$ (tCO_2e)
1	479,220
2	412,760
3	412,760
4	412,760
5	412,760
6	412,080
7	410,575
8	410,575
9	410,575
10	410,575
11	138,258
12	20,390
13	20,390
14	20,390
15	20,390
16	20,390
17	20,390
18	20,390
19	20,390
20	20,390
21	20,390
22	12,358
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-
32	-
33	-

Year	$\Delta C_{BSL,l,t}$ (tCO_2e)
34	-
35	-
36	-
37	-
38	-
39	-
40	-
41	-
42	-
43	-
44	-
45	-
46	-
47	-
48	-
49	-
50	-
51	-
52	-
53	-
54	-
55	-
56	-
57	-
58	-
59	-
60	-
Total	4,559,546

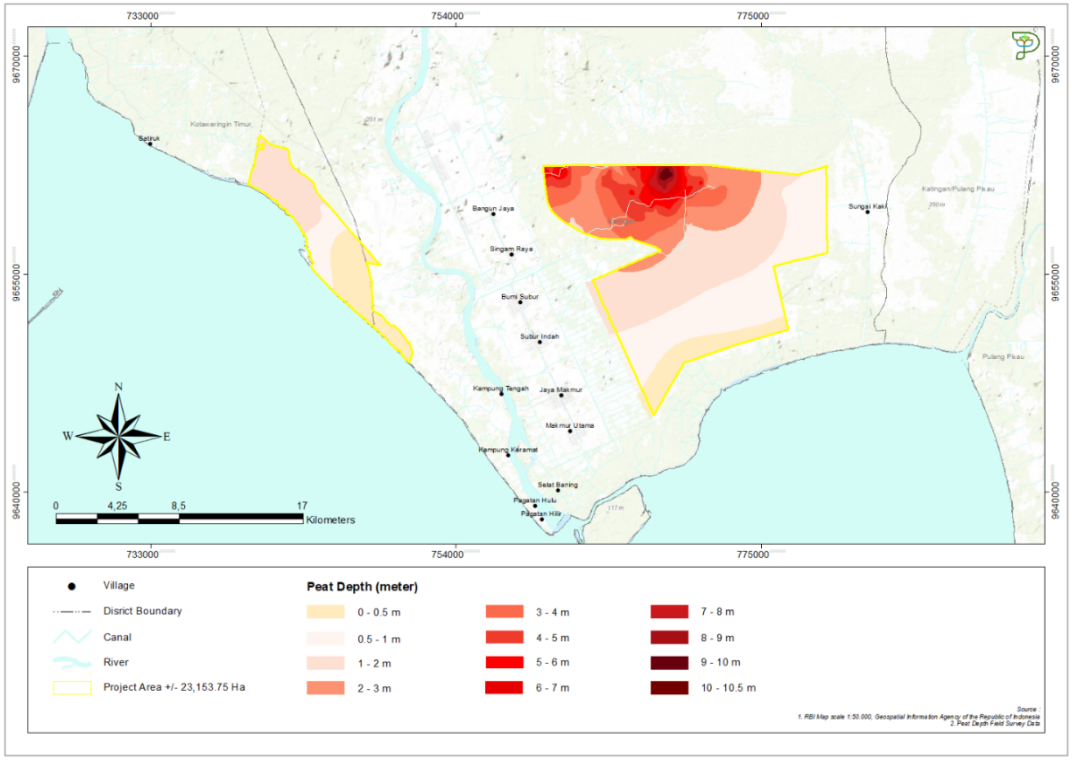
VMD0042 (BL-PEAT)

Step 5.2: Assessing GHG emissions in the baseline scenario of the CUPP Project Activity

The VMD0042 (BL-PEAT) indicates the steps that need to be followed for estimating the baseline emissions. The project area meets the VCS definition for peatland. The total eligible area for WRC Peat is 21,009.91 ha (90.74% of the project area). The project area is drained and partially drained (please refer to the map of legacy canals in Map 3-5).



Map 3-5. Legacy canals distribution



Map 3-6. Peat Depth Map

The estimation of carbon loss and GHG emissions from peat fires is based on the mass of peat lost by fire and emission factors from IPCC. The project will implement peatland rewetting and best-practice fire management as determined by relevant authorities (i.e. MoEF, BRGM[59]). Hence, peat fires in the project scenario are assumed to be catastrophic (unavoidable) events. Under CP-AB, the belowground biomass is already included as peat component and is not used separately including for shallow peat (where the entire peat layer is above the water table depth-as defined in VMD0016 X-STR).

GHG emissions in the baseline scenario are estimated using **Equation 1** VMD0042 as follows:

$$GHG_{BSL-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} (A_{peatsoil-BSL,i,t} \times GHG_{peatsoil-BSL,i,t} + A_{ditch-BSL,i,t} \times GHG_{peatditch-BSL,i,t} + A_{peastburn-BSL,i,t} \times GHG_{peatburn-BSL,i,t})$$

[59] Peatland and Mangrove Restoration Agency.

Where:

$GHG_{BSL\text{-}PEAT}$	Net GHG emissions in the WRC baseline scenario on peatland up to year *t** (t CO_2e)
$GHG_{peatsoil\text{-}BSL,i,t}$	GHG emissions from the peat soil within the project boundary in the baseline scenario in stratum *i* at year *t* (t CO_2e ha^{-1} yr^{-1})
$GHG_{peatditch\text{-}BSL,i,t}$	GHG emissions from water bodies in the baseline scenario in stratum *i* at year *t* (t CO_2e ha^{-1} yr^{-1})
$GHG_{peatburn\text{-}BSL,i,t}$	GHG emissions from burning of peat in the base line scenario in stratum *i* at year *t* (t CO_2e ha^{-1} yr^{-1})
$A_{peatsoil\text{-}BSL,i,t}$	Area of peatland (not open water, not burnt) in stratum *i* in year *t* in the baseline scenario (ha)
$A_{ditch\text{-}BSL,i,t}$	Area of ditch and other open water in stratum *i* in year *t* in the baseline scenario (ha)
$A_{peatburn\text{-}BSL,i,t}$	Area of peat burnt in stratum *i* in year *t* in the baseline scenario (ha)
i	1, 2, 3 …*M* strata in the baseline scenario (unitless)
t	1, 2, 3, … *t** times elapsed since the project start (yr)

Step 5.3: Assessing GHG emissions due to peat drainage ($GHG_{peatsoil,BSL,i,t}$)

GHG emissions from the peat soil per stratum as a result of drainage in the baseline scenario are estimated using **Equation 6** VMD0042 as follows:

$$GHG_{proxy\text{-}BSL,i,t} = GHG_{proxy\text{-}CO2,i,t} + GHG_{proxy\text{-}CH4,i,t}$$

Where:

$GHG_{proxy\text{-}BSL,i,t}$	GHG emissions in relation to the chosen proxy in the baseline scenario in stratum *i* at year *t* (t CO_2e ha^{-1} yr^{-1})
$GHG_{proxy\text{-}CO2,i,t}$	Emission of CO_2 in relation to the chosen proxy in stratum *i* at year *t* (t CO_2e ha^{-1} yr^{-1})
$GHG_{proxy\text{-}CH4,i,t}$	Emission of CH_4 in relation to the chosen proxy in stratum *i* at year *t*; can conservatively be omitted in the baseline scenario (t CO_2e ha^{-1} yr^{-1})
i	1, 2, 3 …M_{BSL} strata[5] in the baseline scenario (unitless)
t	1, 2, 3, … *t** time elapsed since the project start (yr)

In case of abandonment of pre-project land use in the baseline scenario, the baseline scenario must also consider non-human induced rewetting brought about by collapsing dikes or ditches that would have naturally closed over time, and progressive subsidence, leading to raising relative water table depths, increasingly thinner aerobic layers and reduced CO_2 emission rates. However, prior to project initiation, the pre-project canals were maintained by actors to have access to the remnant peat forest inside the concessions. This demonstrates that non-human induced rewetting will not happen. Hence, the annual subsidence is assumed to result in a 1:1 proportional rise of the water table relative to the surface in the area between ditches.

It Is assumed that the entire peatland inside the project area will be drained by canals from the development of oil palm plantation. This was supported by the evidence of common practices in oil palm development (refer to Section 3.1.5). The annual emissions of CO_2 from drained peat soil are estimated using the IPCC emission factor of 11 tCO_2-C ha^{-1} yr^{-1} or 40.33 tCO_2e ha^{-1} yr^{-1} [60]. The rate of drained area due to oil palm plantation canals follows the proxy analysis of the VMD0006 BL-PL with the average of 665.99 ha/year. The project conservatively assumes canals will affect the peatland water table into 400 meters away from the canals.[61] [62]

Step 5.4: Assessing GHG emissions from ditches and other open water bodies ($GHG_{peatditch,BSL,i,t}$)

GHG emissions from the peat soil per stratum as a result of drainage in the baseline scenario are estimated using **Equation 7** VMD0042 as follows:

$$GHG_{peatditch\text{-}BSL,i,t} = GHG_{peatditch\text{-}CO2,i,t} + GHG_{peatditch\text{-}CH4,i,t})$$

Where:

$GHG_{peatditch\text{-}BSL,i,t}$	GHG emissions from ditch and other open water stratum *i* at year *t* in the baseline scenario (t CO_2e $ha^{-1}yr^{-1}$)
$GHG_{peatditch\text{-}CO2,i,t}$	Emission of CO_2 from ditch and open water stratum *i* at year *t* in the baseline scenario (t CO_2e $ha^{-1}yr^{-1}$)
$GHG_{peatditch\text{-}CH4,i,t}$	Emission of CH_4 from ditch and open water stratum *i* at year *t* in the baseline scenario (t CO_2e $ha^{-1}yr^{-1}$)
i	1, 2, 3 …M_{BSL} strata[6] in the baseline scenario (unitless)
t	1, 2, 3, … *t** time elapsed since the project start (yr)

The annual emissions of CO_2 from drained peat soil are estimated using the IPCC emission factor 0.82 for DOC (DOC converted to CO_2e using conversion factor of 3.667) (IPCC. 2013 Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands). In the baseline scenario, emissions of CH_4 can conservatively be omitted.

Table 3-17. Legacy canals inside project area

Legacy Canals	Length (m)	Depth (m)	Width (m)	Surface Area (ha)	Drained Areas (ha)*
Bejungkal	371.43	1.37	7.52	0.28	15.14
Tatah Bangun Jaya	4,100.57	0.64	2.02	0.83	164.85

[60] Table 2.1, IPCC. 2013 Supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands
[61] Astiani, D., Burhanuddin, B., Curran, L. M., Mujiman, M., & Salim, R. Effects of drainage ditches on water table level, soil conditions and tree growth of degraded peatland forests in West Kalimantan, Indonesian Journal of Forestry Research, Volume 4, Issue 1, 2017, Pages 15-25. https://doi.org/10.20886/ijfr.2017.4.1.15-25
[62] Evans, C. D., Williamson, J. M., Kacaribu, F., Irawan, D., Suardiwerianto, Y., Hidayat, M. F., Laurén, A., & Page, S. E. Rates and spatial variability of peat subsidence in Acacia plantation and forest landscapes in Sumatra, Indonesia, Geoderma, Volume 338, 2019, Pages 410-421. https://doi.org/10.1016/j.geoderma.2018.11.002

Legacy Canals	Length (m)	Depth (m)	Width (m)	Surface Area (ha)	Drained Areas (ha)*
Tatah Haji Dian	12,415.45	0.65	3.74	4.64	501.26
Tatah Haji Dudu	6,307.09	0.73	1.52	0.96	253.24
Total	**23,194.54**			**6.71**	**934.49**

* assumes canals will affect peat water table 400m away from the canals (Evans 2019 and Astiani 2017)

Table 3-18 Oil palm plantation canals

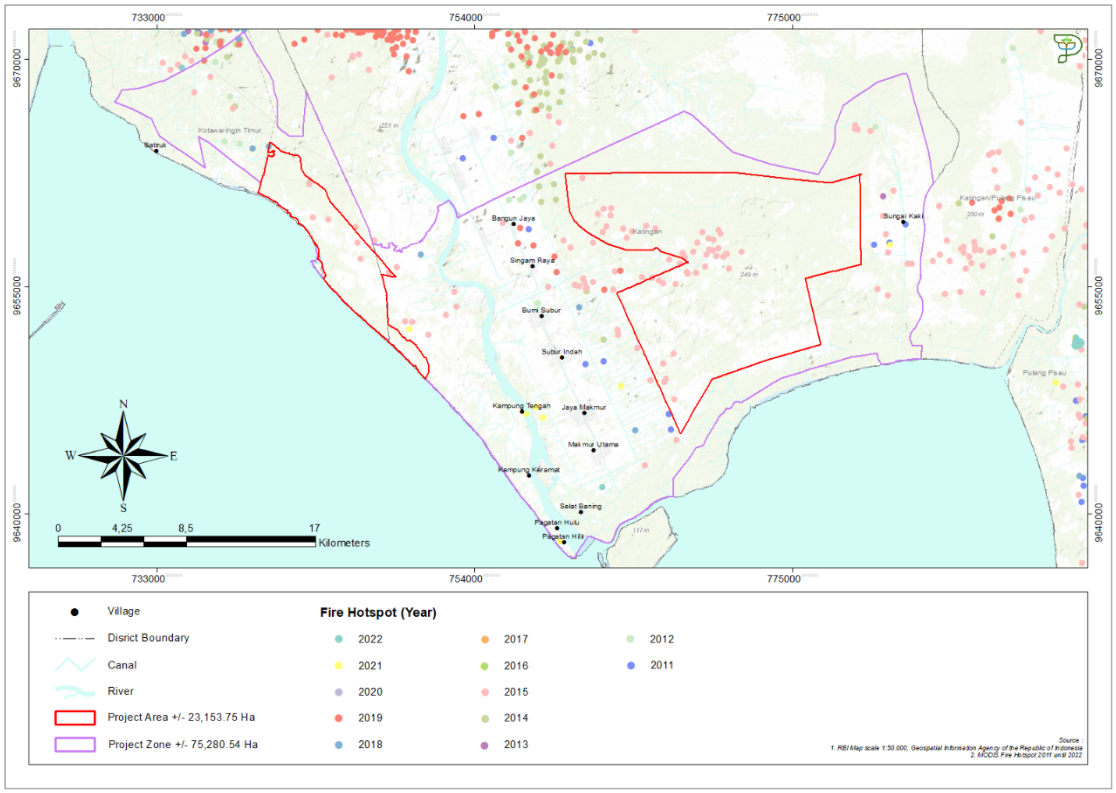
Year	Estimated Surface Area of Oil Palm Canals (Ha)
1	-
2	37.52
3	75.05
4	112.57
5	150.10
6	187.62

Note: Assumes all canals will be constructed from Y2-Y6.

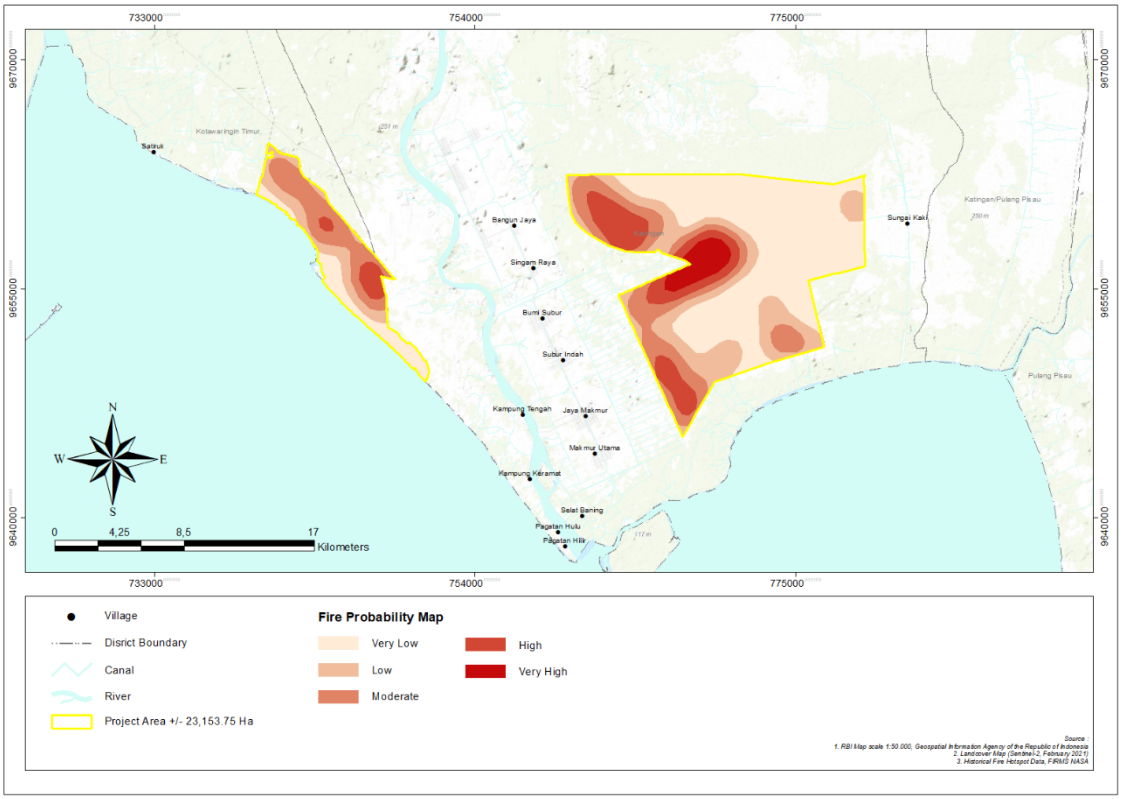
Step 5.5: Assessing GHG emissions due to peat fire ($E_{peatburn,BSL,l,t}$)

Procedures for quantification of GHG emissions from peat fires are provided in module E-BPB. The baseline scenario sets out the frequency of peat fires and the volume (or mass) of peat burnt. Procedures to assess the area and depth of peat burnt from field observations or remote sensing data are provided in module M-PEAT. Module M-PEAT also provides a simplified fire reduction premium approach to acknowledge peat fire emissions based on historic burnt area alone. The project used the VMD0046 M-PEAT and VMD0013 E-BPB to assess the GHG emission.

The PLUM Project is a rewetting project with historical incidents of uncontrolled (unplanned) burning. The baseline fire frequency and impact are assessed using annual historic data in the project area (in case of rewetting projects) over a period of minimum 10 to maximum 15 years ending 2 years before the project start date. The map below shows fire hotspot from 2012 until 2022 within and around project areas (Map 3-7).



Map 3-7. The fire hotspots within and around project areas. Project area is shown red polygons



Map 3-8. Fire probability map

Under the VMD0013 E-BPB, the GHG emissions due to peat burning is calculated using **Equation 3** as below:

$$GHG_{peatburn,i,t} = \sum_{g=1}^{G}(P_{i,t} \times G_{g,i} \times 10^{-3} \times GWP_g)$$

Where:		
GHGpeatburn,i,t	Greenhouse emissions due to peat burning in stratum i in year t of each GHG (CO2, CH4, N2O)	(t CO2e ha-1 yr-1)
Pi,t	Average mass of peat burnt in stratum i, year t	(t d.m. ha-1)
Gpeat,g,i	Emission factor in stratum i for gas g	(kg t-1 d.m. burnt)
GWPg	GWPg Global warming potential for gas g	(t CO2/t g)
g	1, 2, 3 … G greenhouse gases including carbon dioxide, methane and nitrous oxide	(unitless)
i	1, 2, 3 … M strata	(unitless)
t	1, 2, 3, … t* time elapsed since the start of the project activity	(year)

And **Equation 4** of the VMD0013 E-BPB as below:

$$P_{i,t} = D_{peatburn,i,t} \times BD_{upper,i} \times 10^4$$

Where:		
Pi,t	Average mass of peat burnt in stratum i in year t	(t d.m. ha-1)
Dpeatburn,i,t	Average fire scar depth in stratum i in year t	(m)
BDupper,i	Bulk density of the upper peat in stratum i	(g cm-3),(t m-3)
i	1, 2, 3 … M strata	(unitless)
t	1, 2, 3, … t* time elapsed since the start of the project activity	(year)

Table 3-19. Default burn scar depths for quantification of GHG emissions from peat burning in the baseline and with-project scenarios.

Repeated Burning Order	Average burn scar depth (cm)	Reference
1st	18	Page et. al., 2014[63], Table 5
2nd	11	Page et. al., 2014, Table 5
3rd onward	4	Page et. al., 2014, Table 5

Table 3-20. IPCC default values for combustion factors and global warming potential used in quantification of GHG emissions from peat and biomass burning.

Gas	Global Warming Potential (GWP)	Combustion Factor (Gg) (g kg^{-1} dry mass)	Reference
CO_2	1	1,580	IPCC Table 2.5

[63] Page, S., K. Tansey, P. Navratil, A. Hooijer, and N. Mawdsley. 2014. Measuring emissions from peat fire: Commentary on a proposed methodology for Indonesia. Report for the Indonesia-Australia Forest Carbon Partnership, IACP, Jakarta.

Table 3-21. Default emission factor per strata for peat burn.

Strata	IPCC land-use category	Emission Factor (tCO_2e/ha/yr)	References
Secondary Swamp Forest	Forest Land and cleared Forest Land, drained	19.43	IPCC Wetlands Supplement 2013, Table 2.1
Wet Shrub	Forest Land and cleared Forest Land, drained	19.43	IPCC Wetlands Supplement 2013, Table 2.1
Paddy Field	Cropland, drained, Paddy Rice	34.47	IPCC Wetlands Supplement 2013, Table 2.1
Bare Ground	Cropland, drained, Paddy Rice	34.47	IPCC Wetlands Supplement 2013, Table 2.1

Hence, the GHG emissions in the baseline scenario for 60 years from peatland rewetting and conservation activities are 41,450,181 tCO_2e (Table 3-22).

Table 3-22. The baseline emissions from peatland rewetting and conservation (BL-PEAT)

Year	$GHG_{proxy\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatditch\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatburn,i,t}$ (tCO_2e)	$GHG_{BL\text{-}PEAT}$ (tCO_2e)
1	55,553	20	230,050	285,623
2	73,415	133	298,296	371,844
3	91,277	246	265,296	356,819
4	109,140	359	275,715	385,213
5	127,002	472	288,979	416,452
6	144,864	584	320,674	466,122
7	162,726	584	358,849	522,159
8	180,588	584	379,822	560,994
9	198,450	584	384,799	583,833
10	216,312	584	429,121	646,017
11	234,174	584	507,085	741,843
12	252,036	584	495,701	748,321
13	269,898	584	516,734	787,217
14	287,760	584	547,678	836,023
15	305,622	584	529,299	835,506
16	323,485	584	714,190	1,038,259
17	341,347	584	567,045	908,976
18	359,209	584	589,292	949,086
19	377,071	584	722,348	1,100,003
20	394,933	584	679,419	1,074,936
21	412,795	584	687,279	1,100,659

Year	$GHG_{proxy\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatditch\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatburn,i,t}$ (tCO_2e)	$GHG_{BL\text{-}PEAT}$ (tCO_2e)
22	430,657	584	798,024	1,229,265
23	430,657	584	575,510	1,006,752
24	430,657	584	326,335	757,577
25	430,657	584	326,335	757,577
26	430,657	584	326,335	757,577
27	430,657	584	323,889	755,130
28	430,657	584	313,284	744,525
29	430,657	584	313,284	744,525
30	430,657	584	313,284	744,525
31	430,657	584	296,506	727,748
32	430,657	584	272,792	704,033
33	430,657	584	265,632	696,873
34	430,657	584	251,498	682,739
35	430,657	584	235,847	667,089
36	430,657	584	228,835	660,077
37	430,657	584	220,148	651,390
38	430,657	584	218,343	649,584
39	430,657	584	386,512	817,753
40	430,657	584	370,451	801,692
41	430,657	584	207,429	638,670
42	430,657	584	201,424	632,666
43	430,657	584	199,558	630,799
44	430,657	584	197,392	628,633
45	430,657	584	195,045	626,287
46	430,657	584	190,907	622,148
47	430,657	584	187,038	618,279
48	430,657	584	186,259	617,501
49	430,657	584	177,702	608,943
50	430,657	584	173,598	604,839
51	430,657	584	172,221	603,462
52	430,657	584	155,551	586,792
53	430,657	584	152,284	583,525
54	430,657	584	141,193	572,435

Year	$GHG_{proxy\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatditch\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatburn,i,t}$ (tCO_2e)	$GHG_{BL\text{-}PEAT}$ (tCO_2e)
55	430,657	584	246,246	677,488
56	430,657	584	134,624	565,865
57	430,657	584	237,900	669,142
58	430,657	584	133,567	564,808
59	430,657	584	133,138	564,379
60	430,657	584	129,939	561,181
Total	21,713,285	33,368	19,703,529	41,450,181

VMD0050 (BL-TW)

Step 5.3: Assessing soil GHG emissions in the baseline scenario

Part of the PLUM Project is implemented on tidal wetland where the wetting and drying cycles of the tides are influencing the ecosystem. The project follows VMD0050 BL-TW module to provide procedures for the establishment of a WRC baseline scenario for tidal wetlands. Emissions in the baseline scenario of WRC project activities in tidal wetlands are attributed to carbon stock changes in biomass carbon pools and soil processes. The SOC data on tidal wetlands is provided in Appendix 6: SOC Tidal Wetland Calculation.

The project also used the VMD0006 BL-PL, VMD0013 E-BPB, and VMD0001 CP-AB to estimate the emissions for REDD-CIW project as guided by VMD0050. The non-tree biomass, however, is conservatively omitted. For ARR-RWE project activities, procedures for biomass and biomass burning are provided in Module BL-ARR (see the following sub-chapter). In this project, the fossil fuel emissions were conservatively omitted.

Net GHG emissions in the WRC baseline scenario on tidal wetland are estimated using **Equation 2** VMD0050 as below:

$$GHG_{BSL-TW} = \sum_{t=1}^{t^*} \sum_{i=1}^{M_{BSL}} (A_{BSL,i,t} \times GHG_{BSL-TW,i,t})$$

Where:

GHGBSL-TW	Net GHG emissions in the WRC baseline scenario on tidal wetland up to year t*; t CO2e
GHGBSL-TW,I,t	GHG emissions in the WRC baseline scenario on tidal wetland in stratum I in year t; t CO2e ha-1 yr-1
ABSL,I,t	Area of stratum I in year t in the baseline scenario; ha

The GHGBSL-TW,I,t was estimated using **Equation 3** VMD0050 as below:

$$GHG_{BSL\text{-}TW,i,t} = GHG_{BSL\text{-}soil\text{-}CO2,i,t} - Deduction_{alloch} + GHG_{BSL\text{-}soil\text{-}CH4,i,t} + GHG_{BSL\text{-}soil\text{-}N2O,i,t}$$

For strata where soil erosion occurs, or soil is exposed to an aerobic environment through excavation or drainage, CH_4 and N_2O emissions are conservatively set to zero. Hence, this project conservatively omitted emissions from CH_4 and N_2O. For strata with eroded soils the SDT is tSDT-BSL,I = 5 years, for strata with soils exposed to aerobic conditions through excavation or drainage a tSDT-BSL is assumed I = 20 years. For strata with eroded soils, the project area corresponds to the eligible area for WRC-TW. It is assumed that no piled-up soil exposed to an aerobic environment exists within the project boundary.

Step 5.3.2: CO_2 emissions from soil – in situ

The CO2 emissions from eroded soil is calculated using **Equation 5** and **Equation 6** VMD0050 as below:

$$GHG_{BSL\text{-}insitu\text{-}CO2,i,t} = 44/12 \times C_{BSL\text{-}soil,i,t} \times C\%_{BSL\text{-}emitted,i,t} / 100$$

$$C_{BSL\text{-}soil,i,t} = C\%_{BSL\text{-}soil,i,t} \times BD \times Depth\_i_{,i,t} \times 10$$

Where:

GHGBSL-insitu-CO_2,I,t	CO_2 emissions from the in-situ tidal wetland SOC pool in the baseline scenario in stratum I in year t; t CO_2e ha^{-1} yr^{-1}. Assumed: -1.46 tC ha^{-1} yr^{-1} x (44/12)
CBSL-soil,I,t	Soil organic carbon stock in in-situ tidal wetland soil material in the baseline scenario in stratum I in year t; t C ha^{-1}
C%BSL-emitted,I,t	Organic carbon loss due to oxidation, as a percentage of C mass present in in-situ tidal wetland soil material in the baseline scenario in stratum I in year t; %. Assumed: 6.79% following rate of loss from BL-PL.
C%BSL-soil,I,t	Percentage of carbon of in-situ tidal wetland soil material in stratum I in year t; %
BD	Soil bulk density; kg m^{-3}
Depth_i I,t	Depth of the in-situ exposed soil in stratum I in year t; m

Step 5.3.3: CO_2 emissions from eroded soil

The CO2 emissions from eroded soil is calculated using **Equation 22** and **Equation 23** VMD0050 as below:

$$GHG_{BSL\text{-}eroded\text{-}CO2,i,t} = 44/12 \times C_{BSL\text{-}eroded,i,t} \times C\%_{BSL\text{-}emitted,i,t} / 100$$

$$C_{BSL\text{-}eroded,i,t} = C\%_{BSL\text{-}eroded,i,t} \times BD \times Depth\_e_{i,t} \times 10$$

Where:

GHGBSL-eroded-CO_2,I,t	CO2 emissions from the in-situ tidal wetland SOC pool in the baseline scenario in stratum I in year t; t CO_2e ha^{-1} yr^{-1}. Assumed: -1.46 tC ha^{-1} yr^{-1} x (44/12)
CBSL-eroded,I,t	Soil organic carbon stock in in-situ tidal wetland soil material in the baseline scenario in stratum I in year t; t C ha^{-1}
C%BSL-emitted,I,t	Organic carbon loss due to oxidation, as a percentage of C mass present in in-situ tidal wetland soil material in the baseline scenario in stratum I in year t; %. Assumed default factor of 80%, as per module BL-TW (CPDE is “Normal Marine” or “Deltaic fluidized muds”)
C%BSL-eroded,I,t	Percentage of carbon of in-situ tidal wetland soil material in stratum I in year t; %

BD	Soil bulk density; kg m^{-3}
Depth_i l,t	Depth of the in-situ exposed soil in stratum l in year t; m

Hence, the GHG emissions in the baseline scenario for 60 years from tidal wetland restoration and conservation activities are 6,484,292 tCO_2e (Table 3-23).

Table 3-23. The baseline emissions from tidal wetland restoration and conservation (BL-TW).

Year	$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}TW}$ (tCO_2e)
1	248,333	198,667	447,000
2	231,466	185,173	416,639
3	215,744	172,595	388,339
4	201,090	160,872	361,962
5	187,431	149,945	337,377
6	174,701	139,760	314,461
7	162,834	130,267	293,102
8	151,774	121,419	273,193
9	141,465	113,172	254,637
10	131,856	105,485	237,342
11	122,900	98,320	221,221
12	114,553	91,642	206,195
13	106,772	85,417	192,189
14	99,520	79,616	179,135
15	92,760	74,208	166,968
16	86,459	69,168	155,627
17	80,587	64,469	145,056
18	75,113	60,090	135,204
19	70,011	56,009	126,020
20	65,256	52,205	117,461
21	60,823	48,659	109,482
22	56,692	45,354	102,046
23	52,841	42,273	95,115
24	49,252	39,402	88,654
25	45,907	36,726	82,632
26	42,789	34,231	77,020
27	39,882	31,906	71,788
28	37,174	29,739	66,912

Year	$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}TW}$ (tCO_2e)
29	34,649	27,719	62,367
30	32,295	25,836	58,131
31	30,102	24,081	54,183
32	28,057	22,446	50,503
33	26,151	20,921	47,072
34	24,375	19,500	43,875
35	22,719	18,175	40,895
36	21,176	16,941	38,117
37	19,738	15,790	35,528
38	18,397	14,718	33,115
39	17,148	13,718	30,866
40	15,983	12,786	28,769
41	14,897	11,918	26,815
42	13,885	11,108	24,994
43	12,942	10,354	23,296
44	12,063	9,651	21,714
45	11,244	8,995	20,239
46	10,480	8,384	18,864
47	9,768	7,815	17,583
48	9,105	7,284	16,389
49	8,486	6,789	15,275
50	7,910	6,328	14,238
51	7,373	5,898	13,271
52	6,872	5,498	12,369
53	6,405	5,124	11,529
54	5,970	4,776	10,746
55	5,565	4,452	10,016
56	5,187	4,149	9,336
57	4,834	3,867	8,702
58	4,506	3,605	8,111
59	4,200	3,360	7,560
60	3,915	3,132	7,046
Total	3,602,384	2,881,907	6,484,292

VMD0041 (BL-ARR)

The net GHG removals under the ARR baseline scenario are estimated using Equation 1 VMD0041 as follows:

$$\Delta C_{BSL-ARR} = \sum_{t=1}^{t*} \Delta C_{BSL,t} + \Delta C_{BSL-herb} \quad \textbf{(1)}$$

Where:

$\Delta C_{BSL-ARR}$	Net GHG removals under the ARR baseline scenario up to time *t** (t CO_2e)
$\Delta C_{BSL,t}$	Baseline net GHG removals by sinks in year *t* (from *AR-ACM0003*) (t CO_2e)
$\Delta C_{BSL-herb}$	Net GHG removals under the ARR baseline scenario in herbaceous vegetation up to time *t** (t CO_2e)
t	1,2,3 … *t* time* since project start (years)

The annual planting rate is established to be equivalent to the rate of deforestation determined through analyses in the reference areas. In the case of oil palm, it was assumed based on common practice that the plantation would follow a 25-year cycle, meaning it would be harvested and replanted every 25 years. For calculating oil palm (*Elaeis guineensis* Jacq) carbon sequestration per year, carbon sequestration was assessed from two carbon pools, namely aboveground biomass (AGB) and belowground biomass (BGB) using certain allometric equations. The AGB estimation utilizes the formula 0.0706 + 0.0976H[64]. Meanwhile, the BGB estimation employs the equation EXP(-1.0587 + 0.8836 * LN(AGB))[65], referred to formula on the Intergovernmental Panel on Climate Change (IPCC) document[66]. These calculations are applied within a planting plot of dimensions 9 meters by 9 meters. With a maximum height potential of 18 meters[67].

Based on satellite image data from the last 10 years in the PLUM project area, there has been a natural growth of 0.13% per year, transforming shrubland into secondary swamp forest. In a conservative approach, we are adopting the figure of 0.13% per year for the conversion of shrubland to secondary swamp forest, which equates to an estimated addition of approximately 17.37 hectares per year.

[64] ICRAF. 2014. Trees on Farm: Analysis of of Agroforestry. United Nation Avenue. Kenya. Gobal Extent and Geogrphival Pattern
[65] Cairns MA, Brown S, Helmer EH, Baumgardner GA (1997) Root biomass allocation in the world's upland forests. Oecologia 111:1–11. doi:10.1007/s004420050201
[66] Watson, R. T., Noble, I. R., Bolin, B., Ravindranath, N. H., Verardo, D. J., & Dokken, D. J. (2000). Land use, land-use change and forestry: a special report of the Intergovernmental Panel on Climate Change. Cambridge University Press.
[67] Barcelos, E., Rios, S. D. A., Cunha, R. N., Lopes, R., Motoike, S. Y., Babiychuk, E., ... & Kushnir, S. (2015). Oil palm natural diversity and the potential for yield improvement. Frontiers in plant science, 6, 190.

Hence, the GHG removals in the baseline scenario for 60 years from ARR activities are 1,219,481 tCO_2e (Table 3-24).

Table 3-24. The baseline removals from ARR (BL-ARR).

Year	$\Delta C_{BSL\text{-}ARR}$ (tCO_2e)
1	(162)
2	(243)
3	(325)
4	(450)
5	(889)
6	(1,638)
7	(2,695)
8	(4,058)
9	(5,727)
10	(7,698)
11	(9,955)
12	(12,319)
13	(14,683)
14	(17,039)
15	(19,386)
16	(21,725)
17	(24,057)
18	(26,384)
19	(28,705)
20	(31,020)
21	(33,331)
22	(35,637)
23	(37,939)
24	(40,238)
25	(42,532)
26	(38,182)
27	(33,535)
28	(28,593)
29	(23,400)
30	(18,226)
31	(13,069)

Year	$\Delta C_{BSL-ARR}$ (tCO_2e)
32	(7,926)
33	(6,378)
34	(7,756)
35	(9,727)
36	(11,984)
37	(14,347)
38	(16,712)
39	(19,068)
40	(21,415)
41	(23,754)
42	(26,086)
43	(28,413)
44	(30,734)
45	(33,049)
46	(35,360)
47	(37,666)
48	(39,968)
49	(42,267)
50	(44,561)
51	(40,211)
52	(35,564)
53	(30,622)
54	(25,385)
55	(19,853)
56	(14,028)
57	(7,909)
58	(5,079)
59	(4,869)
60	(4,951)
Total	(1,219,481)

3.2.1.2 Quantification of the net baseline emissions and removals

The project does not consider GHG emissions originating from CO_2 emissions produced by the combustion of fossil fuels, direct emissions of CH_4 or N_2O produced through the application of methane and nitrogen in

the alternative soil use within the project limits. The net emissions of CO_2 from the project area under the baseline scenario are calculated using this equation:

$$\Delta C_{BSL,unplanned} = \Delta C_{BSL,PA,unplanned} = \Delta C_{TOT,PA}$$

Where:

$\Delta C_{BSL,unplanned}$ Net emissions of GHG due to the unplanned deforestation under the baseline scenario; tCO_2e

$\Delta C_{BSL,PA,unplanned}$ Total change in the carbon stocks of all the reservoirs from stratum I; tCO_2e

$\Delta C_{TOT,PA}$ Total change in the carbon stocks of all reservoirs from the PA in time t*; tCO_2e

Hence, the GHG emissions and removals in the baseline scenario for 60 years from (1) planned deforestation, (2) peatland rewetting and conservation, (3) tidal wetland restoration and conservation, and (4) ARR activities are 51,274,538 tCO_2e (Table 3-25).

Table 3-25. The total GHG emissions and removals under the baseline scenario (GHG_{BSL})

Year	Baseline Emissions and Removals (tCO_2e)				
	$\Delta C_{BSL-REDD}$	$GHG_{BSL-PEAT}$	GHG_{BSL-TW}	$\Delta C_{BSL-ARR}$	Total GHG_{BSL}
1	479,220	285,623	447,000	(162)	1,211,681
2	412,760	371,844	416,639	(243)	1,200,999
3	412,760	356,819	388,339	(325)	1,157,593
4	412,760	385,213	361,962	(450)	1,159,484
5	412,760	416,452	337,377	(889)	1,165,699
6	412,080	466,122	314,461	(1,638)	1,191,025
7	410,575	522,159	293,102	(2,695)	1,223,141
8	410,575	560,994	273,193	(4,058)	1,240,704
9	410,575	583,833	254,637	(5,727)	1,243,319
10	410,575	646,017	237,342	(7,698)	1,286,235
11	138,258	741,843	221,221	(9,955)	1,091,366
12	20,390	748,321	206,195	(12,319)	962,588
13	20,390	787,217	192,189	(14,683)	985,113
14	20,390	836,023	179,135	(17,039)	1,018,510
15	20,390	835,506	166,968	(19,386)	1,003,479
16	20,390	1,038,259	155,627	(21,725)	1,192,551
17	20,390	908,976	145,056	(24,057)	1,050,365
18	20,390	949,086	135,204	(26,384)	1,078,296
19	20,390	1,100,003	126,020	(28,705)	1,217,709
20	20,390	1,074,936	117,461	(31,020)	1,181,767
21	20,390	1,100,659	109,482	(33,331)	1,197,200
22	20,390	1,229,265	102,046	(35,637)	1,316,064

Year	Baseline Emissions and Removals (tCO_2e)				
	$\Delta C_{BSL-REDD}$	$GHG_{BSL-PEAT}$	GHG_{BSL-TW}	$\Delta C_{BSL-ARR}$	Total GHG_{BSL}
23	12,358	1,006,752	95,115	(37,939)	1,076,285
24	-	757,577	88,654	(40,238)	805,993
25	-	757,577	82,632	(42,532)	797,677
26	-	757,577	77,020	(38,182)	796,415
27	-	755,130	71,788	(33,535)	793,383
28	-	744,525	66,912	(28,593)	782,845
29	-	744,525	62,367	(23,400)	783,492
30	-	744,525	58,131	(18,226)	784,430
31	-	727,748	54,183	(13,069)	768,862
32	-	704,033	50,503	(7,926)	746,611
33	-	696,873	47,072	(6,378)	737,568
34	-	682,739	43,875	(7,756)	718,859
35	-	667,089	40,895	(9,727)	698,256
36	-	660,077	38,117	(11,984)	686,210
37	-	651,390	35,528	(14,347)	672,570
38	-	649,584	33,115	(16,712)	665,987
39	-	817,753	30,866	(19,068)	829,551
40	-	801,692	28,769	(21,415)	809,047
41	-	638,670	26,815	(23,754)	641,732
42	-	632,666	24,994	(26,086)	631,573
43	-	630,799	23,296	(28,413)	625,683
44	-	628,633	21,714	(30,734)	619,613
45	-	626,287	20,239	(33,049)	613,477
46	-	622,148	18,864	(35,360)	605,652
47	-	618,279	17,583	(37,666)	598,196
48	-	617,501	16,389	(39,968)	593,921
49	-	608,943	15,275	(42,267)	581,952
50	-	604,839	14,238	(44,561)	574,516
51	-	603,462	13,271	(40,211)	576,523
52	-	586,792	12,369	(35,564)	563,598
53	-	583,525	11,529	(30,622)	564,433
54	-	572,435	10,746	(25,385)	557,796
55	-	677,488	10,016	(19,853)	667,651

Year	Baseline Emissions and Removals (tCO_2e)				
	$\Delta C_{BSL-REDD}$	$GHG_{BSL-PEAT}$	GHG_{BSL-TW}	$\Delta C_{BSL-ARR}$	Total GHG_{BSL}
56	-	565,865	9,336	(14,028)	561,173
57	-	669,142	8,702	(7,909)	669,935
58	-	564,808	8,111	(5,079)	567,841
59	-	564,379	7,560	(4,869)	567,070
60	-	561,181	7,046	(4,951)	563,277
Total	4,559,546	41,450,181	6,484,292	(1,219,481)	51,274,538

3.2.2 Project Emissions

3.2.2.1 General Procedures and Assumptions

The project used VM0007 (REDD+ MF), VMD0015 (M-REDD), VMD0046 (M-PEAT), VMD0051 (M-TW), and VMD0045 (M-ARR) to assess the project scenario emissions.

Calculations for the estimation of changes in carbon sinks and GHG emissions under the project scenario followed the same methodological guidelines presented in Section 3.2.1. CH_4 and N_2O emissions were not considered as they were negligible according to the results of the "Tool for testing significance of GHG emissions in A/R CDM project activities" (T-SIG). Both gases had a contribution of 0.02% to the GHG emissions of the project scenario.

VMD0015 (M-REDD)

An efficiency index of a 85% decrease in deforestation (100% decrease starting from Year 10) was considered for the project scenario and applied to the historical annual deforestation rate from the project zone for the period of 2012 – 2022. Hence, the annual rate of deforestation under project scenario is 0.36% (Table 3-26) and the annual rate of deforestation under the project scenario is 19.67 ha/year (Table 3-27).

$$A_{PS,PA,planned,t} = A_{BSL,PA,planned,t} * (1 - \mathrm{EI})$$

Where:

$A_{PS,PA,planned,t}$	Planned deforestation area projected for the PA under the project scenario in year t; ha
$A_{BSL,PA,planned,t}$	Planned deforestation area projected for the PA under the baseline scenario in year t; ha
EI	Efficiency index of the activities from the REDD project, without dimensions
t	1, 2, 3, … t * years lapsed since the start date of the activity from the REDD project

Table 3-26. Rate of deforestation under project scenario.

Strata	D%planned,I,t
Primary Mangrove Forest to Non Forest	2.37%
Secondary Mangrove Forest to Non Forest	0%
Primary Swamp Forest to Non Forest	2.37%
Secondary Swamp Forest to Non Forest	2.37%
Average	**0.36%**

Table 3-27. Annual area of deforestation under project scenario.

Strata	A planned,I (Ha)	AA planned,I,t (ha/yr)
Primary Mangrove Forest to Non Forest	1,371.43	4.88
Secondary Mangrove Forest to Non Forest	-	-
Primary Swamp Forest to Non Forest	3,895.72	13.88
Secondary Swamp Forest to Non Forest	255.99	0.91
Total		**19.67**

The estimated GHG emissions in the project scenario for 60 years from planned deforestation and wetland degradation are tCO_2e (Table 3-28).

The calculation of carbon stock in the project stratum is estimated by using annual C increment of the strata at project area. As required by M-REDD, the areas projected to experience C enhancement from forest growth are limited to those that would be deforested in the baseline. Carbon stock enhancement is not accounted for in areas not deforested in the baseline. The calculation of carbon stock in the project stratum is estimated by using annual C increment of peat swamp forest and mangrove forest. The mean annual increment of carbon stock in peat swamp forests was reported as 3.27 tC ha^{-1} yr^{-1} [68]. Additionally, the annual increment for mangrove forests was documented at 3.18 tC ha^{-1} yr^{-1} [69].

$$\Delta C_{P,Enh,i,t} = \sum_{t=1}^{t}\sum_{i=1}^{M}\left(\left(C_{P,i,t} - C_{BSL,i}\right) * A_{Enh,PL,i,t}\right)$$

Where:

$\Delta C_{P,Enh,i,t}$	Net carbon stock changes as a result of forest carbon stock enhancement in stratum *i* in the project area in year *t*; t CO_2-e
$C_{P,i,t}$	Carbon stock in all pools in the project case in stratum *i* in year *t*; t CO_2-e
$C_{BSL,i}$	Carbon stock in all pools in the baseline in stratum *i*; t CO_2-e ha^{-1}
$A_{Enh,PL,i,t}$	Project area in stratum *i* in which carbon stocks are accumulating but that would have undergone planned deforestation in the baseline scenario in year *t*; ha
i	1, 2, 3, …*M* strata
t	1, 2, 3, … *t** years elapsed since the start of the project activity

[68] Krisnawati, H., Adinugroho, W. C., Imanuddin, R., Weston, C. J., & Volkova, L. (2021). The Dynamic Of Aboveground Carbon Stock In Peat Swamp Forest. Proceedings of International Symposium on Wild Fire and Carbon Management in Peat-Forest in Indonesia 2012.
[69] Yudha, R. P., & Sillanpää, M. (2022). The dynamics of secondary mangrove forests in Bintuni Bay, West Papua after harvested on the first 30-year rotation cycle. Jurnal Sylva Lestari, 10(1), 83-106.

Table 3-28. The estimated project emissions from planned deforestation and wetland degradation.

Year	ΔC_{WPS} (tCO_2e)
1	10,946
2	5,654
3	361
4	(4,932)
5	(10,225)
6	(15,281)
7	(20,278)
8	(25,275)
9	(30,272)
10	(35,269)
11	(52,110)
12	(52,711)
13	(53,312)
14	(53,914)
15	(54,515)
16	(55,117)
17	(55,718)
18	(56,319)
19	(56,921)
20	(57,522)
21	(58,123)
22	(58,725)
23	(58,725)
24	(58,725)
25	(58,725)
26	(58,725)
27	(58,725)
28	(58,725)
29	(58,725)
30	(58,725)
31	(58,725)
32	(58,725)
33	(58,725)

Year	ΔC_{WPS} (tCO_2e)
34	(58,725)
35	(58,725)
36	(58,725)
37	(58,725)
38	(58,725)
39	(58,725)
40	(58,725)
41	(58,725)
42	(58,725)
43	(58,725)
44	(58,725)
45	(58,725)
46	(58,725)
47	(58,725)
48	(58,725)
49	(58,725)
50	(58,725)
51	(58,725)
52	(58,725)
53	(58,725)
54	(58,725)
55	(58,725)
56	(58,725)
57	(58,725)
58	(58,725)
59	(58,725)
60	(58,725)
Total	(3,021,120)

VMD0046 (M-PEAT)

Regarding the peatland rewetting aspect of the project scenario, the calculation only considers emissions from legacy canals. The project scenario does not include peat drainage and peat ditches from oil palm canals. The assumption in the project scenario is that the opening of canals due to oil palm cultivation can be avoided. Meanwhile, peat burning is assumed to be zero in the project scenario, based on the assumption that with the implementation of the project, there will be no more instances of fires. The

estimated GHG emissions in the project scenario for 60 years from peatland rewetting and conservation activities are 2,262,679 tCO_2e (Table 3-29).

Table 3-29. The estimated project emissions from peatland rewetting and conservation activities.

Year	$GHG_{proxy\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatditch\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{WPS\text{-}WRC}$ (tCO_2e)
1	37,691	20	37,711
2	37,691	20	37,711
3	37,691	20	37,711
4	37,691	20	37,711
5	37,691	20	37,711
6	37,691	20	37,711
7	37,691	20	37,711
8	37,691	20	37,711
9	37,691	20	37,711
10	37,691	20	37,711
11	37,691	20	37,711
12	37,691	20	37,711
13	37,691	20	37,711
14	37,691	20	37,711
15	37,691	20	37,711
16	37,691	20	37,711
17	37,691	20	37,711
18	37,691	20	37,711
19	37,691	20	37,711
20	37,691	20	37,711
21	37,691	20	37,711
22	37,691	20	37,711
23	37,691	20	37,711
24	37,691	20	37,711
25	37,691	20	37,711
26	37,691	20	37,711
27	37,691	20	37,711
28	37,691	20	37,711
29	37,691	20	37,711
30	37,691	20	37,711

Year	$GHG_{proxy\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{peatditch\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{WPS\text{-}WRC}$ (tCO_2e)
31	37,691	20	37,711
32	37,691	20	37,711
33	37,691	20	37,711
34	37,691	20	37,711
35	37,691	20	37,711
36	37,691	20	37,711
37	37,691	20	37,711
38	37,691	20	37,711
39	37,691	20	37,711
40	37,691	20	37,711
41	37,691	20	37,711
42	37,691	20	37,711
43	37,691	20	37,711
44	37,691	20	37,711
45	37,691	20	37,711
46	37,691	20	37,711
47	37,691	20	37,711
48	37,691	20	37,711
49	37,691	20	37,711
50	37,691	20	37,711
51	37,691	20	37,711
52	37,691	20	37,711
53	37,691	20	37,711
54	37,691	20	37,711
55	37,691	20	37,711
56	37,691	20	37,711
57	37,691	20	37,711
58	37,691	20	37,711
59	37,691	20	37,711
60	37,691	20	37,711
Total	2,261,469	1,211	2,262,679

VMD0051 (M-TW)

For tidal wetlands in the project scenario, the applied deforestation rate is 0.36% per year; this value is based on the M-REDD module. The soil organic carbon value for tidal wetlands was 584 tC/ha obtained from the initial study survey. Estimated GHG emissions in the project scenario for 60 years from tidal wetland restoration and conservation project activities amount to 886,309 tCO2e (Table 3-30).

Table 3-30. The estimated project emissions from tidal wetland restoration and conservation activities.

Year	$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}TW}$ (tCO_2e)
1	13,022	3,125	16,147
2	12,975	3,122	16,097
3	12,929	3,119	16,048
4	12,883	3,115	15,998
5	12,837	3,112	15,949
6	12,791	3,109	15,900
7	12,746	3,105	15,851
8	12,700	3,102	15,802
9	12,655	3,099	15,754
10	12,610	3,095	15,705
11	12,565	3,092	15,657
12	12,520	3,089	15,609
13	12,476	3,085	15,561
14	12,431	3,082	15,514
15	12,387	3,079	15,466
16	12,343	3,075	15,419
17	12,299	3,072	15,371
18	12,255	3,069	15,324
19	12,212	3,066	15,277
20	12,168	3,062	15,231
21	12,125	3,059	15,184
22	12,082	3,056	15,137
23	12,039	3,053	15,091
24	11,996	3,049	15,045
25	11,953	3,046	14,999
26	11,910	3,043	14,953
27	11,868	3,040	14,908

Year	$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}TW}$ (tCO_2e)
28	11,826	3,036	14,862
29	11,784	3,033	14,817
30	11,742	3,030	14,771
31	11,700	3,027	14,726
32	11,658	3,023	14,681
33	11,617	3,020	14,637
34	11,575	3,017	14,592
35	11,534	3,014	14,548
36	11,493	3,010	14,503
37	11,452	3,007	14,459
38	11,411	3,004	14,415
39	11,371	3,001	14,371
40	11,330	2,998	14,328
41	11,290	2,994	14,284
42	11,250	2,991	14,241
43	11,209	2,988	14,197
44	11,170	2,985	14,154
45	11,130	2,982	14,111
46	11,090	2,978	14,069
47	11,051	2,975	14,026
48	11,011	2,972	13,983
49	10,972	2,969	13,941
50	10,933	2,966	13,899
51	10,894	2,963	13,857
52	10,855	2,959	13,815
53	10,817	2,956	13,773
54	10,778	2,953	13,731
55	10,740	2,950	13,690
56	10,701	2,947	13,648
57	10,663	2,944	13,607
58	10,625	2,940	13,566
59	10,587	2,937	13,525
60	10,550	2,934	13,484

Year	$GHG_{BSL\text{-}insitu\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}eroded\text{-}CO2,i,t}$ (tCO_2e)	$GHG_{BSL\text{-}TW}$ (tCO_2e)
Total	704,587	181,722	886,309

VMD0045 (M-ARR)

Under the project scenario for ARR activities, the project will rehabilitate a total of 15,088 ha degraded land, composed of 424 ha of ARR in mangrove, 1,306 ha of ARR on peatland, and 13,358 ha of Assisted Natural Regeneration on peat (Map 3-9). The carbon stock Assisted Natural Regeneration (ANR) increment, which is 6.68 tCO_2e/ha/yr, is estimated from the carbon stock changes between wet shrub to secondary swamp forest stratum and assumes the natural regeneration will take 30 years. Areas replanted with high diversity and density took approximately 10 years to establish a tree canopy as dense as that found in mature remnant rainforests. In comparison, natural regrowth sites typically require an average of 30-40 years to achieve a similar level of canopy density. Areas subjected to reforestation activities can thus transition back into a forested state within a decade, whereas naturally regenerating areas take a longer period.[70] With project interventions, the aim is for areas to undergo regrowth within 30 years, developing into a secondary forest.

In the project scenario, the selection of plant species for planting includes endemics such as Jelutung (*Dyera costulata*), Balangeran (*Shorea balangeran*), Ramin (*Gonystilus bancanus*), etc., specifically chosen for planting activities on peat soil. Meanwhile, for mangrove areas, the selected species *are Rhizophora apiculata* and *Rhizophora stylosa*. The approach in calculating the Afforestation, Reforestation, and Revegetation (ARR) involves using allometric equations as follows:

- *Shorea Balangeran*: Aboveground Biomass (AGB) is calculated using the formula 0.11 * Diameter^2.62[71], and Belowground Biomass (BGB) is determined by EXP(-1.0587 + 0.8836 * LN(AGB))[67]. The growth rate is 2 cm/year, with a maximum diameter of 30 cm. Planting spacing is 5 meters x 5 meters, with a survival rate of 80% per year in the first 3 years..
- *Rhizophora apiculata*: Aboveground Biomass (AGB) is determined by the equation 0.1709 * DBH^2.516[72], and Belowground Biomass (BGB) is calculated using EXP(-1.0587 + 0.8836 * LN(AGB))[67]. The growth rate is 0.52 cm/year, with planting spacing of 3 meters x 3 meters and a 60% survival rate per year in the first 3 years.

Hence, the estimated GHG removals in the project scenario for 60 years from ARR project activities are (33,190,608) tCO_2e (Table 3-31).

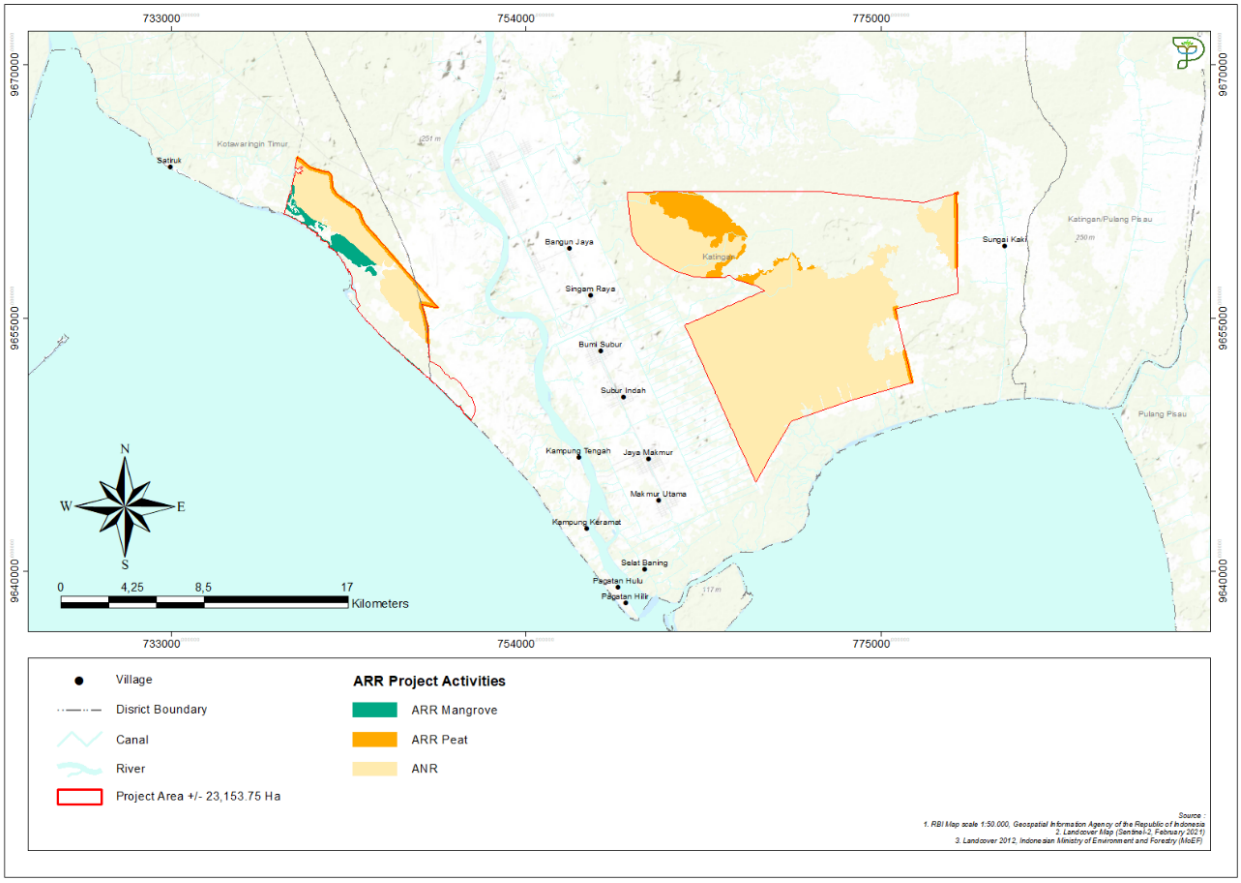
Table 3-31. The estimated project removals from ARR activities.

Year	$\Delta C_{WPS\text{-}ARR}$ (tCO_2e)
1	(2,676)
2	(5,351)

[70] Catterall, C. P., Shoo, L. P., & Freebody, K. Natural regeneration and rainforest restoration.
[71] Ketterings, Q.M., Cie, R., Noordwijk, v.M., Ambagau, Y., and Palm, C.A. (2001). Reducing uncertainty in the use of allometric biomass equations for predicting above-ground tree biomass in mixed secondary forests. Forest Ecology and Management 146 : 199-209.
[72] Kauffman, J. B., & Donato, D. C. (2012). Protocols for the measurement, monitoring and reporting of structure, biomass and carbon stocks in mangrove forests (Vol. 86). Bogor, Indonesia: CIFOR.

Year	$\Delta C_{WPS\text{-}ARR}$ (tCO_2e)
3	(8,027)
4	(10,702)
5	(13,378)
6	(16,053)
7	(19,476)
8	(24,255)
9	(30,940)
10	(40,166)
11	(52,705)
12	(69,167)
13	(90,089)
14	(116,253)
15	(148,294)
16	(186,845)
17	(232,459)
18	(285,691)
19	(341,896)
20	(395,621)
21	(446,095)
22	(492,574)
23	(534,310)
24	(571,484)
25	(605,445)
26	(635,636)
27	(661,388)
28	(683,209)
29	(701,656)
30	(717,436)
31	(727,495)
32	(734,115)
33	(738,991)
34	(744,131)
35	(749,537)
36	(755,215)

Year	$\Delta C_{WPS\text{-}ARR}$ (tCO_2e)
37	(761,169)
38	(767,402)
39	(773,919)
40	(780,723)
41	(787,819)
42	(795,210)
43	(802,900)
44	(810,892)
45	(819,191)
46	(827,800)
47	(836,722)
48	(845,961)
49	(855,520)
50	(865,404)
51	(875,614)
52	(886,155)
53	(897,030)
54	(908,242)
55	(919,794)
56	(931,690)
57	(943,932)
58	(956,524)
59	(969,469)
60	(982,770)
Total	(33,190,608)



Map 3-9. Area planned for ARR activities

The estimated GHG emissions and removals in the project scenario for 60 years from (1) avoided planned deforestation, (2) peatland rewetting and conservation activities, (3) tidal wetland restoration and conservation activities, and (4) ARR activities are (33,062,739) tCO_2e (Table 3-32).

Table 3-32. The total GHG emissions and removals under project scenario.

Year	Project Emissions and Removals (tCO_2e)				
	ΔC_{WPS}	$GHG_{WPS-PEAT}$	GHG_{WPS-TW}	$\Delta C_{WPS-ARR}$	Total GHG_{WPS}
1	10,946	37,711	16,147	(2,676)	62,129
2	5,654	37,711	16,097	(5,351)	54,111
3	361	37,711	16,048	(8,027)	46,093
4	(4,932)	37,711	15,998	(10,702)	38,075
5	(10,225)	37,711	15,949	(13,378)	30,058
6	(15,281)	37,711	15,900	(16,053)	22,277
7	(20,278)	37,711	15,851	(19,476)	13,809
8	(25,275)	37,711	15,802	(24,255)	3,984
9	(30,272)	37,711	15,754	(30,940)	(7,747)

Year	Project Emissions and Removals (tCO_2e)				
	ΔC_{WPS}	$GHG_{WPS-PEAT}$	GHG_{WPS-TW}	$\Delta C_{WPS-ARR}$	Total GHG_{WPS}
10	(35,269)	37,711	15,705	(40,166)	(22,018)
11	(52,110)	37,711	15,657	(52,705)	(51,446)
12	(52,711)	37,711	15,609	(69,167)	(68,557)
13	(53,312)	37,711	15,561	(90,089)	(90,129)
14	(53,914)	37,711	15,514	(116,253)	(116,942)
15	(54,515)	37,711	15,466	(148,294)	(149,632)
16	(55,117)	37,711	15,419	(186,845)	(188,832)
17	(55,718)	37,711	15,371	(232,459)	(235,094)
18	(56,319)	37,711	15,324	(285,691)	(288,975)
19	(56,921)	37,711	15,277	(341,896)	(345,828)
20	(57,522)	37,711	15,231	(395,621)	(400,201)
21	(58,123)	37,711	15,184	(446,095)	(451,323)
22	(58,725)	37,711	15,137	(492,574)	(498,450)
23	(58,725)	37,711	15,091	(534,310)	(540,233)
24	(58,725)	37,711	15,045	(571,484)	(577,453)
25	(58,725)	37,711	14,999	(605,445)	(611,460)
26	(58,725)	37,711	14,953	(635,636)	(641,697)
27	(58,725)	37,711	14,908	(661,388)	(667,494)
28	(58,725)	37,711	14,862	(683,209)	(689,360)
29	(58,725)	37,711	14,817	(701,656)	(707,852)
30	(58,725)	37,711	14,771	(717,436)	(723,678)
31	(58,725)	37,711	14,726	(727,495)	(733,782)
32	(58,725)	37,711	14,681	(734,115)	(740,447)
33	(58,725)	37,711	14,637	(738,991)	(745,368)
34	(58,725)	37,711	14,592	(744,131)	(750,552)
35	(58,725)	37,711	14,548	(749,537)	(756,003)
36	(58,725)	37,711	14,503	(755,215)	(761,725)
37	(58,725)	37,711	14,459	(761,169)	(767,723)
38	(58,725)	37,711	14,415	(767,402)	(774,000)
39	(58,725)	37,711	14,371	(773,919)	(780,561)
40	(58,725)	37,711	14,328	(780,723)	(787,409)
41	(58,725)	37,711	14,284	(787,819)	(794,548)
42	(58,725)	37,711	14,241	(795,210)	(801,982)

Year	Project Emissions and Removals (tCO_2e)				
	ΔC_{WPS}	$GHG_{WPS-PEAT}$	GHG_{WPS-TW}	$\Delta C_{WPS-ARR}$	Total GHG_{WPS}
43	(58,725)	37,711	14,197	(802,900)	(809,716)
44	(58,725)	37,711	14,154	(810,892)	(817,751)
45	(58,725)	37,711	14,111	(819,191)	(826,093)
46	(58,725)	37,711	14,069	(827,800)	(834,745)
47	(58,725)	37,711	14,026	(836,722)	(843,709)
48	(58,725)	37,711	13,983	(845,961)	(852,991)
49	(58,725)	37,711	13,941	(855,520)	(862,593)
50	(58,725)	37,711	13,899	(865,404)	(872,518)
51	(58,725)	37,711	13,857	(875,614)	(882,771)
52	(58,725)	37,711	13,815	(886,155)	(893,354)
53	(58,725)	37,711	13,773	(897,030)	(904,270)
54	(58,725)	37,711	13,731	(908,242)	(915,524)
55	(58,725)	37,711	13,690	(919,794)	(927,118)
56	(58,725)	37,711	13,648	(931,690)	(939,055)
57	(58,725)	37,711	13,607	(943,932)	(951,338)
58	(58,725)	37,711	13,566	(956,524)	(963,972)
59	(58,725)	37,711	13,525	(969,469)	(976,958)
60	(58,725)	37,711	13,484	(982,770)	(990,300)
Total	(3,021,120)	2,262,679	886,309	(33,190,608)	(33,062,739)

3.2.3 Leakage

Applicable leakage modules were determined according to the requirements set in the VM0007 REDD+ Methodology Framework. As demonstrated in Section 3.1.5, the baseline scenario is determined as planned deforestation and peatland drainage as a result of conversion to oil palm plantation. The project is therefore categorized as a combination of Avoiding Planned Deforestation (APD), Reforestation (ARR), in combination with Restoration of Wetlands Ecosystem (RWE) and Conservation of Intact Wetlands (CIW).

As a result, potential sources of leakage emissions include:

(a) Displacement of planned deforestation activities,
(b) Displacement of pre-project agricultural activities on non-forest land, and
(c) Ecological leakage due to possible alterations of mean annual water table depth in adjacent areas.

These potential sources are covered in the VCS Methodology VM0007 Modules LK-ASP, LK-ARR, and LK-ECO respectively. The applicability of modules for the quantification of leakage emissions is shown in Table 3-33.

Table 3-33. Applicability of leakage modules.

Module	Applicability
Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (**LK-ASP**)	**Applicable.** The project may cause activity shifting of avoided planned deforestation.
Estimation of emissions from activity shifting for avoiding unplanned deforestation (**LK-ASU)**	**Not applicable.** The project is not categorized as avoiding unplanned deforestation.
Estimation of emissions from displacement of fuelwood extraction (**LK-DFW)**	**Not applicable.** The project is not categorized as avoiding unsustainable fuelwood extraction.
Estimation of emissions from displacement of pre-project agricultural activities (**LK-ARR**)	**Not applicable.** There are no pre-project agricultural activities in the ARR areas.
Estimation of emissions from market-effects (**LK-ME**)	**Not applicable.** The project does not reduce the production of timber, fuelwood, or charcoal.
Estimation of emissions from ecological leakage (**LK-ECO**)	**Applicable.** The project is categorized as WRC and may cause ecological leakage.

3.2.3.1 Estimation of emissions from activity shifting for avoiding planned deforestation and planned degradation (LK-ASP)

This module is applicable for estimating the leakage emissions due to activity shifting from forest lands that are legally authorized and documented to be converted to non-forest land, including activity shifting to forested peatland that is drained as a consequence of project implementation. Under these situations, displacement of baseline activities can be controlled and measured directly by monitoring the baseline deforestation agents or class of agents.

In the context of the VMD0009 LK-ASP module, leakage monitoring is refined by the understanding that leakage does not need to be considered where a specific deforestation agent has been identified and there is verifiable information demonstrating that the management plans and/or land-use designations of the deforestation agents' other lands remain unchanged by the project activities. As described in Sections 2.2.1, 2.2.2 and 3.1.5, the specific deforestation agent has been established as PT AIS who formerly owned PT PUM. After the acquisition of PT PUM by Hutan Kencana Group in 2021, PT AIS group still has two other oil palm plantation concessions (PT KMS and PT TBS) adjacent to PT PUM, which have already started the process of conversion of the peat forest into oil palm plantation. PT AIS did not change the management plan or land use of these other two concessions as a result of the PLUM Project, since these concessions had already been granted oil palm plantation licenses and started the approval and conversion process prior to the project start (Map 3-2). Additionally, the project furnishes robust information and evidence to the effect that PT AIS operates exclusively within a delineated area. Through the operations and activities of the PLUM Project, any threat of potential leakage is deemed effectively mitigated.

Consequently, this document proceeds under the assumption that project-induced leakage is unlikely. Nonetheless, vigilance against actual leakage remains a cornerstone of the project's strategy, with ongoing monitoring throughout the crediting period and reporting at each monitoring event to ensure transparency and accountability. Hence, the project will be closely monitoring PT AIS and any of its subsidiaries for new developments related to oil palm plantations within the same bioregional landscape of Kalimantan. This

approach underscores a proactive stance against the risk of leakage, ensuring that any shifts in land use or management by PT AIS or its subsidiaries, indicative of moving deforestation activities to new areas as a response to the project, are monitored and identified.

Adding to this framework, it is imperative to monitor all activities that result in landcover changes within the project zone, irrespective of the deforestation agent. Therefore, the project will monitor and report any new oil palm development in the project zone, irrespective of the deforestation agent, at each monitoring event.

By integrating these measures, the project ensures a comprehensive surveillance over the project's direct and indirect impacts on deforestation rates, to identify any displacement of such activities to other forested areas under the management or influence of PT AIS within Kalimantan, as well as any displacement of such activities within the project zone by any other deforestation agent.

3.2.3.2 Estimation of emissions from displacement of pre-project agricultural activities (LK-ARR)

No agricultural activities currently take place in the areas where the project will implement ARR and Assisted Natural Regeneration (ANR). Therefore, this module is not applicable.

3.2.3.3 Estimation of emissions from ecological leakage (LK-ECO)

Ecological leakage under the VMD0044 module occurs when the hydrological connectivity of the project area with adjacent areas leads to the drainage of peatlands in the project area. The project was designed to ensure that its hydrological connectivity does not lead to a significant increase in greenhouse gas emissions outside and in the project area.

The PLUM project area consists of peatland and mangroves, and some of the baseline conditions of this project are:

1. The construction of canals in the project area has occurred since several decades ago. The canals are used as a source of fisheries for villagers as they help villagers find fish. In the 2000s, these canals changed their function to become transportation routes for illegal timber collection. Since the prohibition of illegal logging by the Government of Indonesia, these canals have been abandoned and are no longer used for transportation of timber. However, they are still used for fishing by some villagers.
2. The Indonesian government has built irrigation channels for rice fields in rice-producing villages around the project area as part of the Strategic Irrigation Modernization and Urgent Rehabilitation Project (SIMURP) project[73]. A 10-km stretch of the irrigation canal crosses the boundary of PT PUM concession. The SIMURP irrigation canal area in PT PUM has been excluded from the project area.

All upstream areas of the project are conservation areas, with Sebangau National Park located upstream of the eastern part and the PT Rimba Makmur Utama (PT RMU) concession and village forest upstream of the western part. Rice paddy areas are downstream of the project area. Hence, despite the hydrological connectivity of the project area with adjacent areas, it is unlikely that these would lead to drainage of

[73] The SIMURP project was implemented through collaboration of four Ministries/Institutions (K/L), namely the Ministry of National Development Planning of the Republic of Indonesia (Bappenas), Ministry of Public Works and Housing (PUPR), Ministry of Home Affairs (Kemendagri), and Ministry of Agriculture (Kementan). It was funded with loans from the World Bank and Asian Infrastructure Investment Bank.

peatlands in the project area. Furthermore, the project scenario is expected to prevent ecological leakage, with the canal blocking and revegetation activities designed to restore the peat ecosystem in the project area to prevent leakage from occurring. The PLUM Project meets the requirement of the VMD0044 module, hence the project assumes that the emission from ecological leakage is zero.

3.2.4 Net GHG Emission Reductions and Removals

3.2.4.1 Estimation of the GHG emission reductions and removals

Uncertainty

Uncertainties were calculated for both REDD and WRC components following the X-UNC module (VMD0017 v2.2). The detailed uncertainty calculation is available in Appendix 11: Uncertainty Analysis.

REDD: Since the baseline deforestation rate was derived from measurements of proxy areas, the uncertainty must be equal to the 95% confidence interval as a percentage of the mean of the area deforested in each proxy ($D\%_{pn}$) divided by the number of years over which deforestation occurred in each proxy (Yrs_{pn}). The uncertainty of baseline deforestation rate was calculated to be 0.0178% or can be assumed zero. The total uncertainty of combined carbon stocks and greenhouse gas sources in the REDD baseline was calculated to be 5.48%. Therefore, the cumulative uncertainty in the REDD baseline scenario is 5.48%. No ex-post (re-)measurements of carbon pools or GHG sources have been made at this stage, therefore the uncertainty in the REDD project scenario is set equal to zero as per the X-UNC module.

WRC: To calculate the uncertainties in WRC-Peat emissions in the baseline and project scenario, the project used the standard errors of default factors provided by the IPCC (IPCC Wetlands Supplement 2013). The uncertainty of CH_4 emissions was set to zero since CH_4 emissions are conservatively omitted in both the baseline and project scenarios calculation. The uncertainty of uncontrolled peat burning in the project scenario was also set to zero since it is assumed that no fires will occur after the project initiation. The cumulative uncertainty of WRC-Peat in the baseline and project scenarios were calculated to be 6.63% and 13.25% respectively. For the WRC-TW, the project used field-collected data (soil bulk density) when estimating the CO_2 emissions. To calculate the uncertainty, standard errors from the field data was used. The cumulative uncertainty of WRC-TW was calculated to be 0.66% for the baseline and 0.64% for the project scenario. The total cumulative of all WRC emissions (peat and tidal wetlands) was 6.67% for baseline and 13.27% for project scenario.

Total error in the REDD+ project activity is equal to the combined uncertainty in baseline and project estimates for the REDD and WRC activities and was calculated to be 5.51%. The value is below the allowable threshold of 15% as stated in the VM0007 REDD+MF methodology, therefore no VCU deduction is necessary.

Avoided Planned Deforestation

The total net GHG emission reductions and removals from the avoided planned deforestation activity were calculated in the following way:

$$NER_{REDD+} = \Delta C_{BSL,REDD} - \Delta C_{PS,REDD} - \Delta C_{LK,REDD}$$

Where:

NER_{REDD+}	Net reduction of GHG emissions in year t*; tCO_2e
$\Delta C_{BSL,REDD}$	Net emissions of GHG in year t* under the baseline scenario; tCO_2

$\Delta C_{PS,REDD}$ Net emissions of GHG in year t*under the project scenario; tCO_2
$\Delta C_{LK,REDD}$ Net emissions of GHG due to leakage in year t*; tCO_2

The GHG emissions in the baseline scenario and project scenario for 60 years from planned deforestation and wetland degradation are 4,559,546 tCO_2e and (3,021,120) tCO_2e respectively with 7,580,665 tCO_2e Net Emissions Reduction (Table 3-34).

Table 3-34. The estimated net GHG emission reductions or removals from avoided planned deforestation.

Year	Estimated baseline emissions $\Delta C_{BSL,REDD}$ (tCO_2e)	Estimated project emissions $\Delta C_{PS,REDD}$ (tCO_2e)	Estimated leakage emissions $\Delta C_{LK,REDD}$ (tCO_2e)	Estimated net GHG emission reductions NER_{REDD+} (tCO_2e)
1	479,220	10,946	0	468,273
2	412,760	5,654	0	407,106
3	412,760	361	0	412,399
4	412,760	(4,932)	0	417,692
5	412,760	(10,225)	0	422,985
6	412,080	(15,281)	0	427,361
7	410,575	(20,278)	0	430,852
8	410,575	(25,275)	0	435,849
9	410,575	(30,272)	0	440,846
10	410,575	(35,269)	0	445,843
11	138,258	(52,110)	0	190,367
12	20,390	(52,711)	0	73,101
13	20,390	(53,312)	0	73,703
14	20,390	(53,914)	0	74,304
15	20,390	(54,515)	0	74,906
16	20,390	(55,117)	0	75,507
17	20,390	(55,718)	0	76,108
18	20,390	(56,319)	0	76,710
19	20,390	(56,921)	0	77,311
20	20,390	(57,522)	0	77,912
21	20,390	(58,123)	0	78,514
22	20,390	(58,725)	0	79,115
23	12,358	(58,725)	0	71,083
24	-	(58,725)	0	58,725
25	-	(58,725)	0	58,725
26	-	(58,725)	0	58,725

27	-	(58,725)	0	58,725
28	-	(58,725)	0	58,725
29	-	(58,725)	0	58,725
30	-	(58,725)	0	58,725
31	-	(58,725)	0	58,725
32	-	(58,725)	0	58,725
33	-	(58,725)	0	58,725
34	-	(58,725)	0	58,725
35	-	(58,725)	0	58,725
36	-	(58,725)	0	58,725
37	-	(58,725)	0	58,725
38	-	(58,725)	0	58,725
39	-	(58,725)	0	58,725
40	-	(58,725)	0	58,725
41	-	(58,725)	0	58,725
42	-	(58,725)	0	58,725
43	-	(58,725)	0	58,725
44	-	(58,725)	0	58,725
45	-	(58,725)	0	58,725
46	-	(58,725)	0	58,725
47	-	(58,725)	0	58,725
48	-	(58,725)	0	58,725
49	-	(58,725)	0	58,725
50	-	(58,725)	0	58,725
51	-	(58,725)	0	58,725
52	-	(58,725)	0	58,725
53	-	(58,725)	0	58,725
54	-	(58,725)	0	58,725
55	-	(58,725)	0	58,725
56	-	(58,725)	0	58,725
57	-	(58,725)	0	58,725
58	-	(58,725)	0	58,725
59	-	(58,725)	0	58,725
60	-	(58,725)	0	58,725
Total	4,559,546	(3,021,120)	0	7,580,665

Peatland rewetting and conservation

The total net GHG emission reductions and removals from the peatland rewetting and conservation activity were calculated in the following way:

$$NER_{PEAT} = \Delta C_{BSL-PEAT} - \Delta C_{WPS-PEAT} - \Delta C_{LK-PEAT}$$

Where:

NER_{PEAT}	Net reduction of GHG emissions in year t*; tCO_2e
$\Delta C_{BSL-PEAT}$	Net emissions of GHG in year t* under the baseline scenario; tCO_2
$\Delta C_{WPS-PEAT}$	Net emissions of GHG in year t*under the project scenario; tCO_2
$\Delta C_{LK-PEAT}$	Net emissions of GHG due to leakage in year t*; tCO_2

The GHG emissions in the baseline scenario and project scenario for 60 years from planned deforestation and wetland degradation are 41,450,181 tCO_2e and 2,262,679 tCO_2e respectively with 39,187,502 tCO_2e Net Emissions Reduction (Table 3-35).

Table 3-35. The estimated net GHG emission reductions or removals from peat rewetting & conservation.

Year	Estimated baseline emissions $\Delta C_{BSL-PEAT}$ (tCO_2e)	Estimated project emissions $\Delta C_{WPS-PEAT}$ (tCO_2e)	Estimated leakage emissions $\Delta C_{LK-PEAT}$ (tCO_2e)	Net reduction of GHG emissions NER_{PEAT} (tCO_2e)
1	285,623	37,711	0	247,912
2	371,844	37,711	0	334,133
3	356,819	37,711	0	319,108
4	385,213	37,711	0	347,501
5	416,452	37,711	0	378,741
6	466,122	37,711	0	428,411
7	522,159	37,711	0	484,448
8	560,994	37,711	0	523,283
9	583,833	37,711	0	546,122
10	646,017	37,711	0	608,306
11	741,843	37,711	0	704,132
12	748,321	37,711	0	710,610
13	787,217	37,711	0	749,505
14	836,023	37,711	0	798,311
15	835,506	37,711	0	797,795
16	1,038,259	37,711	0	1,000,548
17	908,976	37,711	0	871,264
18	949,086	37,711	0	911,374
19	1,100,003	37,711	0	1,062,292

20	1,074,936	37,711	0	1,037,225
21	1,100,659	37,711	0	1,062,947
22	1,229,265	37,711	0	1,191,554
23	1,006,752	37,711	0	969,040
24	757,577	37,711	0	719,865
25	757,577	37,711	0	719,865
26	757,577	37,711	0	719,865
27	755,130	37,711	0	717,419
28	744,525	37,711	0	706,814
29	744,525	37,711	0	706,814
30	744,525	37,711	0	706,814
31	727,748	37,711	0	690,037
32	704,033	37,711	0	666,322
33	696,873	37,711	0	659,162
34	682,739	37,711	0	645,028
35	667,089	37,711	0	629,378
36	660,077	37,711	0	622,365
37	651,390	37,711	0	613,678
38	649,584	37,711	0	611,873
39	817,753	37,711	0	780,042
40	801,692	37,711	0	763,981
41	638,670	37,711	0	600,959
42	632,666	37,711	0	594,954
43	630,799	37,711	0	593,088
44	628,633	37,711	0	590,922
45	626,287	37,711	0	588,576
46	622,148	37,711	0	584,437
47	618,279	37,711	0	580,568
48	617,501	37,711	0	579,789
49	608,943	37,711	0	571,232
50	604,839	37,711	0	567,128
51	603,462	37,711	0	565,751
52	586,792	37,711	0	549,081
53	583,525	37,711	0	545,814
54	572,435	37,711	0	534,724

55	677,488	37,711	0	639,776
56	565,865	37,711	0	528,154
57	669,142	37,711	0	631,431
58	564,808	37,711	0	527,097
59	564,379	37,711	0	526,668
60	561,181	37,711	0	523,470
Total	41,450,181	2,262,679	0	39,187,502

Tidal wetland restoration and conservation

The total net GHG emission reductions and removals from the tidal wetland restoration and conservation activity were calculated in the following way:

$$NER_{TW} = \Delta C_{BSL-TW} - \Delta C_{WPS-TW} - \Delta C_{LK-TW}$$

Where:

NER_{TW} Net reduction of GHG emissions in year t*; tCO_2e
ΔC_{BSL-TW} Net emissions of GHG in year t* under the baseline scenario; tCO_2
ΔC_{WPS-TW} Net emissions of GHG in year t*under the project scenario; tCO_2
ΔC_{LK-TW} Net emissions of GHG due to leakage in year t*; tCO_2

The GHG emissions in the baseline scenario and project scenario for 60 years from tidal wetland restoration and conservation activity are 6,484,292 tCO_2e and 886,309 tCO_2e respectively with 1,909,054 tCO_2e Net Emissions Reduction (Table 3-36).

Table 3-36. The estimated net GHG emission reductions or removals from tidal wetlands.

Year	Estimated baseline emissions ΔC_{BSL-TW} (tCO_2e)	Estimated project emissions ΔC_{WPS-TW} (tCO_2e)	Estimated leakage emissions ΔC_{LK-TW} (tCO_2e)	Estimated net GHG emission reductions NER_{TW} (tCO_2e)
1	447,000	16,147	0	430,853
2	416,639	16,097	0	400,541
3	388,339	16,048	0	372,292
4	361,962	15,998	0	345,964
5	337,377	15,949	0	321,428
6	314,461	15,900	0	298,561
7	293,102	15,851	0	277,251
8	273,193	15,802	0	257,391
9	254,637	15,754	0	238,884
10	237,342	15,705	0	221,636
11	221,221	15,657	0	205,563

12	206,195	15,609	0	190,586
13	192,189	15,561	0	176,628
14	179,135	15,514	0	163,622
15	166,968	15,466	0	151,502
16	155,627	15,419	0	140,208
17	145,056	15,371	0	129,685
18	135,204	15,324	0	119,879
19	126,020	15,277	0	110,743
20	117,461	15,231	0	102,230
21	109,482	15,184	0	94,298
22	102,046	15,137	0	86,908
23	95,115	15,091	0	80,023
24	88,654	15,045	0	73,609
25	82,632	14,999	0	67,633
26	77,020	14,953	0	62,067
27	71,788	14,908	0	56,881
28	66,912	14,862	0	52,050
29	62,367	14,817	0	47,551
30	58,131	14,771	0	43,360
31	54,183	14,726	0	39,456
32	50,503	14,681	0	35,821
33	47,072	14,637	0	32,436
34	43,875	14,592	0	29,283
35	40,895	14,548	0	26,347
36	38,117	14,503	0	23,614
37	35,528	14,459	0	21,069
38	33,115	14,415	0	18,700
39	30,866	14,371	0	16,494
40	28,769	14,328	0	14,442
41	26,815	14,284	0	12,531
42	24,994	14,241	0	10,753
43	23,296	14,197	0	9,099
44	21,714	14,154	0	7,559

45	20,239	14,111	0	6,128
46	18,864	14,069	0	4,796
47	17,583	14,026	0	3,557
48	16,389	13,983	0	2,405
49	15,275	13,941	0	1,335
50	14,238	13,899	0	339
51	13,271	13,857	0	(586)
52	12,369	13,815	0	(1,445)
53	11,529	13,773	0	(2,244)
54	10,746	13,731	0	(2,985)
55	10,016	13,690	0	(3,673)
56	9,336	13,648	0	(4,312)
57	8,702	13,607	0	(4,905)
58	8,111	13,566	0	(5,455)
59	7,560	13,525	0	(5,965)
60	7,046	13,484	0	(6,438)
Total	6,484,292	886,309	0	5,597,983

ARR activity

The total net GHG emission reductions and removals from ARR activity were calculated in the following way:

$$NGR_{ARR} = \Delta C_{BSL-ARR} - \Delta C_{WPS-ARR} - \Delta C_{LK-ARR}$$

Where:

NGR_{ARR}	Net removals of GHG emissions in year t*; tCO_2e
$\Delta C_{BSL-ARR}$	Net removals of GHG in year t* under the baseline scenario; tCO_2
$\Delta C_{WPS-ARR}$	Net removals of GHG in year t*under the project scenario; tCO_2
ΔC_{LK-ARR}	Net removals of GHG due to leakage in year t*; tCO_2

The GHG emissions in the baseline scenario and project scenario for 60 years from ARR activity are (1,219,481) tCO_2e and (33,190,608) tCO_2e respectively with 31,971,127 tCO_2e Net Emissions Reduction (Table 3-37).

Table 3-37. The estimated net GHG emission removals from ARR activity.

Year	Estimated baseline GHG removals $\Delta C_{BSL-ARR}$ (tCO_2e)	Estimated project GHG removals $\Delta C_{WPS-ARR}$ (tCO_2e)	Estimated leakage GHG removals ΔC_{LK-ARR} (tCO_2e)	Estimated net GHG emission removals NGR_{ARR} (tCO_2e)
1	(162)	(2,676)	0	(2,513)
2	(243)	(5,351)	0	(5,108)
3	(325)	(8,027)	0	(7,702)
4	(450)	(10,702)	0	(10,252)
5	(889)	(13,378)	0	(12,489)
6	(1,638)	(16,053)	0	(14,415)
7	(2,695)	(19,476)	0	(16,781)
8	(4,058)	(24,255)	0	(20,197)
9	(5,727)	(30,940)	0	(25,214)
10	(7,698)	(40,166)	0	(32,467)
11	(9,955)	(52,705)	0	(42,749)
12	(12,319)	(69,167)	0	(56,848)
13	(14,683)	(90,089)	0	(75,406)
14	(17,039)	(116,253)	0	(99,214)
15	(19,386)	(148,294)	0	(128,908)
16	(21,725)	(186,845)	0	(165,121)
17	(24,057)	(232,459)	0	(208,402)
18	(26,384)	(285,691)	0	(259,307)
19	(28,705)	(341,896)	0	(313,191)
20	(31,020)	(395,621)	0	(364,600)
21	(33,331)	(446,095)	0	(412,764)
22	(35,637)	(492,574)	0	(456,937)
23	(37,939)	(534,310)	0	(496,371)
24	(40,238)	(571,484)	0	(531,246)
25	(42,532)	(605,445)	0	(562,913)
26	(38,182)	(635,636)	0	(597,455)
27	(33,535)	(661,388)	0	(627,853)
28	(28,593)	(683,209)	0	(654,616)
29	(23,400)	(701,656)	0	(678,255)
30	(18,226)	(717,436)	0	(699,209)
31	(13,069)	(727,495)	0	(714,427)
32	(7,926)	(734,115)	0	(726,189)
33	(6,378)	(738,991)	0	(732,614)
34	(7,756)	(744,131)	0	(736,375)

35	(9,727)	(749,537)	0	(739,810)
36	(11,984)	(755,215)	0	(743,231)
37	(14,347)	(761,169)	0	(746,821)
38	(16,712)	(767,402)	0	(750,689)
39	(19,068)	(773,919)	0	(754,851)
40	(21,415)	(780,723)	0	(759,309)
41	(23,754)	(787,819)	0	(764,065)
42	(26,086)	(795,210)	0	(769,123)
43	(28,413)	(802,900)	0	(774,487)
44	(30,734)	(810,892)	0	(780,159)
45	(33,049)	(819,191)	0	(786,142)
46	(35,360)	(827,800)	0	(792,440)
47	(37,666)	(836,722)	0	(799,055)
48	(39,968)	(845,961)	0	(805,992)
49	(42,267)	(855,520)	0	(813,254)
50	(44,561)	(865,404)	0	(820,842)
51	(40,211)	(875,614)	0	(835,403)
52	(35,564)	(886,155)	0	(850,591)
53	(30,622)	(897,030)	0	(866,408)
54	(25,385)	(908,242)	0	(882,857)
55	(19,853)	(919,794)	0	(899,940)
56	(14,028)	(931,690)	0	(917,662)
57	(7,909)	(943,932)	0	(936,023)
58	(5,079)	(956,524)	0	(951,445)
59	(4,869)	(969,469)	0	(964,600)
60	(4,951)	(982,770)	0	(977,819)
Total	(1,219,481)	(33,190,608)	0	(31,971,127)

3.2.4.2 Non-Permanence Risk Buffer Withholding

The annual buffer withheld for all activities under the VM0007 REDD+ Methodology Framework was calculated as a percentage of the total carbon stock benefits, excluding any emissions due to leakage. As the project does not account for emissions from fossil fuel combustion, direct N_2O emissions and emissions from biomass burning were also omitted from the calculations. The project used the AFOLU Non-Permanence Risk Report Excel Calculation Tool, v4.2 (Appendix 7: AFOLU Non-permanence Risk Report) where the overall risk rating of 17% was determined (Table 3-38). The total estimated buffer pool from the project is 14,337,337 tCO_2e for 60 years.

Table 3-38. Risk rating from the AFOLU Non-Permanence Risk Report.

Risk Category		Rating
a)	Internal risk	14.00
b)	External risk	0.00
c)	Natural risk	3.02
Overall risk rating (a + b + c)		**17.00**

Table 3-39. The non-permanence risk buffer withholding from the project.

Year	Buffer Pool $Buffer_{REDD}$ (tCO_2e)	Buffer Pool $Buffer_{PEAT}$ (tCO_2e)	Buffer Pool $Buffer_{TW}$ (tCO_2e)	Buffer Pool $Buffer_{ARR}$ (tCO_2e)	Total Buffer Pool $Buffer_{TOTAL}$ (tCO_2e)
1	79,606	42,145	73,245	427	195,424
2	69,208	56,803	68,092	868	194,971
3	70,108	54,248	63,290	1,309	188,955
4	71,008	59,075	58,814	1,743	190,640
5	71,907	64,386	54,643	2,123	193,059
6	72,651	72,830	50,755	2,451	198,687
7	73,245	82,356	47,133	2,853	205,586
8	74,094	88,958	43,756	3,433	210,242
9	74,944	92,841	40,610	4,286	212,681
10	75,793	103,412	37,678	5,519	222,403
11	32,362	119,702	34,946	7,267	194,278
12	12,427	120,804	32,400	9,664	175,295
13	12,529	127,416	30,027	12,819	182,791
14	12,632	135,713	27,816	16,866	193,027
15	12,734	135,625	25,755	21,914	196,029
16	12,836	170,093	23,835	28,071	234,835
17	12,938	148,115	22,046	35,428	218,528
18	13,041	154,934	20,379	44,082	232,436
19	13,143	180,590	18,826	53,243	265,801
20	13,245	176,328	17,379	61,982	268,935
21	13,347	180,701	16,031	70,170	280,249
22	13,450	202,564	14,774	77,679	308,467
23	12,084	164,737	13,604	84,383	274,808
24	9,983	122,377	12,514	90,312	235,186

25	9,983	122,377	11,498	95,695	239,553
26	9,983	122,377	10,551	101,567	244,479
27	9,983	121,961	9,670	106,735	248,349
28	9,983	120,158	8,849	111,285	250,275
29	9,983	120,158	8,084	115,303	253,529
30	9,983	120,158	7,371	118,866	256,378
31	9,983	117,306	6,708	121,453	255,450
32	9,983	113,275	6,090	123,452	252,800
33	9,983	112,058	5,514	124,544	252,099
34	9,983	109,655	4,978	125,184	249,800
35	9,983	106,994	4,479	125,768	247,224
36	9,983	105,802	4,014	126,349	246,149
37	9,983	104,325	3,582	126,960	244,850
38	9,983	104,018	3,179	127,617	244,798
39	9,983	132,607	2,804	128,325	273,719
40	9,983	129,877	2,455	129,082	271,397
41	9,983	102,163	2,130	129,891	244,168
42	9,983	101,142	1,828	130,751	243,704
43	9,983	100,825	1,547	131,663	244,018
44	9,983	100,457	1,285	132,627	244,352
45	9,983	100,058	1,042	133,644	244,727
46	9,983	99,354	815	134,715	244,867
47	9,983	98,697	605	135,839	245,124
48	9,983	98,564	409	137,019	245,975
49	9,983	97,109	227	138,253	245,573
50	9,983	96,412	58	139,543	245,996
51	9,983	96,178	(100)	142,019	248,080
52	9,983	93,344	(246)	144,600	247,682
53	9,983	92,788	(381)	147,289	249,680
54	9,983	90,903	(507)	150,086	250,464
55	9,983	108,762	(624)	152,990	271,111
56	9,983	89,786	(733)	156,002	255,039
57	9,983	107,343	(834)	159,124	275,616
58	9,983	89,607	(927)	161,746	260,408
59	9,983	89,534	(1,014)	163,982	262,485

60	9,983	88,990	(1,094)	166,229	264,108
Total	1,288,713	6,661,875	951,657	5,435,092	14,337,337

3.2.4.3 Verified Carbon Units

Avoided Planned Deforestation

VCUs are calculated by subtracting the VCS non-permanence risk buffer withholding from the net emission reductions for each project activity as follows:

$$VCU_t = NER_{REDD+} - Buffer_{REDD}$$

Where:

VCU_t	Number of Verified Carbon Units (VCU); tCO_2e
NER_{REDD+}	Net reduction of GHG emissions in year t*; tCO_2e
$Buffer_{REDD}$	Total reservation for risk of non-permanence; tCO_2e

The total VCUs from avoided planned deforestation activity in 60 years of project crediting period is 6,291,952 tCO_2e (Table 3-40).

Table 3-40. Calculated Verified Carbon Units from avoided planned deforestation.

Year	Estimated net GHG emission reductions NER_{REDD+} (tCO_2e)	Buffer Pool $Buffer_{REDD}$ (tCO_2e)	Estimated Net VCU_{REDD} (tCO_2e)
1	468,273	79,606	388,667
2	407,106	69,208	337,898
3	412,399	70,108	342,291
4	417,692	71,008	346,684
5	422,985	71,907	351,077
6	427,361	72,651	354,709
7	430,852	73,245	357,607
8	435,849	74,094	361,755
9	440,846	74,944	365,902
10	445,843	75,793	370,050
11	190,367	32,362	158,005
12	73,101	12,427	60,674
13	73,703	12,529	61,173
14	74,304	12,632	61,672
15	74,906	12,734	62,172
16	75,507	12,836	62,671
17	76,108	12,938	63,170

18	76,710	13,041	63,669
19	77,311	13,143	64,168
20	77,912	13,245	64,667
21	78,514	13,347	65,166
22	79,115	13,450	65,666
23	71,083	12,084	58,999
24	58,725	9,983	48,742
25	58,725	9,983	48,742
26	58,725	9,983	48,742
27	58,725	9,983	48,742
28	58,725	9,983	48,742
29	58,725	9,983	48,742
30	58,725	9,983	48,742
31	58,725	9,983	48,742
32	58,725	9,983	48,742
33	58,725	9,983	48,742
34	58,725	9,983	48,742
35	58,725	9,983	48,742
36	58,725	9,983	48,742
37	58,725	9,983	48,742
38	58,725	9,983	48,742
39	58,725	9,983	48,742
40	58,725	9,983	48,742
41	58,725	9,983	48,742
42	58,725	9,983	48,742
43	58,725	9,983	48,742
44	58,725	9,983	48,742
45	58,725	9,983	48,742
46	58,725	9,983	48,742
47	58,725	9,983	48,742
48	58,725	9,983	48,742
49	58,725	9,983	48,742
50	58,725	9,983	48,742
51	58,725	9,983	48,742
52	58,725	9,983	48,742

53	58,725	9,983	48,742
54	58,725	9,983	48,742
55	58,725	9,983	48,742
56	58,725	9,983	48,742
57	58,725	9,983	48,742
58	58,725	9,983	48,742
59	58,725	9,983	48,742
60	58,725	9,983	48,742
Total	7,580,665	1,288,713	6,291,952

Peatland rewetting and conservation

VCUs are calculated by subtracting the VCS non-permanence risk buffer withholding from the net emission reductions for each project activity as follows:

$$VCU_t = NER_{PEAT} - Buffer_{PEAT}$$

Where:

VCU_t	Number of Verified Carbon Units (VCU); tCO_2e
NER_{PEAT}	Net reduction of GHG emissions in year t*; tCO_2e
$Buffer_{PEAT}$	Total reservation for risk of non-permanence; tCO_2e

The total VCUs from peat rewetting and conservation activity in 60 years of project crediting period is 32,525,626 tCO_2e (Table 3-41).

Table 3-41. Calculated Verified Carbon Units from peat rewetting and conservation activity.

Year	Estimated net GHG emission reductions NER_{PEAT} (tCO_2e)	Buffer Pool $Buffer_{PEAT}$ (tCO_2e)	Estimated Net VCU_{PEAT} (tCO_2e)
1	247,912	42,145	205,767
2	334,133	56,803	277,331
3	319,108	54,248	264,860
4	347,501	59,075	288,426
5	378,741	64,386	314,355
6	428,411	72,830	355,581
7	484,448	82,356	402,092
8	523,283	88,958	434,325
9	546,122	92,841	453,281
10	608,306	103,412	504,894
11	704,132	119,702	584,430

12	710,610	120,804	589,806
13	749,505	127,416	622,089
14	798,311	135,713	662,599
15	797,795	135,625	662,170
16	1,000,548	170,093	830,455
17	871,264	148,115	723,149
18	911,374	154,934	756,441
19	1,062,292	180,590	881,702
20	1,037,225	176,328	860,897
21	1,062,947	180,701	882,246
22	1,191,554	202,564	988,990
23	969,040	164,737	804,303
24	719,865	122,377	597,488
25	719,865	122,377	597,488
26	719,865	122,377	597,488
27	717,419	121,961	595,458
28	706,814	120,158	586,655
29	706,814	120,158	586,655
30	706,814	120,158	586,655
31	690,037	117,306	572,730
32	666,322	113,275	553,047
33	659,162	112,058	547,104
34	645,028	109,655	535,373
35	629,378	106,994	522,383
36	622,365	105,802	516,563
37	613,678	104,325	509,353
38	611,873	104,018	507,854
39	780,042	132,607	647,435
40	763,981	129,877	634,104
41	600,959	102,163	498,796
42	594,954	101,142	493,812
43	593,088	100,825	492,263
44	590,922	100,457	490,465
45	588,576	100,058	488,518
46	584,437	99,354	485,082

47	580,568	98,697	481,871
48	579,789	98,564	481,225
49	571,232	97,109	474,122
50	567,128	96,412	470,716
51	565,751	96,178	469,573
52	549,081	93,344	455,737
53	545,814	92,788	453,026
54	534,724	90,903	443,821
55	639,776	108,762	531,014
56	528,154	89,786	438,368
57	631,431	107,343	524,087
58	527,097	89,607	437,491
59	526,668	89,534	437,134
60	523,470	88,990	434,480
Total	39,187,502	6,661,875	32,525,626

Tidal wetland restoration and conservation

VCUs are calculated by subtracting the VCS non-permanence risk buffer withholding from the net emission reductions for each project activity as follows:

$$VCU_t = NER_{TW} - Buffer_{TW}$$

Where:

VCU_t	Number of Verified Carbon Units (VCU); tCO_2e
NER_{TW}	Net reduction of GHG emissions in year t*; tCO_2e
$Buffer_{TW}$	Total reservation for risk of non-permanence; tCO_2e

The total VCUs from tidal wetland restoration and conservation activity in 60 years of project crediting period is 4,646,326 tCO_2e (Table 3-42).

Table 3-42. Calculated Verified Carbon Units from tidal wetland restoration and conservation activity.

Year	Estimated net GHG emission reductions NER_{TW} (tCO_2e)	Buffer Pool $Buffer_{TW}$ (tCO_2e)	Estimated Net VCU_{TW} (tCO_2e)
1	430,853	73,245	357,608
2	400,541	68,092	332,449
3	372,292	63,290	309,002
4	345,964	58,814	287,150
5	321,428	54,643	266,785

6	298,561	50,755	247,806
7	277,251	47,133	230,118
8	257,391	43,756	213,635
9	238,884	40,610	198,273
10	221,636	37,678	183,958
11	205,563	34,946	170,618
12	190,586	32,400	158,186
13	176,628	30,027	146,601
14	163,622	27,816	135,806
15	151,502	25,755	125,747
16	140,208	23,835	116,373
17	129,685	22,046	107,639
18	119,879	20,379	99,500
19	110,743	18,826	91,917
20	102,230	17,379	84,851
21	94,298	16,031	78,268
22	86,908	14,774	72,134
23	80,023	13,604	66,419
24	73,609	12,514	61,096
25	67,633	11,498	56,136
26	62,067	10,551	51,515
27	56,881	9,670	47,211
28	52,050	8,849	43,202
29	47,551	8,084	39,467
30	43,360	7,371	35,989
31	39,456	6,708	32,749
32	35,821	6,090	29,731
33	32,436	5,514	26,921
34	29,283	4,978	24,305
35	26,347	4,479	21,868
36	23,614	4,014	19,599
37	21,069	3,582	17,487
38	18,700	3,179	15,521
39	16,494	2,804	13,690
40	14,442	2,455	11,986

41	12,531	2,130	10,401
42	10,753	1,828	8,925
43	9,099	1,547	7,552
44	7,559	1,285	6,274
45	6,128	1,042	5,086
46	4,796	815	3,980
47	3,557	605	2,952
48	2,405	409	1,996
49	1,335	227	1,108
50	339	58	282
51	(586)	(100)	(486)
52	(1,445)	(246)	(1,200)
53	(2,244)	(381)	(1,862)
54	(2,985)	(507)	(2,478)
55	(3,673)	(624)	(3,049)
56	(4,312)	(733)	(3,579)
57	(4,905)	(834)	(4,071)
58	(5,455)	(927)	(4,528)
59	(5,965)	(1,014)	(4,951)
60	(6,438)	(1,094)	(5,343)
Total	5,597,983	951,657	4,646,326

ARR activity

VCUs are calculated by subtracting the VCS non-permanence risk buffer withholding from the net GHG removals for each project activity as follows:

$$VCU_t = NGR_{ARR} - Buffer_{ARR}$$

Where:

VCU_t	Number of Verified Carbon Units (VCU); tCO_2e
NGR_{ARR}	Net reduction of GHG emissions in year t*; tCO_2e
$Buffer_{ARR}$	Total reservation for risk of non-permanence; tCO_2e

The total VCUs from ARR activity in 60 years project crediting period is 26,536,036 tCO_2e (Table 3-43).

Table 3-43. Calculated Verified Carbon Units from ARR activity.

Year	Estimated net GHG emission reductions NGR_{ARR} (tCO_2e)	Buffer Pool $Buffer_{ARR}$ (tCO_2e)	Estimated Net VCU_{ARR} (tCO_2e)
1	2,513	427	2,086
2	5,108	868	4,239
3	7,702	1,309	6,393
4	10,252	1,743	8,509
5	12,489	2,123	10,366
6	14,415	2,451	11,965
7	16,781	2,853	13,928
8	20,197	3,433	16,763
9	25,214	4,286	20,927
10	32,467	5,519	26,948
11	42,749	7,267	35,482
12	56,848	9,664	47,184
13	75,406	12,819	62,587
14	99,214	16,866	82,348
15	128,908	21,914	106,994
16	165,121	28,071	137,050
17	208,402	35,428	172,974
18	259,307	44,082	215,225
19	313,191	53,243	259,949
20	364,600	61,982	302,618
21	412,764	70,170	342,594
22	456,937	77,679	379,258
23	496,371	84,383	411,988
24	531,246	90,312	440,935
25	562,913	95,695	467,218
26	597,455	101,567	495,888
27	627,853	106,735	521,118
28	654,616	111,285	543,331
29	678,255	115,303	562,952
30	699,209	118,866	580,344
31	714,427	121,453	592,974

32	726,189	123,452	602,737
33	732,614	124,544	608,069
34	736,375	125,184	611,191
35	739,810	125,768	614,042
36	743,231	126,349	616,882
37	746,821	126,960	619,862
38	750,689	127,617	623,072
39	754,851	128,325	626,526
40	759,309	129,082	630,226
41	764,065	129,891	634,174
42	769,123	130,751	638,372
43	774,487	131,663	642,824
44	780,159	132,627	647,532
45	786,142	133,644	652,498
46	792,440	134,715	657,725
47	799,055	135,839	663,216
48	805,992	137,019	668,974
49	813,254	138,253	675,001
50	820,842	139,543	681,299
51	835,403	142,019	693,385
52	850,591	144,600	705,991
53	866,408	147,289	719,119
54	882,857	150,086	732,771
55	899,940	152,990	746,951
56	917,662	156,002	761,659
57	936,023	159,124	776,899
58	951,445	161,746	789,700
59	964,600	163,982	800,618
60	977,819	166,229	811,590
Total	31,971,127	5,435,092	26,536,036

Total VCUs for all project activities

The total VCUs from all project activities in 60 years of project crediting period is 69,999,940 tCO_2e (Table 3-44).

Table 3-44. The total estimated ex-ante Verified Carbon Units (VCUs) from all project activities.

Year	Estimated Net VCU_{REDD} (tCO_2e)	Estimated Net VCU_{PEAT} (tCO_2e)	Estimated Net VCU_{TW} (tCO_2e)	Estimated Net VCU_{ARR} (tCO_2e)	Estimated Total Net VCU_{TOTAL} (tCO_2e)
1	388,667	205,767	357,608	2,086	954,128
2	337,898	277,331	332,449	4,239	951,917
3	342,291	264,860	309,002	6,393	922,545
4	346,684	288,426	287,150	8,509	930,769
5	351,077	314,355	266,785	10,366	942,582
6	354,709	355,581	247,806	11,965	970,060
7	357,607	402,092	230,118	13,928	1,003,745
8	361,755	434,325	213,635	16,763	1,026,477
9	365,902	453,281	198,273	20,927	1,038,384
10	370,050	504,894	183,958	26,948	1,085,850
11	158,005	584,430	170,618	35,482	948,534
12	60,674	589,806	158,186	47,184	855,850
13	61,173	622,089	146,601	62,587	892,451
14	61,672	662,599	135,806	82,348	942,425
15	62,172	662,170	125,747	106,994	957,082
16	62,671	830,455	116,373	137,050	1,146,548
17	63,170	723,149	107,639	172,974	1,066,931
18	63,669	756,441	99,500	215,225	1,134,835
19	64,168	881,702	91,917	259,949	1,297,736
20	64,667	860,897	84,851	302,618	1,313,033
21	65,166	882,246	78,268	342,594	1,368,274
22	65,666	988,990	72,134	379,258	1,506,047
23	58,999	804,303	66,419	411,988	1,341,710
24	48,742	597,488	61,096	440,935	1,148,260
25	48,742	597,488	56,136	467,218	1,169,583
26	48,742	597,488	51,515	495,888	1,193,633
27	48,742	595,458	47,211	521,118	1,212,529
28	48,742	586,655	43,202	543,331	1,221,930
29	48,742	586,655	39,467	562,952	1,237,816
30	48,742	586,655	35,989	580,344	1,251,729
31	48,742	572,730	32,749	592,974	1,247,195

32	48,742	553,047	29,731	602,737	1,234,258
33	48,742	547,104	26,921	608,069	1,230,837
34	48,742	535,373	24,305	611,191	1,219,611
35	48,742	522,383	21,868	614,042	1,207,035
36	48,742	516,563	19,599	616,882	1,201,786
37	48,742	509,353	17,487	619,862	1,195,444
38	48,742	507,854	15,521	623,072	1,195,189
39	48,742	647,435	13,690	626,526	1,336,393
40	48,742	634,104	11,986	630,226	1,325,058
41	48,742	498,796	10,401	634,174	1,192,112
42	48,742	493,812	8,925	638,372	1,189,851
43	48,742	492,263	7,552	642,824	1,191,380
44	48,742	490,465	6,274	647,532	1,193,013
45	48,742	488,518	5,086	652,498	1,194,843
46	48,742	485,082	3,980	657,725	1,195,529
47	48,742	481,871	2,952	663,216	1,196,781
48	48,742	481,225	1,996	668,974	1,200,937
49	48,742	474,122	1,108	675,001	1,198,972
50	48,742	470,716	282	681,299	1,201,039
51	48,742	469,573	(486)	693,385	1,211,214
52	48,742	455,737	(1,200)	705,991	1,209,270
53	48,742	453,026	(1,862)	719,119	1,219,024
54	48,742	443,821	(2,478)	732,771	1,222,856
55	48,742	531,014	(3,049)	746,951	1,323,658
56	48,742	438,368	(3,579)	761,659	1,245,189
57	48,742	524,087	(4,071)	776,899	1,345,657
58	48,742	437,491	(4,528)	789,700	1,271,404
59	48,742	437,134	(4,951)	800,618	1,281,543
60	48,742	434,480	(5,343)	811,590	1,289,468
Total 60 years	6,291,952	32,525,626	4,646,326	26,536,036	69,999,940
Average annual	104,866	542,094	77,439	442,267	1,166,666

3.3 Monitoring

3.3.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,planned}$
Data unit	t CO_2e
Description	Net greenhouse gas emissions in the baseline from planned deforestation
Equation	3, 14
Source of data	Module BL-PL
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-PL, among others the module is applicable for estimating the baseline emissions on forest lands (usually privately or government owned) that are legally authorized and documented to be converted to non-forest land.
Purpose of data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$\Delta C_{BSL-ARR}$
Data unit	t CO_2e
Description	Net GHG removals in the ARR baseline scenario up to year t*
Equation	5
Source of data	Module BL-ARR
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-ARR, among others the project scenarios involving the harvesting of trees are excluded from this module.
Purpose of data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$GHG_{BSL-PEAT}$
Data unit	t CO_2e
Description	Net GHG emissions in the WRC baseline scenario up to year t*
Equation	6, 7
Source of data	Module BL-PEAT
Value applied	N/A

Justification of choice of data or description of measurement methods and procedures applied	See Module BL-PEAT, among others this module applies to the baseline scenario of WRC project activities on peatlands that are expected to be or remain (partly) drained in the absence of the project activity.
Purpose of data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	GHG_{BSL-TW}
Data unit	t CO_2e
Description	Net GHG emissions in the WRC baseline scenario up to year t*
Equation	6, 7
Source of data	Module BL-TW
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module BL-TW, among others this module applies to the baseline scenario of WRC project activities on tidal wetlands that are expected to be or remain (partly) drained in the absence of the project activity.
Purpose of data	Calculation of baseline emissions
Comments	N/A

3.3.2 Data and Parameters Monitored

Data/Parameter	$\Delta C_{WPS-REDD}$
Data Unit	t CO_2e
Description	Net GHG emissions in the REDD project scenario up to year t*
Equation	2
Source of data	Module M-REDD
Description of measurement methods and procedures to be applied	Applicable to monitoring ex-post emissions and removals of GHGs due to avoiding planned deforestation and forest degradation, and carbon stock enhancement that has been induced as a result of REDD project implementation within the project area and leakage belt and as a result of natural disturbances
Frequency of monitoring/recording	See Module M-REDD (Every 10 years (when the project baseline must be revisited) or every five years where conditions trigger more frequent baseline renewal)
Value applied	N/A
Monitoring equipment	Tool T-SIG
QA/QC procedures to be applied	See Module M-REDD
Purpose of Data	Calculation of project emissions
Calculation method	See Module M-REDD

Comments	N/A

Data/Parameter	$\Delta C_{WPS-ARR}$
Data Unit	t CO_2e
Description	Net GHG emissions in the ARR project scenario up to year t*
Equation	5
Source of data	Module M-ARR
Description of measurement methods and procedures to be applied	See Module M-ARR
Frequency of monitoring/recording	See Module M-ARR
Value applied	N/A
Monitoring equipment	See Module M-ARR
QA/QC procedures to be applied	See Module M-ARR
Purpose of Data	Calculation of project emissions
Calculation method	See Module M-ARR
Comments	N/A

Data/Parameter	$GHG_{WPS-PEAT}$
Data Unit	t CO_2e
Description	Net GHG emissions in the WRC project scenario up to year t*
Equation	6
Source of data	Module M-PEAT
Description of measurement methods and procedures to be applied	See Module M-PEAT
Frequency of monitoring/recording	See Module M-PEAT
Value applied	N/A
Monitoring equipment	See Module M-PEAT
QA/QC procedures to be applied	See Module M-PEAT
Purpose of Data	Calculation of project emissions
Calculation method	See Module M-PEAT
Comments	N/A

Data/Parameter	GHG_{WPS-TW}
Data Unit	t CO_2e
Description	Net GHG emissions in the WRC project scenario up to year t*
Equation	6
Source of data	Module M-TW

Description of measurement methods and procedures to be applied	See Module M-TW
Frequency of monitoring/recording	See Module M-TW
Value applied	N/A
Monitoring equipment	See Module M-TW
QA/QC procedures to be applied	See Module M-TW
Purpose of Data	Calculation of project emissions
Calculation method	See Module M-TW
Comments	N/A

Data/Parameter	Frequency of patrol activities
Data Unit	Number of activities per year
Description	Record of the number of patrol activities carried out in the project area and leakage belt during the monitoring period.
Equation	N/A
Source of data	Patrol reports
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Calculation method	N/A
Comments	N/A

Data/Parameter	Monitoring of forest cover by high-resolution satellite imagery
Data Unit	Number of activities per year
Description	Presentation of monitoring reports on land cover and land cover changes through high resolution satellite images.
Equation	N/A
Source of data	Forest cover monitoring reports
Description of measurement methods and procedures to be applied	High-resolution satellite data obtained through reliable and valid data sources, will be analyzed in order to examine the forest coverage monitoring data in the project area and leakage belt. To identify changes in land use in the monitored area, the data from the examined periods will be automatically categorized and visually interpreted.

Frequency of monitoring/recording	To be established
Value applied	N/A
Monitoring equipment	Geographical Information System (GIS) and Remote Sensing (RS) including the variety of tools, will be selected to support monitoring processes
QA/QC procedures to be applied	Precision target of >90% confidence interval at +/-10% of mean. >90% [Overall Classification Accuracy = 'Number of Pixels Classified Correctly' divided by 'Total Number of Classified Pixels']. Resolution (satellite imagery): <= 30 meter (m). Selection of Remote sensing instruments are, amongst others: Landsat, Resourcesat-1, Sentinel-1, Sentinel-2, JERS-1, ALOS/PALSAR, SPOT, Rapid Eye, PlanetLab. Cloud cover <10% during 12-month period.
Calculation method	N/A
Comments	N/A

3.3.3 Monitoring Plan

Climate impacts will be monitored in accordance with Appendix 13: Monitoring Plan, which includes land cover change monitoring, fire monitoring (e.g., hotspots, burnt areas), peat water table and subsidence monitoring following the requirements under VCS VM0007 methodology. The project will use both remote sensing approach and field data measurement for monitoring climate impacts. The monitoring plan outlines the indicators to be monitored, monitoring frequency, and data collection method.

3.3.3.1 Remote Sensing

Remote sensing approach will be used to monitor land cover change and burnt areas (if any fire incidences occur within the project area) and will be conducted annually. Satellite imageries with resolution of ≤ 30 meters (e.g., PlanetLab, Sentinel-1, Sentinel-2, ALOS/PALSAR, etc.) with cloud cover <10% will be used. Land cover change analysis will follow the procedures set out in Appendix 1: Remote Sensing Approach and Land Cover Classification Reports. Any deforested areas within the project area and project zone will be groundtruthed by the field team by directly visiting the location and/or using drones if the location is inaccessible. Overall classification accuracy is targeted at >90%.

Leakage monitoring in this project is undertaken to address the risk that deforestation activities are displaced elsewhere. By focusing on a specific identified actor, namely PT AIS, the project applies a targeted approach that draws on historical information and present circumstances and practices to demonstrate low potential for project-induced leakage.

Additionally, a robust and diversified monitoring strategy is implemented by the project as a commitment to transparency and environmental integrity, as follows:

- Remote Sensing: Satellite imagery tracking land cover changes across the project area and project zone to provide a general view of possible changes in land use patterns indicative of leakage.

- GLAD Alerts: The incorporation of the Global Land Analysis & Discovery system to provide near-real-time deforestation alert data, a tool that helps in rapid identification of unexpected changes to forest cover and enables prompt investigation and response.

- Ground Truthing: Regular field visits shall be undertaken to verify remote sensing and alert data to ensure accuracy for detection and attribution of leakage to actual activities or developments.

These sources of information are gathered and analyzed each time a new verification event occurs, with a special focus on the production, changes in the water table, and new oil palm developments. This integrated approach not only meets the specifications of the VMD0009 LK-ASP module but also serves to further build the project's capacity in monitoring any potential leakage and responding appropriately, hence delivering on its commitment to reducing deforestation and the related climate impact.

The project's approach to monitoring tidal wetlands adopts a comprehensive strategy to effectively curb GHG emissions. By combining direct measurements of GHG flux through both chamber methods with water quality evaluations for nutrients and dissolved carbon, this method offers a robust analysis of environmental health. The use of remote sensing technology, such as satellite imagery and drone surveys, provides detailed insights into the dynamics of the wetland, including changes in vegetation and shoreline changes. Ground evaluations further contribute by assessing the vegetation and soil's carbon storage potential. Monitoring the hydrological aspects, such as water table levels and the impact of tides, is fundamental for understanding how water movements influence emission trends. This integrated system ensures that the project can enhance the wetland's capacity for carbon capture while keeping GHG releases to a minimum.

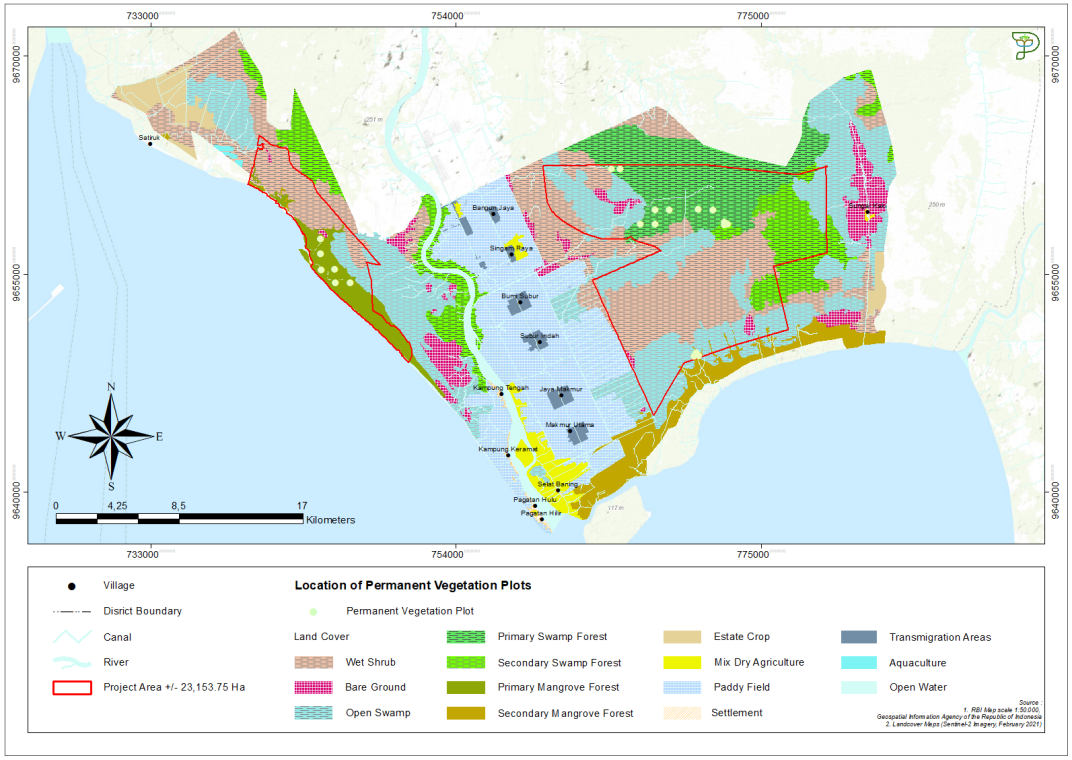
3.3.3.2 Field Data Measurement

3.3.3.2.1 AGB C Stock

To monitor the C stock within the project area, the project will establish 20 permanent vegetation/biomass plots in the same locations that were used for the baseline assessment. The plots will be monitored annually for tree growth (DBH). To estimate the C stock from DBH, we will use the same allometric equations that were used when determining the baseline AGB C stock[74].

For ARR activities, the project will establish new plots that will represent the areas of ARR (including ANR) activities for both mangrove and peat ARR. DBH will be the main parameter measured in the field and species specific allometric equations will be used to estimate the C stock (in accordance with the species that will be planted). Field measurement will be conducted annually. In addition, the project will create a logbook that records the number of seedlings planted by species, survival rate, DBH, and height for active planting activities.

[74] PT PUM's Biomass Carbon Stock Assessment Report.



Map 3-10. Planned location of permanent vegetation plots

3.3.3.2.2 Fire Hotspots and Burnt Areas

The project will develop a Fire Danger Rating System (FDRS) to serve as an early warning system of fire risk in the project area. Automatic Weather Stations (AWS) will be installed on the ground to collect climate data that correlate with fire risk (e.g., temperature, precipitation, soil moisture, and peat water level) and these data will be supplied into the FDRS to calculate the Peat Fire Vulnerability Index (PFVI). The FDRS will then provide a 7-day forecast of fire risk in the project area. The FDRS will categorize the fire risk based on PFVI's value as Safe / Alert / Dangerous / Extreme.

In the field, the project will monitor fire hotspots through daily monitoring from fire watch tower and fire prevention patrols during the dry season when the FDRS rates the fire risk as Alert / Dangerous / Extreme. In addition, the project also monitors fire hotspots from NASA's Fire Information for Resource Management System (FIRMS). FIRMS provides near real-time active fire data within three hours of satellite observation from the MODIS and VIIRS instruments. The fire patrol team will verify fire hotspots on the ground by directly visiting the location and/or using drone if the location is inaccessible.

Burnt areas within the project area will be mapped and calculated using remote sensing approach with high-resolution satellite imagery within one month of fire incidences with detailed procedure listed in the Standard Operational Procedure document for Prevention and Management of Forest and Land Fire (please refer to Appendix 12: List of SOPs). Areas with repeated burning will be analyzed using historical burning records. GHG emissions from biomass and peat burning will be calculated annually following the E-BPB module.

3.3.3.2.3 Peat Water Table and Subsidence

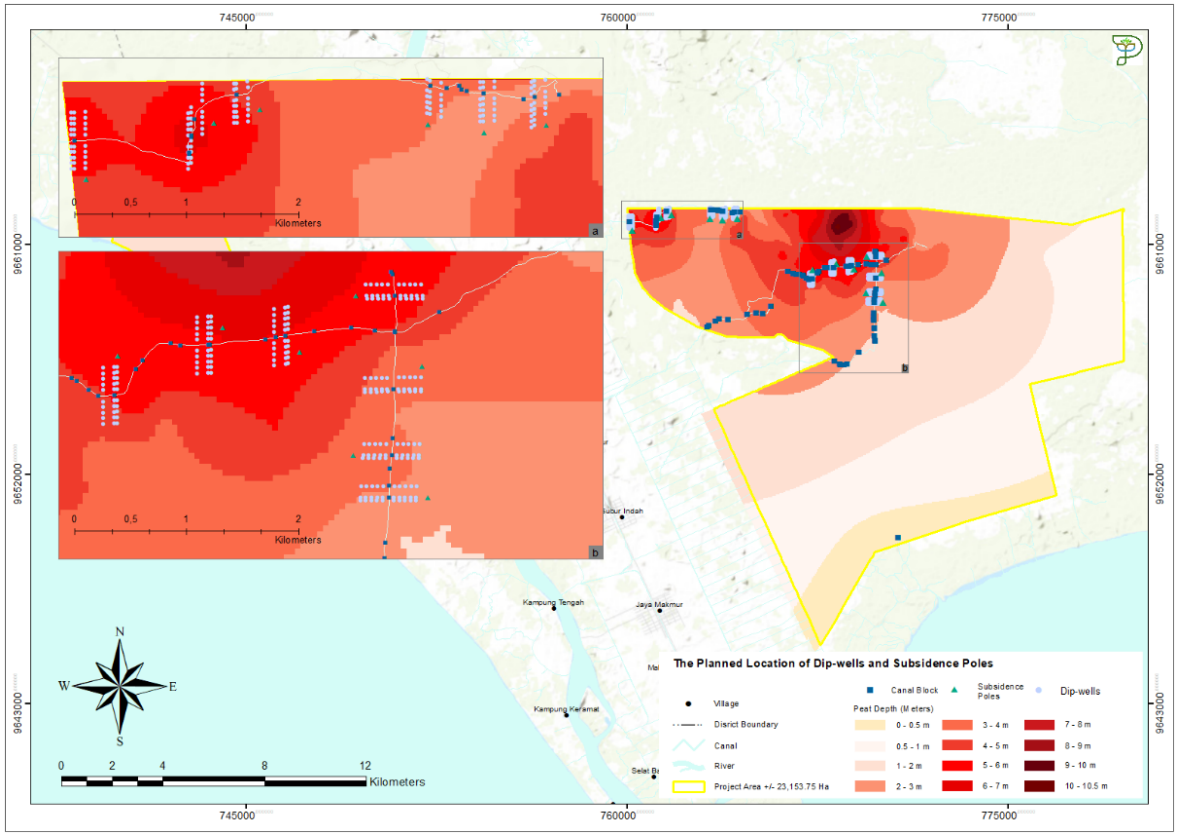
The project plans to install 352 dipwells and 13 subsidence poles along the planned canal blocks in the project area to monitor peat water level and peat subsidence. However, the numbers of monitoring stations may be adjusted depending on field conditions. Peat water level will be measured automatically (daily) or manually (weekly), while peat subsidence will be monitored manually every three months.

The project implements a detailed approach to monitor peat water levels and subsidence, crucial for evaluating its impact on peatland conservation and carbon sequestration. Through both automatic (daily) and manual (weekly) measurements of water levels, as well as quarterly manual checks of peat subsidence, it captures essential data on hydrology and land stability. This is followed by data analysis on peat water levels and subsidence to provide further understanding of this influential factor on greenhouse gas (GHG) emissions. Water-level fluctuations in peat, in fact, determine the rate of decomposition. Generally, low water levels imply more decomposition, hence higher emissions of GHGs. Equally, peat subsidence data provide information on the long-term stability in the peat and also the storage of carbon in peatland. Summed with other data points, the project can then very accurately infer GHG emissions from peat decomposition in tropical peatlands.

3.3.3.2.4 GHG Emissions

The project is exploring future installation of greenhouse gas (GHG) monitoring equipment aimed at providing long-term data on atmospheric GHG flux in peatlands, including carbon dioxide (CO_2), methane (CH_4), among others. Atmospheric monitoring of GHG flux enhances the understanding on the sequestration of carbon from the atmosphere by vegetation and its subsequent integration into the soils. The project may leverage atmospheric-based monitoring, potentially employing GHG flux towers, in collaboration with Hyphen Global AG to further these objectives.[75]

[75] Hyphen Global AG is a Switzerland-based climate tech company pioneering science driven digital MRV by way of precision emissions validation through real-time atmospheric greenhouse gas (GHG) monitoring. Atmospheric-based methodologies for monitoring these processes receive international endorsement from authoritative bodies such as the Intergovernmental Panel on Climate Change (IPCC), the United Nations Framework Convention on Climate Change (UNFCCC), and the World Meteorological Organization (WMO). These endorsements underscore the peer-reviewed accuracy of measured sequestration data obtained through atmospheric monitoring.



Map 3-11. Planned location of canal blocks, dip-wells and subsidence poles

Table 3-45 Monitoring Indicators

No	Monitoring Indicator	Remote Sensing	Field Data	Monitoring Frequency
1	Land Cover Change	●	●	Annually
2	Shoreline Change	●	●	Annually
3	AGB C Stock		●	Annually
4	Fire Hotspots and Burnt Areas	●	●	Daily during the dry season, burnt areas analysis within one month of incidence
5	Peat Water Table		●	Daily (automatic)/ weekly (manual)
6	Peat Subsidence		●	Every three months

3.3.3.3 Data Management

The procedures for data management, internal auditing and QA/QC are described in Figure 3-7 below. Please also refer to Section 2.3.8 and Figure 2-4 on the project's adaptive management.

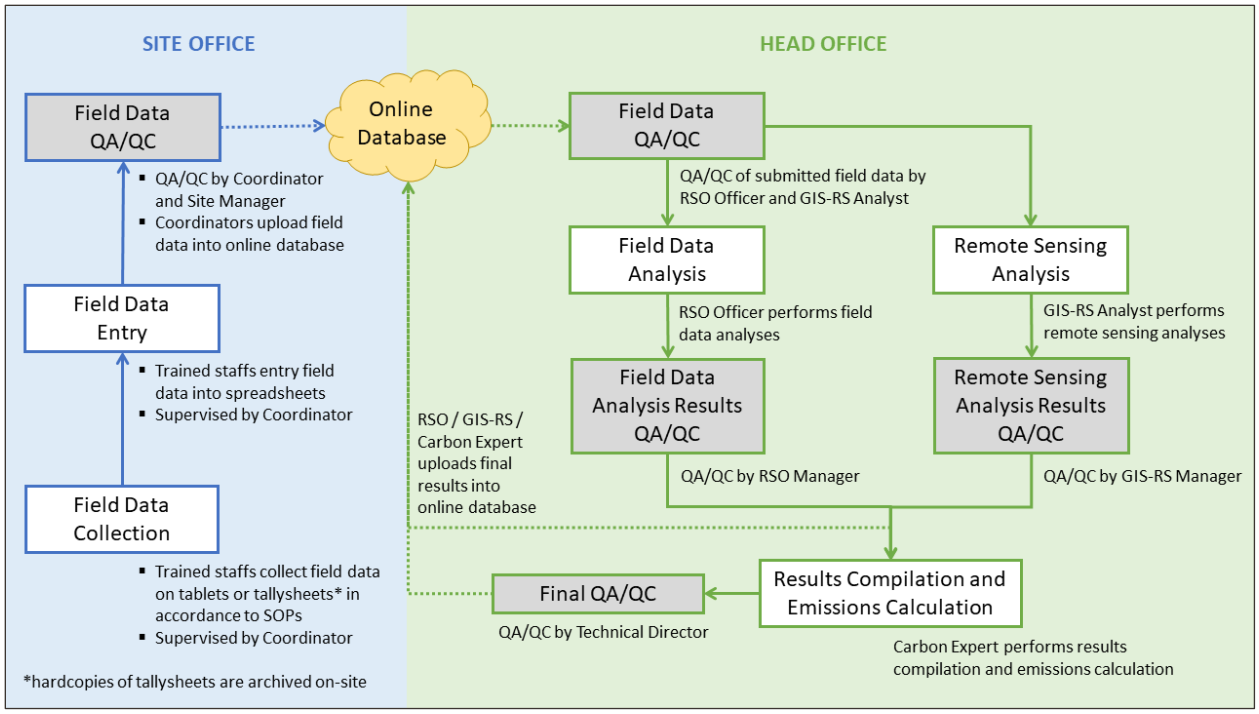


Figure 3-7. Data management process

The project will also adopt the Spatial Monitoring and Reporting Tool (SMART) Patrol System[76] to digitize the process of field data collection (including data for Community and Biodiversity) and therefore minimizing the risk of human error in manual data entry. The SMART Patrol Mobile application will be installed on tablets or smartphones that will be used by the field staff for data collection. The SMART Patrol Desktop application will serve as the main database of all field data.

To avoid non-conformances with the monitoring plan, the project has developed and will develop SOPs at each level (e.g., field data collection, data management, data analysis, etc.). A list of available SOPs and planned SOPs that will be developed is available in Appendix 12: List of SOPs. A copy of SOPs can be provided to the validator upon request. All project staff will be trained to follow procedures in accordance with the SOPs and will continuously be supervised. The project will also implement multiple QA/QC at various levels. All of the data collected, entered, uploaded, and analyzed are subject to review and approval by the Coordinator or Manager or Expert or Director (depending on the level) to ensure that the SOPs are correctly followed (Figure 3-7). In addition, the project also adopts adaptive management principle (please refer to Section 2.3.8) and will regularly evaluate the implementation of monitoring procedures and make improvements when required.

The following table provides the list of monitoring team members, responsibilities, and competencies.

[76] https://smartconservationtools.org/

Table 3-46. Monitoring team members

No	Name / Position	Responsibilities	Competencies
1	TBD / Technical Director	Oversee and provide technical advice on all processes, final QA/QC of technical analysis and emissions calculation	Please refer to Section 2.1.4
2	TBD / GIS-Remote Sensing Manager	Supervise SOPs development, remote sensing and GIS analyses QA/QC	Please refer to Section 2.1.4
3	Imanuddin Utoro / RSO Manager	Supervise SOPs development, field data analysis QA/QC	Please refer to Section 2.4.3
4	TBD / Carbon Expert	Develop carbon models, calculate emissions from monitoring data analyses results	Please refer to Section 2.1.4
5	Vanny Milenia / GIS-Remote Sensing Analyst	Development of SOPs, spatial field data QA/QC, perform remote sensing and GIS analyses	Please refer to Section 2.4.3
6	Larissa D Salaki / Senior RSO Officer	Development of SOPs, field data QA/QC, field data analysis, progress tracking	Please refer to Section 2.4.3
7	Andreina Triyantari / RSO Officer	Development of SOPs, field data QA/QC, field data analysis, progress tracking	Please refer to Section 2.4.3
8	Siti Nadia / RSO Officer	Development of SOPs, field data QA/QC, field data analysis, progress tracking	Please refer to Section 2.4.3
9	Soni Budiawan / Site Manager	Field data QA/QC	Please refer to Section 2.4.3
10	Pandji A. Fauzan / Biodiversity & Forest Protection Coordinator	Assist and supervise field staff on field data collection and entry, field data QA/QC, field data upload	Please refer to Section 2.4.3
11	Field Staff	Field data collection, field data entry	Various, please refer to Section 2.4.1

RSO = Restoration and Sustainability

3.3.4 Dissemination of Monitoring Plan and Results (CL4.2)

There are three types of stakeholders involved in the project, namely government, local communities, and business entities. For all stakeholders, the summary of project documents, including monitoring plan and results, will be shared and given access to through regular coordination, printed documents at the project offices and village information boards, and online resources through Verra and the project website (www.plumproject.id).

Specifically for communities, the project documents will be shared through village meetings and village information boards. Regular communication will occur during the project lifetime, as the project will closely involve the community in the project activities and monitoring. Formally, at least two village meetings will be conducted annually to disseminate project activities updates and reports.

3.4 Optional Criterion: Climate Change Adaptation Benefits

The project area and adjacent communities in Central Kalimantan are vulnerable to climate change impacts. The project will implement strategies that help local communities, in particular vulnerable groups, and biodiversity adapt to climate change. Overall, the project interventions are expected to increase the resilience of local communities and biodiversity to climate change. The project seeks to be validated to the Gold Level for climate change adaptation benefits.

3.4.1 Regional Climate Change Scenarios (GL1.1)

1) Climate change and climate variability scenarios and impacts

Exposure

Historical and Future Projections

- *Temperature*

Regionally, Indonesia has seen a positive trend in changes in minimum, average and maximum temperatures. Based on Indonesian Meteorological, Climatological, and Geophysical Agency (BMKG) observation data historically observed from 1981 to 2018, it shows a trend of increasing temperature of 0.03°C every year.[77] Future projections in the Indonesia Climate Change Sectoral Roadmap (ICCSR) 2010[78] were obtained from GCM (global climate model) output analysis. The projected upward trend of the Indonesian region's temperature in Kalimantan, following the global trend, is 1°C for 2020-2050 period and 1.5°C - 3°C for 2070-2100 relative to the baseline period of 1961-1990.[79] According to this analysis, there are higher probabilities for higher temperature increase in Kalimantan compared to the national average. Therefore, it is likely that the project zone will experience warming temperatures due to climate change in the order of an estimated 1°C for 2020-2050 and 1.5°C - 3°C for 2070-2100.

- *Precipitation*

Based on BMKG observation data from 1981 to 2018, in general in Indonesia rainfall has seen a positive trend at all levels of rain intensity. The trend equation has a slope value of 0.1149 (intensity of 20 mm/day) which means that rainy days with an intensity of 20 mm/day tend to increase by 0.1149 days every year, or the equivalent of 1.149 more rainy days every decade.[80] The anticipated changes in rainfall patterns across Borneo are strongly influenced by alterations in the monsoon seasons and the region's geographical characteristics. Most parts of Borneo are expected to experience an overall increase in rainfall. Projections suggest that the Southwest monsoon rainfall will be more evenly distributed, while the Northeast monsoon

[77] [BMKG] Meteorological, Climatological, and Geophysical Agency. temperature trend.
[78] https://perpustakaan.bappenas.go.id/e-library/file_upload/koleksi/migrasi-data-publikasi/file/Policy_Paper/synthesis-roadmap__20110217190358__0.pdf
[79] [ICCSR] Indonesia Climate Change Sectoral Roadmap. 2010. Scientific Basis: Analysis and Projection of Temperature and Rainfall
[80] [BMKG] Meteorological, Climatological, and Geophysical Agency. Precipitation trend (in Bahasa Indonesia). [accessed Oct 3, 2023]. precipitation trend.

will be shorter and more intense in the majority of regions.[81] Thus, it is anticipated that the project zone will, overall, experience an increase in mean annual precipitation.

- *Extreme Weather Events (droughts, forest fires)*

Climate change can alter the natural patterns and processes that drive climate variability. In Central Kalimantan, climate variability is influenced by factors such as El Niño/La Niña events, which can lead to changes in precipitation patterns. Climate change can exacerbate these natural fluctuations, leading to more extreme weather events and longer-lasting impacts on the region.[82] Extreme weather events that occur in Indonesia, especially in the Kalimantan region, relate to drought and forest fires. Historical extreme weather that has occurred (1997 and 2015) has been exacerbated by the very strong ENSO and positive IOD phenomena showing an increase in forest fire events in Kalimantan.[83] Increase in drought risk is characterised by an anomalous increase in temperature reaching 0.4°C by September 2023[84] considered as the highest anomalous temperature throughout the observation period since 1991, and occurring longer predicted until early 2024 which is influenced by the El Niño-Southern Oscillation (ENSO) phenomenon and exacerbated by the Indian Ocean Dipole (IOD) phenomenon.[85] It is, therefore, expected that episodes of drought caused by El Niño will increase in the project zone, leading to an increased risk of fires in the degraded peat areas.

- *Sea Level Rise*

Previous research on the analysis of sea level rise in Indonesia used available altimetry satellites to analyse historical, and projected sea level rise in Indonesia. From 1992 to 2022, the Indonesian region experienced an average sea level rise of 4.6 +- 0.4 mm/year.[86]

Table 3-47. Future projection of vertical land measurement of sea level rise in Indonesia[87]

Year	Satellite Altimetry (cm)
2030	16.5 ±1.5
2050	27.5 ±2.5
2080	44.0 ±4.0

[81] Zulfaqar S., *et al*. Multi-variable model output statistics downscaling for the projection of spatio-temporal changes in rainfall of Borneo Island, *Journal of Hydro-environment Research*, Volume 31, 2020, Pages 62-75. https://doi.org/10.1016/j.jher.2020.05.002
[82] Jadmiko SD, *et al*. (2017). Climate Changes Projection for Land and Forest Fire Risk Assessment in West Kalimantan. IOP Conf. Series: Earth and Environmental Science 58 (2017) 012030 https://doi.org/doi:10.1088/1755-1315/58/1/012030
[83] Nurdiati, S., *et al*. (2022). The impact of El Niño southern oscillation and Indian Ocean Dipole on the burned area in Indonesia. Terrestrial, Atmospheric and Oceanic Sciences. 33:16. https://doi.org/10.1007/s44195-022-00016-0
[84] [BMKG] Meteorological, Climatological, and Geophysical Agency. Extreme climate change (in Bahasa Indonesia). [accessed Oct 3, 2023]. Extreme highest temperature
[85] [BMKG] Meteorological, Climatological, and Geophysical Agency. Extreme weather events (in Bahasa Indonesia). [accessed Oct 3, 2023]. Extreme Weather Events ENSO and IOD
[86] [NOAA] National Oceanic and Atmospheric Administration. 2016. Laboratory for Satellite Altimetry: Sea level rise. [accessed Oct 3, 2023]. Laboratory for Satellite Altimetry / Sea Level Rise (noaa.gov)
[87] Triana, K., *et al*. (2020). Sea Level Rise in Indonesia: The Drivers and the Combined Impacts from Land Subsidence. ASEAN Journal on Science & Technology for Development. 37(03):115-121. https://doi.org/10.29037/ajstd.627

Year	Satellite Altimetry (cm)
2100	60.0 ±5.0

The exposure of the coastal zone area to sea level rise has a direct impact on shoreline changes.[88] PT PUM carried out an analysis to detect shoreline changes in the western part where the project is in a coastal zone. The analysis concluded that a total of 104.99 m was lost to coastal abrasion between the period 2010 to 2021, with an average rate of 10.64 m/year. There is also an accretion area of 15.03 m/year. It is noted that the site of coastal abrasion is located in the project zone (Satiruk village), but not in the project area (i.e., not in the area where mangroves will be planted/restored by the project).

Table 3-48. Shoreline Change Analysis in the Western part of PUM from 2010 to 2021

Net Shoreline Movement (NSM)	Average Movement Distance (m)	Positive Distance		Negative Distance	
		Ave (m)	Max (m)	Ave (m)	Max (m)
	-104,99	153,07	482,45	-114,13	-396,33
Shoreline Change Envelope (SCE)	Average Distance (m)	Max Distance (m)		Min Distance (m)	
	149,12	589,73		14,33	
End Point Rate (ERP)	Average rate (m/year)	Accretion (m/year)		Erosion (m/year)	
		Ave	Max	Ave	Max
	(-9,76 +/-0,04)	15,03	49,95	-10,64	-36,9

- *Location specific differences*

While detailed downscaled information is not available for each of the project villages, it is understood that there will be some differences in climate change scenarios for each village. For examples, information from the Climate Information Portal[89] suggests that in Pulau Hanaut Sub-district (western part of the project zone) annual mean temperature will not increase for the period 2011-2040 under Representative Concentration Pathway (RCP) 4.5 scenario. Annual mean precipitation would decrease by 2%. In turn, for Pagatan in Katingan Kuala Sub-district (eastern part), Climate Information Portal data suggests that annual mean temperature would increase by 1% and annual mean precipitation by 2% in the same period, while actual aridity[90] would also increase.

[88] Gao W., *et al.* (2023). Shoreline change due to global climate change and human activity at the Shandong Peninsula from 2007 to 2020. Front. Mar. Sci. 9:1123067. doi: 10.3389/fmars.2022.1123067
[89] SMHI *Climate Information Portal.* Available at: https://climateinformation.org (accessed Jan 21, 2024).
[90] Calculated as mean annual value of the ratio between actual evapotranspiration and precipitation for a 30 years period. https://climateinformation.org

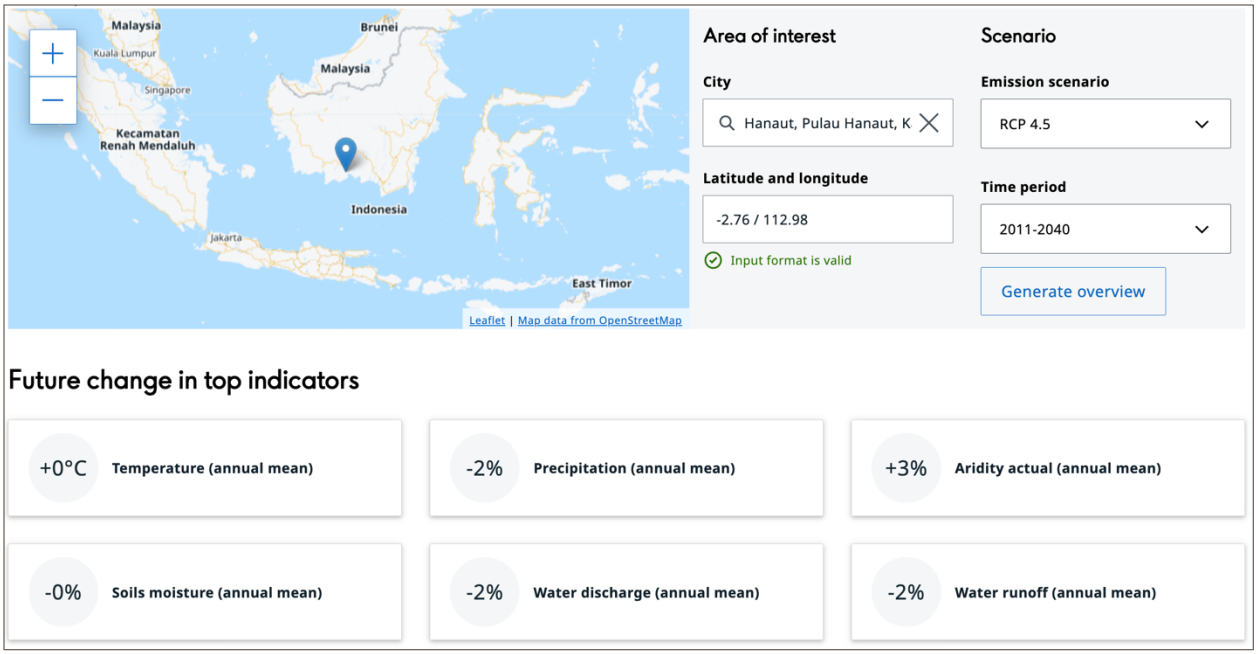


Figure 3-8. Site-specific summary climate report for Pulau Hanaut Sub-district: projected changes for the period 2011-2040, RCP 4.5.[91]

[91] SMHI *Climate Information Portal.* Available at: https://climateinformation.org (accessed Jan 21, 2024).

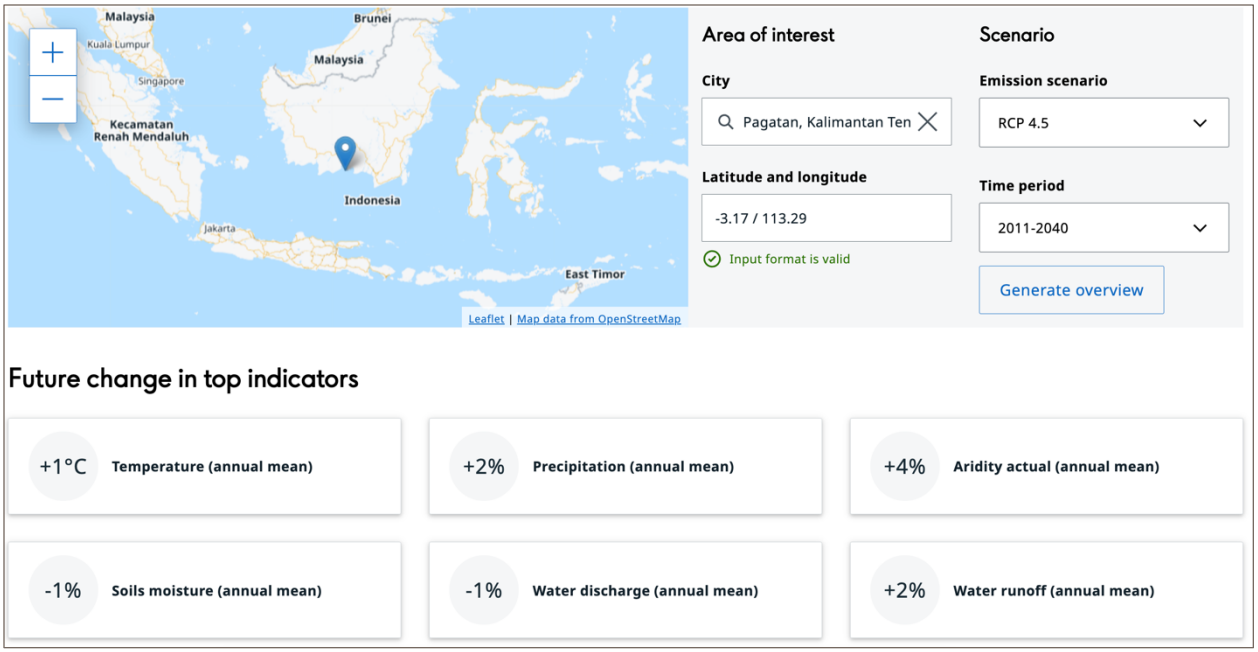


Figure 3-9. Site-specific summary climate report for Pagatan in Katingan Kuala Sub-district: projected changes for the period 2011-2040, RCP 4.5.[92]

In conclusion, overall, the project zone is expected to experience rising temperatures, increased rainfall, and greater variability in rainfall patterns due to changes in the monsoon seasons and geography. Additionally, the region is likely to face further sea level rise and an increase in extreme weather events, particularly droughts leading to an increased risk of fires.

2) Potential changes in the local land use scenario due to climate change

Climate change can affect the local land use scenario in the project area and adjacent local communities in various ways. The expansion of oil palm plantations in the region is one of the major drivers of deforestation and land use change, resulting in the loss of forest cover, biodiversity, and ecosystem services. Climate change can affect the productivity and yield of oil palm plantations, as well as other crops grown in the region, due to changes in temperature, rainfall, and other climatic factors. Changes in precipitation patterns, such as higher precipitation or floods, can cause stress and decrease the production and quality of crude palm oil (CPO).[93] The impacts of climate change can also affect the livelihoods of local communities, such as rice farmers and fishermen, who depend on natural resources and ecosystem services that are affected by climate change and land use change. Therefore, the impacts of climate change may, in the long term, lead to changes in land use such as adopting alternative crops or adding additional planting areas. However, in the short to medium term, it is unlikely that the land use scenarios would change because of the impacts of climate change.

[92] SMHI *Climate Information Portal.* Available at: https://climateinformation.org (accessed Jan 21, 2024).
[93] Paterson RRM, Lima N. Climate change affecting oil palm agronomy, and oil palm cultivation increasing climate change, require amelioration. Ecol Evol. 2017 Nov 30;8(1):452-461. https://doi.org/10.1002/ece3.3610

3.4.2 Climate Change Impacts (GL1.2)

The projected climate changes described above are likely to have an impact on both the conservation status of biodiversity in the project zone and surrounding regions and on the well-being of communities.

Sensitivity

- *Ecosystems and biodiversity*

Habitation loss and fragmentation. Ecosystems and biodiversity in the project region are vulnerable to the impacts of climate change. PT PUM concession is part of the remaining lowland forest of Kalimantan which is a habitat for many threatened species such as orangutan, proboscis monkey and white-bearded gibbon. Forest loss and high levels of habitat fragmentation, exacerbated by the impacts of climate change, threaten the survival of these key species. A study has shown that the Bornean orangutan lost 36% of its habitat between 1973 and 2015 due to deforestation and conversion to oil palm, rubber, timber, and other plantations. Extensive deforestation has resulted in the loss of not only important forest habitat for species, but also the availability of functionally connected habitats.[94] Habitat loss and fragmentation impacts the connectivity of forest species and renders them more vulnerable to climate change due to smaller population sizes, increased isolation, and reduced genetic diversity.[95]

The decline in ecosystem functions and connectivity compromises species' adaptability and resilience in future landscapes under climate change.[96] In turn, the preservation of ecosystem functions and connectivity can contribute to the adaptability and resilience of threatened species, such as orangutans in Kalimantan. Ecosystem functions provide essential resources and services that support the survival and well-being of species. By preserving these functions, species are better able to adapt to changing environmental conditions and maintain their populations. Additionally, connectivity allows species to move and interact with other populations, which can help them adapt to new conditions and maintain genetic diversity. Overall, the preservation of ecosystem functions and connectivity is an important component of conservation strategies for threatened species, as it can help them adapt to the impacts of climate change and maintain their populations. The eastern part of PT PUM concession area is adjacent to the larger forested area of Sebangau National Park to the north. Therefore, protecting and restoring PT PUM's area will increase the connectivity of the forest fragments in the Sebangau landscape (see Figure 3-10).

[94] Ocampo-Peñuela N., *et al*. (2020). Impacts of Four Decades of Forest Loss on Vertebrate Functional Habitat on Borneo. Front. For. Glob. Change 3:53. https://doi.org/10.3389/ffgc.2020.00053
[95] Püttker T., *et al.* (2020). Indirect effects of habitat loss via habitat fragmentation: A cross-taxa analysis of forest-dependent species, Biological Conservation, Volume 241, 2020. https://doi.org/10.1016/j.biocon.2019.108368
[96] Ocampo-Peñuela N., *et al*. (2020).

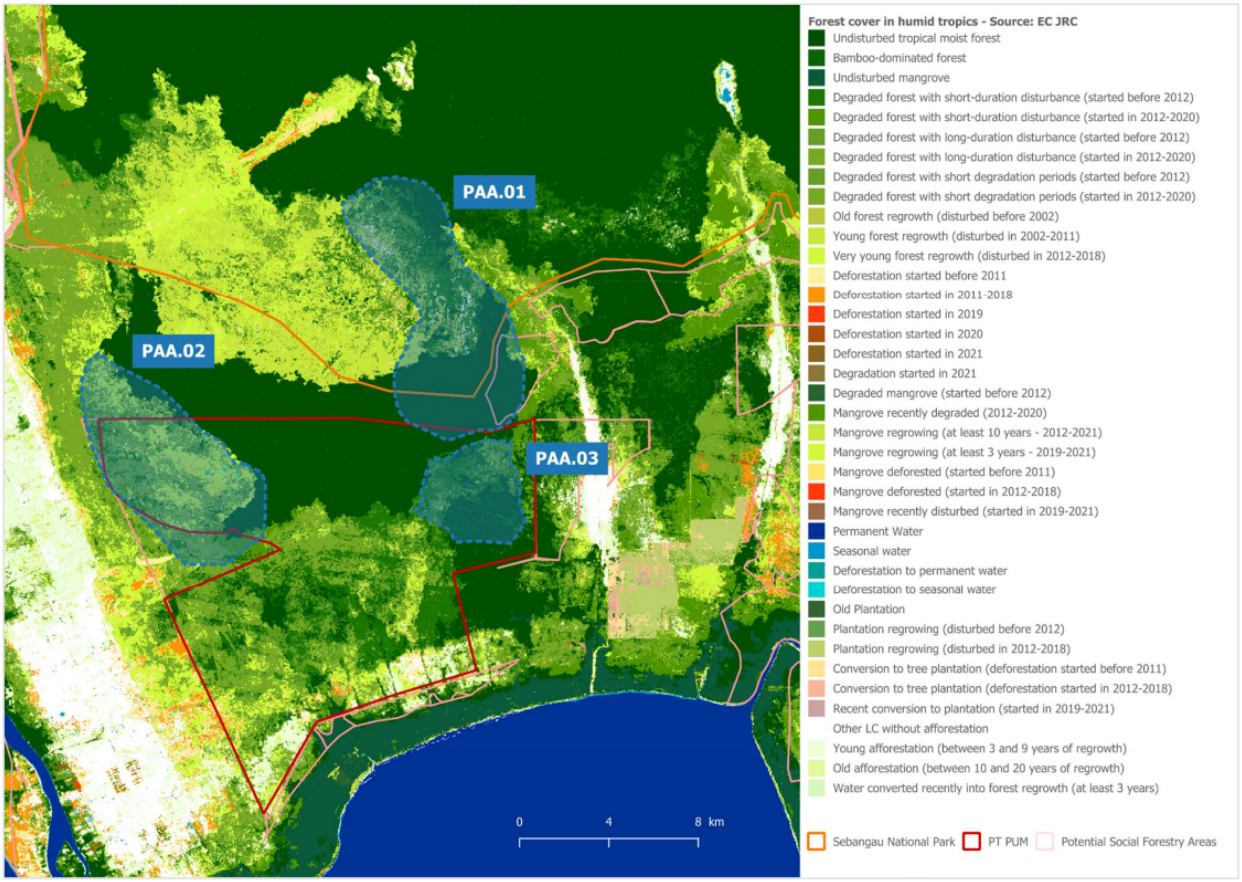


Figure 3-10. Priority Attention Areas (PAA) for critical connectivity linkages between PT PUM concession area and Sebangau National Park.[97]

Changes in phenology. Changes in precipitation patterns and increasing temperatures are expected to impact the phenology and fruiting season in tropical forests. This is likely to lead to reduced fruit availability, affecting orangutan behavior and potentially reducing their reproduction rates due to food scarcity. Furthermore, this phenomenon will also impact other species that depend on tropical forest fruits for food.[98]

Increased risk of fires threatening habitat and species survival. The increase in temperatures and periods of prolonged drought (e.g., due to El Niño) lead to an increased risk of fires in the peatlands of Kalimantan. A study on peatland fire weather conditions in Central Kalimantan, Indonesia, found that high air temperature is one of several fire weather conditions that contribute to the risk of fires[99]. Strong winds that result from the difference in sea and land temperatures further contribute to the spread of fires. For example, during El Niño in 2015, there was an increased record of hotspots in the project zone and project area of PT PUM compared to a non-El Niño year. Additionally, deforestation and climate change have been identified as significant factors in increasing fire risk in Borneo, including Kalimantan, amid a warming

[97] Borneo Nature Foundation (2023). Orangutan Population Survey: Baseline Survey of the Orangutan Population within the PT. Pagatan Usaha Makmur (PUM) Concession.
[98] Numata, S., *et al.* Impacts of climate change on reproductive phenology in tropical rainforests of Southeast Asia. *Commun Biol* **5**, 311 (2022). https://doi.org/10.1038/s42003-022-03245-8
[99] Usup, A., *et al.* Peatland Fire Weather Conditions in Central Kalimantan, Indonesia. *Fire* **2023**,*6*,182. https://doi.org/10.3390/fire6050182

climate.[100] The vulnerability of deforested tropical peatlands to fire emissions is exacerbated by the drainage and desiccation of the surface peat, which makes it highly susceptible to ignition and sustained underground smoldering combustion, particularly in the context of increased air temperature and drier microclimate in deforested landscapes[101]. This directly threatens the habitat of threatened species in the project area, including the three trigger species of the project, the Bornean orangutan (*Pongo pygmaeus wurmbii*), Proboscis monkey (*Nasalis larvatus*), and the Bornean white-bearded gibbon (*Hylobates albibarbis*). Thus, rewetting of peatlands and avoiding further drainage are important measures to mitigate the impacts of climate change on these species by preserving ecosystem integrity and resilience.

Sea level rise. Sea level rise may pose a long-term threat to the mangrove habitat specifically in the western part of PUM concession area. Sea level rise is known to increase coastal erosion, salinity level, and cause inundation which can exceed the salinity tolerance level of mangroves.[102] Although mangroves are known to have the ability to adapt with inundation through the accretion of sediments, a study on the vulnerability of Indo-Pacific mangrove forests to SLR shows that the rate of SLR exceeds the rate of soil surface elevation gain in 69% of the study areas.[103] In addition, coastal abrasion may also be exacerbated by SLR. The historical annual average rate of coastal abrasion in the western part of PUM concession was 10.64 meters inland. The potential negative impact of SLR on coastal habitat will likely affect the species that inhabit the areas, such as the endangered proboscis monkey and the far eastern curlew (*Numenius madagascariensis*), a migratory bird that was found to forage on the mudflat areas of the western part of PUM concession area. Therefore, protecting the remaining mangrove habitat and restoring the degraded areas are critical for the long-term integrity of the habitat and the survival of the species that depend on it.

- *Local communities and livelihoods*

Communities in the project zone, including women and vulnerable groups, rely on natural resources including water for agriculture, non-timber forest products, etc. PT PUM's project zone, which is dominated by rice farming, will suffer from prolonged droughts due to El Niño and high precipitation levels due to La Niña. Crop failure will also potentially increase which leads to increasing levels of poverty in communities who live in the project zone.

Based on Indonesia Statistic Bureau (BPS 2020), the main livelihoods of the communities in the project zone include rice farmers (69.1%), vegetable farmers (12.1%), fishermen (10.1%), fish farmers (3.5%), loggers (1.8%), and NTFPs collectors (3.3%) (Yayasan Puter, 2022). These communities relying on farming and fishing livelihoods are considered more vulnerable to climate change and are more likely to live in poverty. Six villages in the project zone are categorized as underdeveloped villages and over 50% of villagers in the project zone are below the national poverty line of IDR 2,120,371/month per household[104].

[100] Taraka D.-B., *et al*. (2023). Future fire risk under climate change and deforestation scenarios in tropical Borneo. *Environ. Res. Lett.* 18 024015. https://doi.org/10.1088/1748-9326/acb225
[101] Nikonovas, T., *et al.* Near-complete loss of fire-resistant primary tropical forest cover in Sumatra and Kalimantan. *Commun Earth Environ* **1**, 65 (2020). https://doi.org/10.1038/s43247-020-00069-4
[102] Krauss, K.W., *et al*. (2014), How mangrove forests adjust to rising sea level. New Phytol, 202: 19-34. https://doi.org/10.1111/nph.12605
[103] Lovelock, C. E., *et al.* (2015). The vulnerability of Indo-Pacific mangrove forests to sea-level rise. USGS Staff -- Published Research. 988. https://digitalcommons.unl.edu/usgsstaffpub/988
[104] In 2021, the national poverty line was set at a per capita expenditure of Rp 450,185/month (approx. USD 28/month) or Rp 2,120,371 (USD 132)/month per household (4.71 members per household).
Poverty Line (Rupiah/Kapita/Month) By Province and Area - BPS-Statistics Indonesia and Indonesia Poverty Profile - BPS-Statistics Indonesia (accessed Jan 30, 2024)

Farmers' average income in Katingan Kuala Sub-district is around IDR 1,800,000/month[105]. Rice farmers income in the project villages is around IDR 446,854/month (Yayasan Puter, 2022).

Agriculture is considered a sector that is vulnerable to climate change. The sector is vulnerable to increases in temperature, increased variability in rainfall, and periods of drought. It is often the poor who are most vulnerable to climate change given a lack of diversification and lack of access to financial resources that would help them recover from shocks and stresses. Climate change impacts can have a disproportionate effect on women, as they often bear the brunt of the consequences of climate change, such as increased workloads, food insecurity, and reduced access to resources.[106,107]

Climate change is likely to affect rice growing areas in Central Kalimantan through long-term changes in sea level rise, alterations in rainfall patterns, and increases in temperature. Rice production is vulnerable to changes in the onset and duration of the wet season, with delays in monsoon and increased floods and droughts impacting production. Climate change can lead to a decline in rice yield due to temperature increments and changes in rainfall patterns, potentially increasing the risk of food insecurity.[108]

Furthermore, coastal communities are threatened by abrasion, inundation, and high waves driven by sea level rise, which can lead to flooding. High waves can threaten small boats and decrease production of local capture fisheries.[109] Additionally, long-term changes in sea levels, alterations in rainfall patterns, and increases in temperature can affect inland fisheries, potentially leading to changes in water quality and fish habitats, ultimately impacting fish production.[110]

Adaptive Capacity

Overall, adaptive capacity of local communities in the project zone is still limited. Factors contributing to the adaptive capacity of the communities are summarized below.

- *National and sub-national climate change policies and strategies*

Since 2011, Indonesia has set up several measures for mitigating the impacts of climate change at the national level. The country has integrated climate change adaptation into its development planning, as evidenced by the National Adaptation Plan process and the incorporation of CCA into the fourth Medium Term Development Plan (RPJMN) from 2020 to 2024. At the provincial level, the Governor of Central Kalimantan has issued several regulations regarding climate change adaptation and mitigation.

[105] Mustapa, L.A., *et al*. 2019. Impact and sustainability of the rice printing program in district Katingan, Central Kalimantan Province (in Bahasa Indonesia). Analisis Kebijakan Pertanian. 17(2):123-137. http://dx.doi.org/10.21082/akp.v17n2.2019.123-137
[106] Marlina, S., *et al.* (2021). Gender role in climate change adaptation on the peat swamp ecosystem in Pulang Pisau Regency Central Kalimantan. *IOP Conf. Ser.: Earth Environ. Sci.* **716**. https://doi.org/10.1088/1755-1315/716/1/012090
[107] Marlina, S., *et al.* (2020). The impact of climate change on community, culture, and gender in Central Kalimantan. https://doi.org/10.1051/e3sconf/202021101001
[108] Andrianto A., *et al*. Evaluating the effect of climate change on rice production in Indonesia using multimodelling approach, Heliyon, Volume 9, Issue 9, 2023. https://doi.org/10.1016/j.heliyon.2023.e19639
[109] Ministry of National Development Planning/Bappenas (2021). Climate Resilience Development Policy 2020-2045.
[110] Estiningtyas W., *et al*. Analysing food farming vulnerability in Kalimantan, Indonesia: Determinant factors and adaptation measures. PLoS One. 2024 Jan 3;19(1):e0296262. https://doi.org/10.1371/journal.pone.0296262

- *Community-level adaptation plans*

At the community level, the GoI promotes a national approach to mitigate climate change namely Kampung Iklim. The objectives of this approach are to promote mitigation and adaptation to climate change by the community at the village level, increase the capacity and participation of the community to mitigate climate change; and to support national programs on climate change adaptation and mitigation. However, this approach is still limited in terms of participation since not all the villages in Indonesia participate in this program. The villages in the project zone currently do not participate in the program.

- *Access to weather/climate information/early warning*

BMKG has established a system for weather forecast, early warning, and fire monitoring[111]. However, this system is not yet widely disseminated to the grassroots level. The information is not yet commonly used for agronomy decision making such as about planting start date and pest management.

- *Farmer and community organization*

Agriculture in Katingan Kuala Sub-district is one of the biggest economic sectors that provides the largest livelihood opportunity for around 65.2% of the population[112]. There are several existing farmer groups and farmer organizations in the project zone that have been promoted by government agencies and other entities. The presence of these farmer groups and organizations can contribute to the adaptive capacity of the communities. By leveraging the knowledge and expertise of these groups, the community can better respond to the challenges posed by climate change and other environmental pressures.

- *Existing adaptive practices*

The Government already established a group of volunteers called *Masyarakat Peduli Api* (Fire Care Community) in each village. However, due to limited funds, these groups are often inactive. The main objective of these groups is to assist the Government when fires occur in villages that are close to the forest area. Other existing adaptive practices at the community level include home gardens and intercropping in rice fields, which helps diversify community livelihoods and food and income sources.

- *Access to finance*

Access to finance remains a significant barrier for communities to become resilient to climate change, particularly for farmers who often rely on high-interest loans from middlemen. This lack of financial support limits livelihood options, especially for poor families whose businesses are not bankable.

3.4.3 Measures Needed and Designed for Adaptation (GL1.3)

As described in the Theory of Change in Section 2.1.11, the project aims to conserve the remaining forest, restore ecosystem function, protect biodiversity, and improve the well-being of communities to become

[111] BMKH 3-Days Weather Early Warning https://www.bmkg.go.id/cuaca/prakiraan-cuaca-tigaharian.bmkg?lang=EN Fire Danger System on Forest Fire and Other Land Use [SPARTAN] by BMKG https://spartan.bmkg.go.id/peta-interactive/

[112] Yayasan Puter (2022). Preparation of Empowerment Program in Affected Livelihood Groups Ecosystem Restoration Project PT. Pagatan Usaha Makmur (PT. PUM) (in Bahasa Indonesia)

resilient to climate change. Among others, it aims to achieve improved ecosystem quality and resilience, biodiversity conservation and protection, and sustainable, resilient livelihoods.

To achieve these benefits of increased resilience and adaptation of ecosystems, biodiversity, and livelihoods to climate change, the project will implement the following measures that will assist communities and biodiversity to adapt to the projected climate change impacts. These activities have been integrated into the project's causal model as reflected in its Theory of Change.

Ecosystems and Biodiversity

- *Conservation and restoration of habitats of threatened species and their connectivity*

The project will enhance the resilience of ecosystems and biodiversity through conservation and restoration of peatlands and mangrove forests. These ecosystems naturally regulate hydrological flows, buffer against coastal flooding, filter freshwater lenses, and reduce fire risk – functions that will be increasingly important under climate change. In particular, the project will contribute to the adaptive capacity of the three trigger species (orangutan, proboscis monkey and white-bearded gibbon) by preserving and increasing habitat connectivity. The project will avoid the conversion of the project area to oil palm plantation and will restore the degraded ecosystems and habitat.

Specifically, under Output 1.4.2, the project will implement mangrove restoration and will establish sediment traps to prevent coastal abrasion in the mangrove area. These activities will contribute to the preservation of habitat for the endangered Proboscis monkey. Under Output 1.4.4, the project will implement planting and assisted natural regeneration of degraded peatland to restore some of the degraded peat forest. This will contribute to the preservation and increase of habitat for the endangered Bornean orangutan and other threatened species present in the project area and surrounding region. In its restoration and reforestation efforts, the project will only use native tree species and will prioritize species that are adapted to climate change. For example, the Balangeran tree (*Shorea balangeran*) has been found to have relatively high survival rates and tolerance to saturated conditions, indicating a degree of resilience to environmental stressors such as flooding.[113]

- *Fire prevention*

Under Outcome 1.2, the project will implement various fire prevention and management activities that will contribute to the preservation of the mangrove and peat ecosystems that provide habitat for threatened species. As part of the forest fire mitigation, PT PUM will install an Automatic Weather Station (AWS) to measure and monitor weather variability such as; precipitation, temperature, soil moisture, and water level and will establish a fire danger rating system (FDRS) for the project's early warning system. Furthermore, the project will establish a fire patrol team, which will collaborate closely with the community firefighting team under Output 3.2.1 (*Masyarakat Peduli Api*). The project will reactivate these groups of volunteers and will provide them with the necessary skills for fire suppression. The project will also provide firefighting equipment and fire watch tower infrastructure. Finally, the project will plant trees species along project boundary of the concession that serve as firebreak trees in peatland areas across Kalimantan.

[113] Tata HL, et al. (2022). Flooding tolerance of four tropical peatland tree species in a nursery trial. PLOS ONE 17(4): e0262375. https://doi.org/10.1371/journal.pone.0262375

- *Peat rewetting*

Under Output 1.3.1, to reduce vulnerability of the peat ecosystem to climate change and in particular episodes of droughts under El Niño while also reducing greenhouse gas emissions, the project will implement canal blocking and peat rewetting activities. Under Output 1.3.2 the peat water level will be monitored. This will support adaptive capacity by maintaining peatland ecosystem services and ecological structure and functions.

- *Biodiversity conservation and monitoring*

Under Outcome 2.1, the project will implement biodiversity conservation and monitoring activities. In particular, it will establish patrol teams and will adopt the SMART Patrol System to collect and monitor data on the three trigger species and biodiversity in general in the project area. This will ensure that the project identifies any threats to biodiversity, monitors the effectiveness of its conservation strategies, and is able to make adjustments as needed and be adaptive to change.

Local Communities

- *Livelihood diversification and other adaptive practices*

The project will implement several strategies to diversify livelihoods and income sources and implement other adaptive practices related to community livelihoods. Under Output 3.1.1 the project will develop alternative, resilient livelihoods for affected communities, in particular women and vulnerable groups such as the poor. It is expected that this will increase the adaptive capacity of local communities to climate change. Initial options for sustainable livelihood development have been identified in consultation with local communities and include agroforestry, mangrove honey, local coffee, duck and chicken rearing, and small-scale fishponds. The activities cover training, start-up capital, and technical assistance. When selecting agroforestry crops in consultation with local communities, the project will take into account climate change considerations building on both scientific and local knowledge. For example, tree species will be selected that are resistant to flood and drought. The project will also build on existing adaptive practices at the community level such as home gardens and intercropping in rice fields, which helps diversify community livelihoods and food and income sources.

Under Output 3.1.3, the project will help increase access to marketing of agricultural products. The project will support enhanced marketing and market access for agricultural products such as honey and coffee. This will enable local communities to increase and diversify their income sources.

Under Output 3.2.2 the project will promote sustainable, resilient agricultural practices. Best practices will be introduced such as crop rotation, integrated pest management, agroforestry, and tillage management. This will support the ability of the agricultural system to adapt to accelerating environmental change and will enhance resilience to droughts, pests, and other climate change impacts.

Finally, as part of the adaptive management approach, the project will regularly discuss climate change impacts with local communities and identify additional measures that can be integrated into the project activities to ensure that they are adaptive to climate change.

- *Farmer and community organization*

The project will also contribute to the adaptive capacity of local communities by strengthening community organizations such as farmers groups and women's groups. PT PUM will assist communities in establishing micro, small, and medium enterprises (MSMEs) and women's groups as an additional source of family income. It is expected that this increased community organization will enhance the ability of local communities to generate, receive, and disseminate knowledge and information in support of appropriate adaptation options and influence their capacity to adapt to changing shocks, stresses and trends.

- *Access to weather/climate information/early warning*

The information provided by the AWS and FDRS systems will be published for the community to increase their awareness of climate change issues.

- *Access to finance*

Under Output 3.1.2 the project will enhance access to financial resources through a revolving fund mechanism that helps households, especially vulnerable groups, develop sustainable alternative livelihoods and income sources. A revolving fund will be made available to local livelihood groups, including women's groups, and/or MSMEs. The targeted groups of the program are low-income households, women's groups, and villagers in general. It is expected that these activities will contribute to strengthening the resilience of local communities to climate change.

Indicators for Adaptation Benefits

The following indicators for adaptation benefits for biodiversity and communities have been incorporated into the monitoring plan (Table 3-49). As described in Sections 4.2.1 and 4.4.1, these benefits will be monitored annually as part of the project's monitoring plan. The project's annual community impact assessment will include an evaluation of the impacts by the affected communities through community meetings and interviews. In this way, community feedback will be incorporated through participatory monitoring to evaluate the effectiveness of adaptation measures.

Table 3-49. Climate Impact Drivers (CIDs), their potential impacts on the projects, and proposed adaptation options with indicators

CIDs	Potential Impacts	Adaptation Option	Adaptation Indicator
1. Increased mean air temperature and extreme heat[114]	Habitat loss and fragmentation/loss of connectivity posing a threat to biodiversity (negative impact)	- Protect and restore remaining habitats of threatened biodiversity	Impact Indicator 2) *- Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario* *- Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario* Output 2.1.3 Indicator 2)

[114] [BMKG] Meteorological, Climatological, and Geophysical Agency. Extreme climate change (in Bahasa Indonesia). [accessed Oct 3, 2023]. Extreme highest temperature

CIDs	Potential Impacts	Adaptation Option	Adaptation Indicator
			Population density estimate of three trigger species (orangutan, gibbon, proboscis monkey)
	Increased risk of fires (negative impact)[115]	- Rewetting of peatlands (with canal blocking) - Water table monitoring - Establishment of fire breaks and fire towers - Regular fire patrols - Availability of fire-fighting equipment - Implementation of innovative solutions such as Development of Automatic Weather Station (AWS), Fire Danger Rating System (FDRS), drones, and smart patrol - Establishing community fire group (Masyarakat Peduli Api)	Output 1.2.2 Indicator 4) *Number of fire hotspots in the project area*
	Reduced survival rate and growth rate of seedlings in ARR activities (negative impact)[116]	- Select tree species adapted to climate change[117]; plant diverse species	Output 1.2.3 Indicator 4) *Average survival rate of planted seedlings (monitored)*
	Increased occurrence of pests and diseases in forests (negative impact)[118]	- Select tree species that are resistant to pests or diseases; plant diverse species	Outputs 1.4.1 and 1.4.3 Indicator 3) *Number of seedlings produced annually (per species)*
	Increased occurrence of pests and diseases in agricultural activities (negative impact)[119]	- Pest and disease prevention and early warning - Implement best practices of Integrated Pest Management (IPM) in collaboration with	Output 3.2.2 Indicator 4) *Occurrence of pest and disease in agricultural activities (monitored)*

[115] Usup, A., *et al*. Peatland Fire Weather Conditions in Central Kalimantan, Indonesia. Fire 2023,6,182. https://doi.org/10.3390/fire6050182

[116] Ernesto I. B., et al. Seed fate, seedling establishment and the role of propagule size in forest regeneration under climate change conditions, Forest Ecology and Management, Volume 503, 2022. https://doi.org/10.1016/j.foreco.2021.119776.

[117] For example, the Balangeran tree (*Shorea balangeran*) has been found to have relatively high survival rates and tolerance to saturated conditions, indicating a degree of resilience to environmental stressors such as flooding. Tata HL, et al. (2022). Flooding tolerance of four tropical peatland tree species in a nursery trial. PLOS ONE 17(4): e0262375. https://doi.org/10.1371/journal.pone.0262375

[118] Pawson, S., et al. Plantation forests, climate change and biodiversity. Biodiversity and Conservation (2013) 22: 1203–1227.

[119] Raza A., *et al*. Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review. Plants (Basel). 2019 Jan 30;8(2):34. doi: 10.3390/plants8020034. PMID: 30704089; PMCID: PMC6409995.

CIDs	Potential Impacts	Adaptation Option	Adaptation Indicator
		agricultural extension staff[120]	
	Reduced availability of fish (freshwater and sea)[121] [122]	- Planting mangrove forest as fish breeding ground[123] - Rewetting of peatlands (with canal blocking)	Output 1.4.2 Indicator 1) *Deforested/degraded mangrove area planted or undergoing restoration (in hectares)* Output 1.3.2 Indicator 1) *Peat water level*
2. Agricultural and ecological drought	Increased risk of fires (negative impact)	As above	As above
	Reduced yields, crop failure (negative impact)[124]	- Drought-tolerant or short-duration rice varieties[125] - Select tree species adapted to climate change for agroforestry activities - Improved access to weather forecasts; timing of harvest	Output 3.2.2 Indicator 2) *Number of farmers (m/f) that have adopted sustainable agricultural practices* (and qualitative description of these activities)
3. Relative sea level	Coastline erosion may affect coastal communities and mangrove restoration efforts (negative impact)	- Sediment traps - Regular monitoring of erosion	Output 1.4.2 Indicator 7) *Coastal abrasion rate (monitored)*
	Increased salinity levels may affect crop yields	- Salt-tolerant crop varieties in collaboration with agricultural extension staff	n/a (may be added at a later stage)
4. Coastal flood[126]	Increase in frequency and extremity of flood events (negative impact)	- Protect and restore mangroves as buffers for flood and storm control	Output 1.4.2 Indicator 1) *Deforested/degraded mangrove area planted or undergoing restoration (in hectares)*
5. Increase in mean precipitation	Increased flood risk Increased crop failure	- Select stress-tolerant crop and tree species[127]	Output 3.2.2 Indicator 1) *Number of farmers groups receiving technical assistance for sustainable agricultural*

[120] National Climate Resilience Development (2021)
[121] Thornton, *et al*. (2018): Peatland fish of Sebangau, Borneo: diversity, monitoring and conservation. Mires and Peat, 22(04), 1-25.
[122] Yamamoto, Y. (2023). "Living under ecosystem degradation: Evidence from the mangrove–fishery linkage in Indonesia", Journal of Environmental Economics and Management, Elsevier, vol. 118(C).
[123] Arceo-Carranza, D., *et al*. (2021). Mangroves as Feeding and Breeding Grounds. In: Rastogi, R.P., Phulwaria, M., Gupta, D.K. (eds) Mangroves: Ecology, Biodiversity and Management. Springer, Singapore. https://doi.org/10.1007/978-981-16-2494-0_3
[124] Raza A., *et al*. (2019). Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review. Plants (Basel). Jan 30;8(2):34. https://doi.org/10.3390/plants8020034.
[125] National Climate Resilience Development (2021)
[126] Flooding driven by episodic high coastal water levels that result from a combination of relative sea level rise, tides, storm surge.
[127] Raza A., *et al.* (2019). Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review. Plants (Basel). Jan 30;8(2):34. https://doi.org/10.3390/plants8020034.

CIDs	Potential Impacts	Adaptation Option	Adaptation Indicator
			practices (and qualitative description of activities implemented)
6. Total monsoon-season rainfall	Increased flood risk (West Monsoon) Increased drought risk (Northeast Monsoon)[128] Increased crop failure	- Select stress-tolerant crop and tree species	As above
7. Heavy precipitation and pluvial flood	Increased flood risk Increased crop failure	- Select stress-tolerant crop and tree species	As above
8. Combination of all the above climate risks/ hazards	Reduced GHG emission reduction potential that may affect the financial viability of the project (negative impact)	- Insurance against losses (e.g., fires) - Adaptive management	n/a (may be added at a later stage)
	Increased vulnerability of local communities, and in particular women and vulnerable groups (negative impact)	- Adaptive management	Qualitative description of community meetings to review implementation plan
		Deployment of innovative solutions with local communities (including revived traditional practices), e.g.: - Planting of species that improve breeding ground for fish, - Agroforestry, - Organic fertilizer[129], - Diversification of income sources, - Early warning systems, - Involvement of university students to bring innovative approaches, - etc.	Qualitative description of activities implemented under Outcome 3.1
		- Strengthening community and farmer organization and access to knowledge and information	Output 3.2.1 Indicator 1) *Number of Masyarakat Peduli Api (Fire Care Communities) re-established* Output 3.2.1 Indicator 2) *Number of trainings implemented*

[128] Yananto, A., *et al*. (2016). Analysis of the event of El Nino and its influence on rainfall intensity in the Jabodetabek area (Case Study: Peak Period of the Rainy Season 2015/2016) (in Bahasa Indonesia). Journal of Weather Modification Science & Technology. 17(2) 2016: 65 - 73.
[129] National Climate Resilience Development (2021)

CIDs	Potential Impacts	Adaptation Option	Adaptation Indicator
		- Empowerment and capacity development of women and vulnerable groups including the poor	Impact Indicator 6) *Number of people (m/f) expected to have improved livelihoods or income generated as a result of project activities* Output Indicator 3.1.1 Indicator 3) *Number of women's groups established and assisted by the project*
		- Access to finance (revolving fund)	Output 3.1.2 Indicator 1) *Number of livelihood groups that benefit from the revolving fund per 3 years*

4 COMMUNITY

4.1 Without-Project Community Scenario

4.1.1 Descriptions of Communities at Project Start (CM1.1)

Administratively, the project area lies in two regencies, East Kotawaringin and Katingan. In East Kotawaringan Regency there is only one village located in the project zone, namely Satiruk Village, part of Pulau Hanaut Sub-district. In Katingan Regency, 12 villages of Katingan Kuala Sub-district are included in the project zone. Historically, the project zone area was the territory of the Banjar Sultanate before the Dutch East Indies Colonial Period. During the Indonesian independence period, this area was included in East Kotawaringin Regency, until 2002, when the region was divided into three regencies, namely East Kotawaringin Regency, Katingan Regency, and Seruyan Regency.

The formation of settlements in the project zone area occurred in two phases. The first phase was the formation of settlements by Banjarese people who migrated from South Kalimantan Province to seek new locations for fishing and timber. In the second phase, transmigration villages were formed in the 1980s by the Indonesian government. The majority of the transmigrants came from Central Java, East Java, and West Java, although there was also a small number of local transmigrants who came from areas around Central Kalimantan Province. The following villages are classified as transmigrant and non-transmigrant or local villages (Table 4-1).

Table 4-1. Villages around the project areas distributed by village history

Transmigrant Villages	Local Villages
Bangun Jaya	Selat Baning
Singam Raya	Kampung Keramat
Bumi Subur	Kampung Tengah
Subur Indah	Satiruk
Jaya Makmur	Pagatan Hilir
Makmur Utama	Pagatan Hulu
	Sungai Kaki

4.1.1.1 Well-Being Information

Livelihood

The livelihoods in the villages can be categorized into two main groups: transmigrant villages are characterized by wet-rice farmers, while local villages have diverse livelihoods with the primary livelihood being fishermen. The main paddy producing transmigrant villages are Makmur Utama, Subur Indah, and Jaya Makmur. Paddy rice in transmigrant villages became the main livelihood in accordance with the development planning of the Indonesian government during the early development of transmigration villages in the 1980s. The success of paddy field development has made these villages a source of rice supply in Katingan Regency and beyond; these villages are known as the rice barns of Katingan Regency.

Livelihoods in the local villages are dominated by fishermen, although there are some villages with rice paddies such as Kampung Tengah and Kampung Keramat. Other occupations found in project zone villages are field farmers, garden farmers, craftsmen, traders, laborers, teachers, farmers (goats, cows, chickens and ducks), loggers, and honey seekers. Some occupations affected by the project are loggers,

honey seekers, fishermen, and hunters. The following table summarizes the main livelihoods in the villages of the project zone.

Table 4-2. Major livelihoods in villages in the project zone.

Villages	Major Livelihood	Interaction to Project Area	Interaction Level	Notes
Katingan Kuala Sub-district				
Pagatan Hilir (urban)	Sea fishermen	-	Low	Location close to the sea
Pagatan Hulu (urban)	Diverse: sea fishermen, retailers, employees	-	Low	Location close to the sea. Has a main market
Jaya Makmur	Paddy field farmers	Hunters, loggers	Low	One of the largest vegetables producers
Subur Indah	Paddy field farmers	-	Low	One of the main paddy producers
Kampung Keramat	Diverse: 90% traditional paddy farmers (1 harvest annually)	River fishermen, loggers, hunters, honey seekers	Medium	
Singam Raya	Diverse: 75% farm workers	River fishermen, loggers, hunters	Low	
Bangun Jaya	Diverse: 50% oil palm plantation workers	Loggers	Low	Mixed plantations of rubber, coffee, and durian
Kampung Tengah	Diverse: 25% paddy farmers	River fishermen, loggers, hunters, honey seekers	Medium	
Sungai Kaki	River fishermen	River fishermen, loggers, hunters, honey seekers	Low	
Selat Baning	Diverse: 40% farmers	Honey seekers, fishermen, loggers, hunters	Low	
Makmur Utama	Paddy field farmers	River fishermen	Low	One of main paddy producers & self-sufficiency
Bumi Subur	Paddy field farmers	River fishermen	Low	Area of new paddy fields as part of the SIMURP program
Pulau Hanaut Sub-district				
Satiruk Village	Sea fishermen	-	Low	Location close to the sea

Source: Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project, PT.PUM (Yayasan Puter, 2022)

Income

The majority of the villagers in the project zone are engaged in multiple livelihoods, meaning that they are not dependent on one livelihood. This provides additional income for each household, increasing the average monthly household income. The average monthly household income reached IDR 1,886,397/month, with the lowest income in Satiruk Village averaging IDR 266,667/month and the highest income in Subur Indah Village averaging IDR 2,900,000/month. This income calculation is based on several

livelihoods that provide income to households. These livelihoods include rice farmers, vegetable farmers, fishermen, fish farmers, and collectors of wood and non-timber forest products (NTFPs). The following table shows the average income of all villages in the project zone.

Table 4-3. The average income per village in the project zone.

No	Village	Average income (IDR)
1	Bangun Jaya	1,472,000
2	Singam Raya	1,842,857
3	Bumi Subur	2,319,444
4	Subur Indah	2,900,862
5	Jaya Makmur	1,806,716
6	Makmur Utama	2,273,214
7	Selat Baning	2,448,718
8	Kampung Keramat	2,170,213
9	Kampung Tengah	1,363,279
10	Satiruk (Cemeti)	266,667

Source: Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project, PT.PUM (Yayasan Puter, 2022)

Access to clean water and sanitation is a major life support factor in the villages in the project zone, which is dominated by river and peat ecosystems. Access to clean water and good sanitation is a challenge because the characteristics of rivers and peat make it difficult for residents to get good quality water. Most villagers utilize refill water, rainwater and river water for drinking water. However, villagers face difficulties in obtaining refill water because the villages are only accessible by river, which makes refill water expensive. Rainwater is the main source for cooking and bathing.

Regarding bathrooms and toilets, the majority of villagers use their own bathrooms in their homes. However, there are still many residents who use the river for bathing and as a toilet. Based on the project survey, 22.7% of the population still use the river as a toilet. This practice is an example of unhealthy sanitation practices and can have an impact on public health and damage the water ecosystem.

Education

The following table shows the total educational facilities in the project zone between 2010 and 2020. In the last 10 years, there has been an increase in the number of schools. Namely, six elementary schools, two junior high schools, and three senior high schools have been added. The ease of reaching public education facilities is the main factor determining educational attainment in the villages. There are two villages with limited access to basic and mid-level education, namely Sungai Kaki and Makmur Utama village. All villages have limited access to higher education.

Table 4-4. Number of schools per village within the project zone between 2010 and 2020.

No	Village	Elementary School (2010)	Elementary School (2020)	Junior High School (2010)	Junior High School (2020)	Senior High School (2010)	Senior High School (2020)
1.	Pagatan Hilir	2	2	0	0	0	1
2.	Pagatan Hulu	2	3	2	2	1	2
3.	Jaya Makmur	2	3	1	1	0	1
4.	Subur Indah	2	2	1	1	0	0

No	Village	Elementary School (2010)	Elementary School (2020)	Junior High School (2010)	Junior High School (2020)	Senior High School (2010)	Senior High School (2020)
5.	Kampung Keramat	2	2	0	0	0	0
6.	Singam Raya	2	2	0	0	0	0
7.	Bangun Jaya	2	2	0	0	0	0
8.	Kampung Tengah	2	2	0	1	0	0
9.	Sungai Kaki	1	2	0	0	0	0
10.	Selat Baning	1	1	0	0	0	0
11.	Makmur Utama	2	2	0	0	0	0
12.	Bumi Subur	2	1	0	0	0	0
13.	Satiruk	1	4	0	1	0	0
	Total	**21**	**27**	**4**	**6**	**1**	**4**

Source: Statistic Report of Katingan Kuala Sub-district and Pulau Hanaut Sub-district 2010 and 2020 (BPS)

Health

The table below details the number of healthcare facilities and personnel in the project area. Healthcare facilities include public health centers (Puskesmas) or auxiliary health centers (Pustu) and integrated service posts (Posyandu). If a village has a public health center, there will not be an auxiliary health center, and vice versa. An integrated service post is a healthcare community basis run by volunteers called village health workers or cadres. The services of integrated service posts include mother and child health monitoring, socialization of birth control, child immunization, and other simple community health monitoring. Each village has at least one healthcare facility and each village's health facilities are supported by healthcare professionals. The nearest hospitals are in Sampit, Kasongan and Banjarmasin, and it takes 5-7 hours to reach them by boat.

Table 4-5. Number of healthcare facilities and workers in each village around project zone.

No	Village	Public Health Center	Auxiliary Health Center	Integrated Service Post	Others	Healthcare Workers
1.	Jaya Makmur	1	-	-		1 doctor 1 midwife 4 registered nurses 3 traditional midwives
2.	Subur Indah	-	1	-		1 midwife
3.	Kampung Keramat	-	1	2		1 midwife
4.	Singam Raya	-	1	2		1 pustu midwife
5.	Bangun Jaya	-	1	1		1 public health center helper midwife 2 midwife practice 1 registered nurse 5 traditional midwives 3 posyandu cadres
6.	Kampung Tengah	-	1	1	1 polindes	1 midwife
7.	Selat Baning	-	1	-		1 midwife 3 posyandu cadres 1 traditional midwife
8.	Makmur Utama	-	1	1	1 polindes	1 midwife 3 posyandu cadres

No	Village	Public Health Center	Auxiliary Health Center	Integrated Service Post	Others	Healthcare Workers
9.	Bumi Subur	-	1	1		1 midwife
10.	Satiruk	-	1	-	1 polindes 1 midwife house	1 nurse 10 posyandu cadres 5 traditional midwives

Polindes = *Pondok Bersalin Desa* (Village Maternity Clinic)
Source: Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project, PT.PUM (Yayasan Puter, 2022)

4.1.1.2 Community Characteristics

Culture and Traditions

There are two main ethnic groups in the project zone: the Banjarese and the Javanese. The Banjar ethnic group originates from southern Kalimantan; its history comes from the Banjar Kingdom in the Martapura and Barito River areas. The Banjarese are known for their hardworking and diligent nature. They are also widely known as successful traders in the regions of southern and central Kalimantan. The language used in daily conversation is Banjar, while to communicate with others they use Indonesian.

The Banjarese in certain locations still apply traditional customs and culture in their daily lives. One of the traditional ceremonies that is still carried out is Ngaju, a traditional ceremony in Banjar society that involves activities such as cleaning the village, purifying river water and honoring ancestors. In weddings, the Banjarese still use traditional clothing called Baju Bodo for women and Baju Kurung for men. Another cultural treasure of the Banjar is a record book of the Banjar people of the past called Hikayat Banjar. This book contains heroic, mythological and historical stories of the Banjar Kingdom.

The Javanese are one of the most dominant ethnic groups in Indonesia, originating from the island of Java. The transmigration program of the Indonesian government has contributed to the broad distribution of the Javanese population in the country. In daily activities the language used is Javanese while to relate to others they use Indonesian. The richness of Javanese culture is reflected in traditional arts such as wayang kulit, wayang orang, and gamelan music. The Javanese batik motif which is Indonesia's national dress has been designated as a world cultural heritage by UNESCO.

History and Mythology

The Banjarese have a written cultural heritage in the form of the Banjar Hikayat. One of the contents of this hikayat is the history of the regions around South Kalimantan and Central Kalimantan. In the Banjar Hikayat, it is told that Katingan Regency was included in the Banjar Kingdom's territory in the 17th century. At this time, the Banjar Kingdom was still influenced by Hindu-Buddhist religions from kingdoms in Java and Sumatra. The area of Katingan Regency at that time consisted of two regions, Mendawai and Katingan, each led by a Sakai Minister. At that time, Mendawai was a transit point for Banjar traders on their way to sail to the Mataram Kingdom in Java.

The Banjarese mythology and folklore closely relate to nature. One of the mythological stories related to rivers is the story of a Naga-shaped creature. Naga is a mythological creature shaped like a giant snake that in Banjar culture is considered the protector of water, especially rivers and lakes. It is said that this creature has a role in maintaining the balance of nature and protecting water sources that are important for

the lives of the Banjar people. The appearance of the Sasamba Dragon is believed to be a sign of impending disaster in the region.

The Javanese have a long history in the history of Indonesia, starting from the Tarumanegara Kingdom located in West Java and Banten to the remaining kingdoms on Java Island today in the Sultanates of Jogja and Solo. This long history began with the influence of Hinduism and Buddhism from kingdoms in India, followed by the arrival of Arab traders who brought Islamization. The Javanese in the project zone are a group of Javanese people who moved from Java Island through the transmigration program of the Indonesian government between 1982 and 1985.

Javanese mythological stories are found in the shadow puppet art that adopts the stories of Mahabarata and Ramayana. One of the most famous characters in wayang kulit is Semar who is an original Javanese puppet character. Semar is a combination of small people and gods because he is a god who transforms himself into a human being in the world. One of the most famous gods in Java in relation to nature is Dewi Sri, the goddess of fertility who is said to sacrifice herself to become rice for human life. In some areas of Java, traditional ceremonies are still performed at harvest time to honor Dewi Sri's sacrifice.

Government Structure and Customs

In the administration of government at the village level, there are three main organizations: the Village Government, the Village Council (*Badan Permusyawaratan Desa*, BPD), and the Mantir Adat Village Institution (Mantir). The Village Government as the executor of development programs in the village functions as an executive agency; the BPD carries out supervision of the Village Government as a legislative function; and the Mantir carries out the function of implementing customary rules governing the life of villagers. The Village Government has a dominant role as an institution that has the mandate to implement village development programs. The Village Government has community institution partners such as *Rukun Tetangga* (RT) or neighborhood, *Rukun Warga* (RW) or hamlet, *Pemberdayaan Kesejahteraan Keluarga* (PKK) or family welfare empowerment, *Karang Taruna* (Youth Organization), *Pos Pelayanan Terpadu* (Posyandu) or Integrated Service Post, and *Lembaga Pemberdayaan Masyarakat Desa* (LPMD) or Village Community Empowerment Institution.

The Mantir as the implementer of customary rules assists the village government as a partner in maintaining harmonious relations between residents. A Mantir is a person who has in-depth knowledge of customs, traditions, and customary rules that regulate social norms among villagers. Mantirs come from the customs of the Dayak people, but Mantirs are also found in transmigration villages inhabited by the Javanese and Sundanese since this apparatus has become part of formal bureaucracy in Central Kalimantan Province. Problems of social conflict between villagers are dealt with by the mantir as a conflict mediator before being referred to the police, such as land ownership disputes, infidelity, and fights between villagers. The mantir also functions as an institution that provides consultation for the village government in organizing development and planning.

4.1.1.3 Demography

Population

Based on BPS[130] Indonesia 2023 data, the total population of project zone villages in Katingan Kuala Sub-district is 17,323 people consisting of 9,009 (52%) males and 8,314 (48%) females. Among these villages, there are three most populous villages with more than 2,000 people, namely Pagatan Hilir, Pagatan Hulu, and Kampung Keramat. These three villages are inhabited by the Banjarese and are located next to each other. The population of Satiruk Village in Pulau Hanaut Sub-district is 1,340 people, composed of 688 (52%) men and 652 (48%) women. The villages with the least population are Sungai Kaki and Selat Baning with a population of under 400 people. The following table is the composition of the population in the project zone.

Table 4-6. Table of villages' population compositions.

Village	Katingan Kuala Sub-district 2023		
	Men	Women	Total
Pagatan Hilir (urban – local)	1,288	1,215	2,503
Pagatan Hulu (urban – local)	1,198	1,075	2,273
Jaya Makmur	653	565	1,218
Subur Indah	764	689	1,453
Kampung Keramat (local)	1,145	1,088	2,233
Singam Raya (local and transmigrant)	719	686	1,405
Bangun Jaya	774	716	1,490
Kampung Tengah	850	797	1,647
Sungai Kaki	178	149	327
Selat Baning	203	175	378
Makmur Utama	562	530	1,092
Bumi Subur	675	629	1,304
Total	*9,009*	*8,314*	*17,323*
Village	Pulau Hanaut Sub-district 2023		
	Men	Women	Total
Satiruk	688	652	1,340

Source: Kecamatan Katingan Kuala Dalam Angka 2023 & Kecamatan Pulau Hanaut Dalam Angka 2023 (BPS 2023).

Ethnicity and Religion

The formation of settlements, which occurred in two phases, resulted in the establishment of two prevalent ethnic groups in the project villages. Phase 1 villages are inhabited by the Banjarese, while transmigration villages are inhabited by the Javanese and Sundanese. The Banjarese are an ethnic group who originated from South Kalimantan, especially the Martapura and Barito River areas. The Javanese and Sundanese are from the island of Java, with the Javanese originating from central and eastern Java and the Sundanese from western Java. Apart from these two main ethnic groups, there are other minority groups, namely the Dayak, Bugis, Lombok, Batak, and others. Indonesian is a unifying language used for inter-ethnic relations and in public spaces. Meanwhile, among themselves, ethnic groups usually use their respective languages.

[130] Central Bureau of Statistics.

The predominant religion of the villagers in the project zone is Islam. Another religion that is quite widely practiced is Protestant Christianity. In addition, some people practice Kaharingan Hinduism, which is the religion of the Dayak on the island of Kalimantan, especially in Central Kalimantan and East Kalimantan. The following table is the ethnic and religious composition of the villages in the project zone.

Table 4-7. Ethnicity and religion within villages in the project zone.

Village	Composition	
	Ethnicity	Religion
Bangun Jaya	Jawa, Banjar, Dayak	Islam, Christian and Kaharingan Hinduism
Singam Raya	Jawa, Dayak, Banjar, Sunda	Islam, Christian, and Kaharingan Hinduism
Bumi Subur	Jawa, Dayak and Banjar	Islam and Christian
Subur Indah	Jawa	Islam
Jaya Makmur	Jawa, Sunda, Banjar	Islam and Christian
Makmur Utama	Jawa	Islam
Selat Baning	Banjar	Islam
Kampung Keramat	Banjar	Islam
Kampung Tengah	Banjar, Madura,	Islam
Satiruk	Banjar, Dayak Kahayan, Jawa, Madura, Bugis	Islam
Pagatan Hulu	Banjar, Jawa, Bugis	Islam and Christian
Pagatan Hilir	Banjar, Jawa, Bugis	Islam and Christian
Sungai Kaki	Banjar	Islam

Village Development Index

To complete the information on the profiles of villages in the project zone, information on the Village Development Index (VDI) or *Indeks Desa Membangun* (IDM) of 11 out of 13 engaged villages is provided[131].

The index is a composite index resulting from the average ecological resilience index (*Indeks Kualitas Lingkungan*, IKL), economic resilience index (*Indeks Kualitas Ekonomi*, IKE), and social resilience index (*Indeks Kualitas Sosial*, IKS) for each village. There are five categories within VDI; however, in villages within the project area, there are only two groups of villages: the developing villages with a VDI score within a range of 0.5989 to 0.707 and the underdeveloped villages with an average VDI score of 0.4907 to 0.5989. The following figure is developed based on this score: there are currently six villages in the project zone that are underdeveloped, as can be seen on the right-hand side of the figure.

[131] The data is not available for the two urban villages.



Figure 4-1. Village Development Index (VDI) of villages around the project area (Source: Indeks Desa Membangun 2022 (https://idm.kemendesa.go.id/)).

4.1.2 Interactions between Communities and Community Groups (CM1.1)

The social groups described in Section 4.1.1 consist of groups based on ethnicity, religion, and livelihood. The biggest differences in inter-group relations are based on ethnic groups and livelihoods, as well as the geographical distance between villages. Javanese and Sundanese, who primarily rely on rice farming, are located in transmigration villages, while the Banjarese, who depend on fishing and trading, are located in local villages. The relationship between these groups runs harmoniously and there is mutual economic cooperation. No inter-ethnic discrimination or conflict has occurred because of the relationship that has blended in daily life. The Banjar people need rice from the Javanese, and the Javanese people need fish and goods from the Banjar people. Despite the ethnic and livelihood differences, these two predominant groups share a common religion.

Other groups not mentioned in 4.1.1 are women's groups, youth groups, coffee farmer groups, honey seeker groups, cattle breeder groups, trader groups, and religious groups. The women's groups in the villages are Family Welfare Empowerment (*Pemberdayaan Kesejahteraan Keluarga*, PKK) and Women Farmers Group (*Kelompok Wanita Tani*, KWT). PKK is a group of housewives who are partners of the village government and are engaged in community empowerment, while KWT is a women farmer group engaged in agricultural development by women in the village. KWT is under the guidance of the village government and the Ministry of Agriculture.

The youth group in the villages is called Karang Taruna, a group that partners with the village government, assisting in youth activities organized by the village government and in village ceremonial activities. Religious groups include the recitation group and the mosque board, both of which play a role in religious activities in the village. Some of these groups were formed formally and some informally. Relationships between groups are mutually cooperative for several joint activities such as major religious activities held in the village.

4.1.3 High Conservation Values (CM1.2)

The project aims to protect and improve the quality of high conservation values (HCVs) that support community well-being in the project zone. To this effect, the project identified areas that provide critical ecosystem services (HCV 4) and areas that are fundamental for the livelihoods of communities (HCV 5) as follows. Sites that are critical for the traditional cultural identity of communities (HCV 6) were not identified in PT PUM concession and the project zone based on the HCV assessment and consultations with local stakeholders.

4.1.3.1 HCV 4: Ecosystem Services

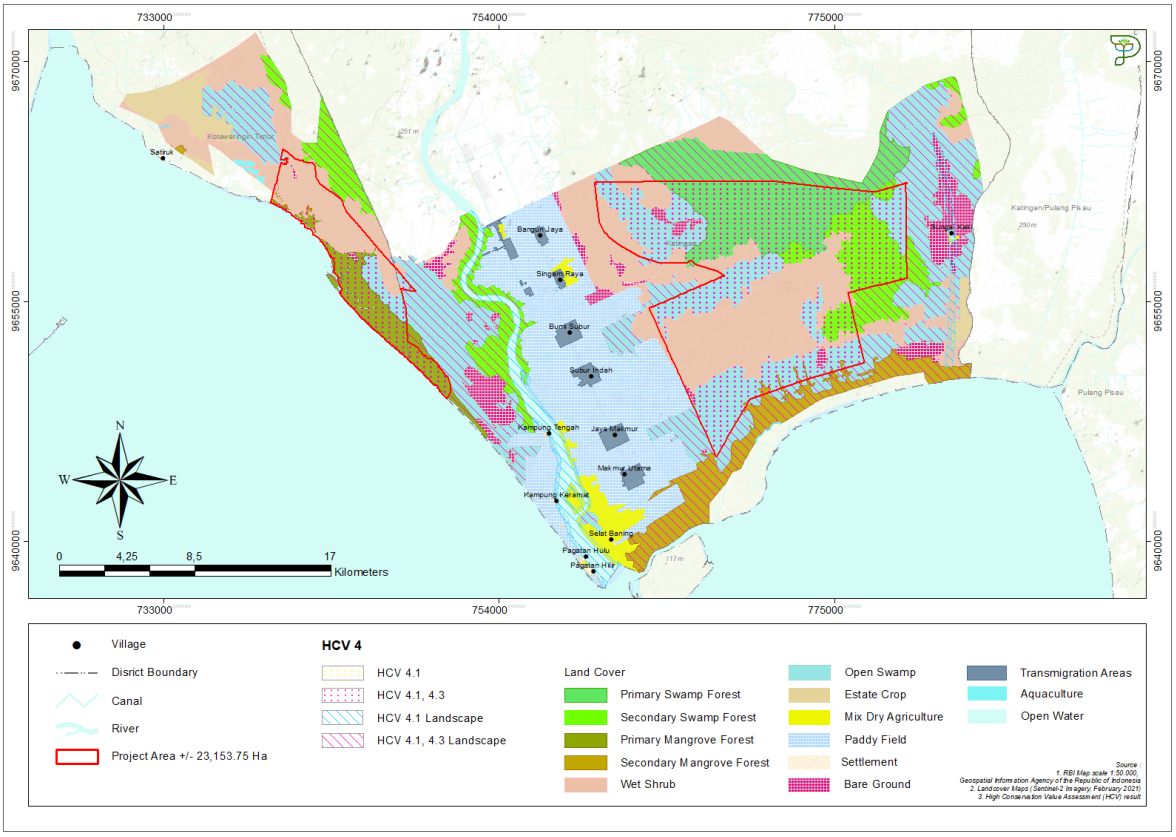
The project team identified areas that provide basic ecosystem services in critical situations. The detailed description is provided below:

High Conservation Value	HCV 4: Rare and endangered ecosystems in the form of secondary forest and shrubs remaining in the project area (Peat Swamp, Freshwater Swamp, Beach Forest, and Mangrove and Intertidal Swamp)
Qualifying Attribute	There are two components of HCV 4 that are found in the project area: **HCV 4.1: Protection of Water Catchments** The mixture of freshwater swamps and riparian areas within the project area resulted in the uniqueness of peat swamps. In addition to storing water and preventing floods, peat swamps play an essential role in the environment as water reservoirs. The peat areas within the project concession area are the result of deposits of organic matter and stagnant water with impeded drainage on depressed interior soils. The nutrients in this form of peat are derived from mineral soil layers at the bottom of the basin, river water, plant remains, and rainwater. These areas are important to the communities for providing water supply for daily household activities and agriculture. **HCV 4.3: Areas that function as natural barriers to the spread of forest or ground fire** In addition to serving as a water catchment, water supply, and flood prevention, the peat swamp area also serves as a natural firebreak, and therefore preventing the negative impacts of peat fire to the communities (e.g., negative health impacts from pollution of the fire haze, spread of fire to communities' agricultural fields). The secondary forests, rivers, and their borders serve as a barrier against the spread of ground and forest fires, thus meeting the requirements of HCV 4.3.
Focal Area	The area containing HCV 4 is shown in Map 4-1; each component of HCV 4 is represented in the legend of the map.

Table 4-8. The area of HCV 4 (HCVA 4) within the project area.

HCV 4	Eastern Part (ha)	Western Part (ha)	Total (ha)
HCV 4.1	12,399.30	2,191.37	14,590.66

HCV 4	Eastern Part (ha)	Western Part (ha)	Total (ha)
HCV 4.3	12,399.30	2,141.57	14,540.86
Net HCV 4 (ha)	**12,399.30**	**2,191.37**	**14,590.66**



Map 4-1. HCVA 4 within the project area

4.1.3.2 HCV 5: Basic Needs of Community

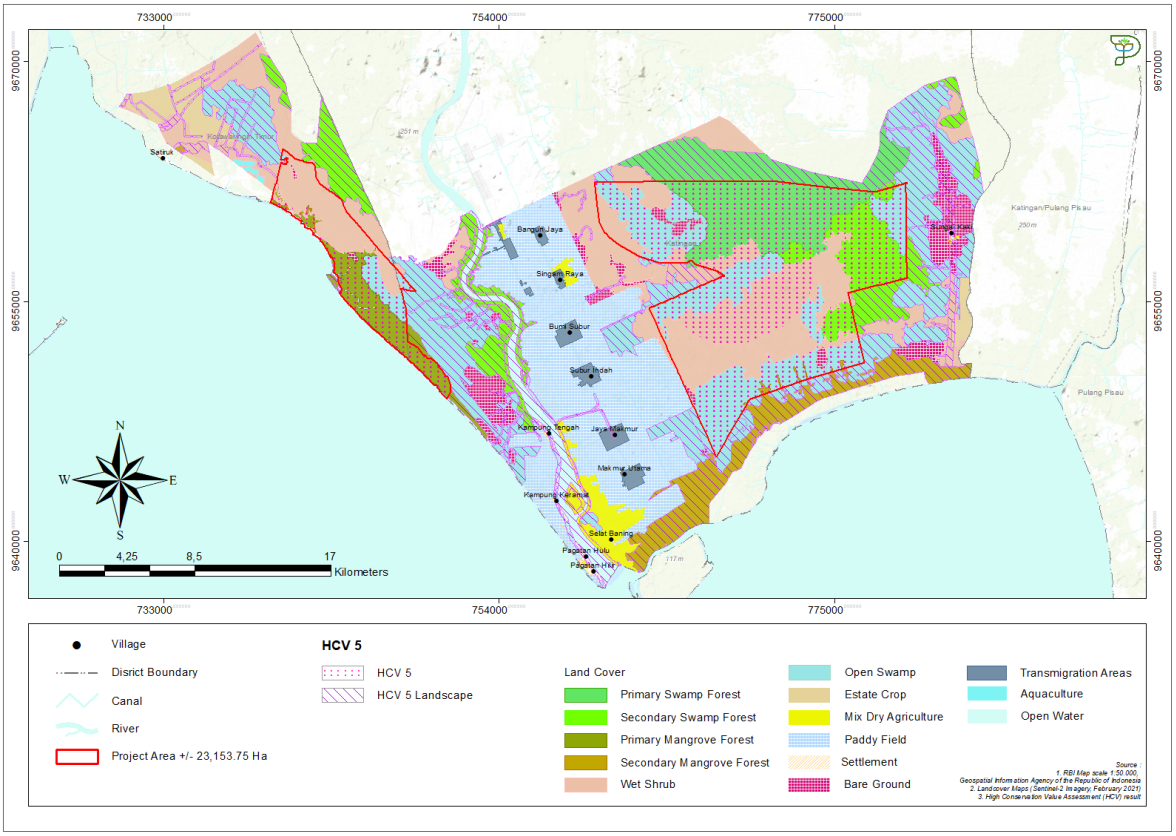
Humans in living their lives need various types of goods and services to meet their needs. Some of these needs are basic needs and some are complementary. Areas that have an important function as a source of livelihood for local communities, especially in meeting basic needs, are areas that have HCV 5.

High Conservation Value	HCV 5: Forests, shrubs, rivers, and their borders, as well as fishing ground.
Qualifying Attribute	An HCV 5 study examines how a local community group relies on nature for fundamental necessities. If the services they provide cannot be replaced, resources are essential to meeting basic needs. Losing or damaging them will greatly impact the affected stakeholders. There are several HCV 5 attributes identified within the project area that are crucial for the community. They include: 1. A fishing ground (ditches) where people go fishing within the project area.

	2. Some community members set snares within the area for traditional hunting. 3. Some individuals collect wood for use as building materials and fuel. 4. Some residents use non-timber forest products such as rattan, honey, and jelutung sap (rubber) from the area.
Focal Area	The area containing HCV 5 is depicted in Map 4-2.

Table 4-9. The area of HCV 5 (HCVA 5) within the project area.

HCV 5	Eastern Part (ha)	Western Part (ha)	Total (ha)
HCV 5	15,015.70	2,191.95	17,207.65
Net HCV 5 (ha)	**15,015.70**	**2,191.95**	**17,207.65**



Map 4-2. HCVA 5 within the project area

4.1.4 Without-Project Scenario: Community (CM1.3)

The without-project scenario involves the conversion of forest and land into oil palm plantation. In this scenario, the communities around the project areas:

1. May have sold their land to the oil palm company for conversion to oil palm plantation. They would gain a one-time payment for selling their lands (including GRTT, *Ganti Rugi Tanam Tumbuh*). The amount of GRTT ranges from IDR 600,000 to IDR 1 million per hectare.

2. May have become smallholder-partners with the oil palm company to convert their land into oil palm plantation. It is expected that they would become the company's smallholder (plasma) suppliers, and they would receive revenue from the partnership. Usually, a farmer that has two hectares of land would receive an average of IDR 1.5 – 2 million per month after the fourth year of planting.
3. Villagers would benefit from employment opportunities in the oil palm company in sectors that match their educational background. The majority of villagers usually work in harvesting and maintenance positions. Work status can be as casual laborers (*Buruh Harian Lepas*, BHL) or contract workers. BHL get a salary based on working days and daily targets with a salary range of IDR 125,000 per day and an average of 20 working days a month. Monthly income can be estimated at IDR 2.5 million.

Although oil palm plantations provide economic income opportunities, there are several negative impacts:

1. Unequal financial capital. Land ownership is not equal among villagers. Some community groups own large tracts of land above two hectares while others own only two hectares and some even less. Large landowners will benefit more from GRTT and plasma; other villagers may lose land and not get plasma.
2. Increased immigration and competition with migrants. The large number of migrants as company workers may provide unhealthy competition for villagers. In many cases companies prefer migrant workers because they may work more with lower salaries. In the management sector, villagers will face challenges competing with migrants who possess higher levels of education and qualifications.
3. Low quality of education services. The level of education quality will not increase significantly because the company is not primarily concerned with the education of villagers. The low quality of education is due to the difficult road access from the city and the district governments' limited resources for education in the project zone. Without intervention from a third party, it will be difficult to improve education in the project zone.
4. Low access to health services. The low level of health services is due to difficult road access and limited government resources. The nearest community health center is located in the sub-district's capital (Pagatan Hilir) which takes two hours to reach by river from the villages. Without third-party intervention, it will be difficult to improve access to health services.
5. Environmental degradation in the form of forest fires, illegal logging, reduced water sources, and coastal abrasion.
6. The without-project scenario would reduce the community's ability to develop their own livelihood sources. At present, the community relies on paddy rice production. With the establishment of an oil palm plantation directly bordering their land, the community would experience an "edge effect" from the plantation, meaning that rice production areas would likely decrease. This situation would reduce the community's resilience and self-sufficiency.

4.2 Net Positive Community Impacts

4.2.1 Expected Community Impacts (CM2.1)

In the villages within the project zone, there are several community groups based on various factors such as livelihood, gender, age, ethnicity, and religion. This section describes the expected impacts of changes in land use scenarios on local communities, focusing on four community groups as well as village communities in general.

To assess the benefits, costs, and risks of the project for community groups, Focus Group Discussions (FGDs) were conducted by Remark Asia during the FPIC consultations and by Yayasan Puter during the livelihood assessment/Social Impact Assessment (SIA). The impacted community groups were gathered and consulted regarding the issues that might arise from the project. The existence of this project will have a direct impact on livelihood groups that depend on income derived from the project area. Impacts are anticipated to be mostly positive, as explained below.

As explained elsewhere, fishermen and farmers will be allowed to continue their livelihood activities in PT PUM; thus, only logging and hunting[132] will be prohibited.

Community Group	Wood Loggers (7 out of 13 villages)
Impact(s)	1. Wood loggers will be affected by the loss of revenue from the project area as a result of the ban on logging in the project area. 2. Affected wood loggers will be provided with alternative livelihood assistance to develop agriculture and non-timber forest products (NTFPs). Some examples of programs that will be implemented are coffee and honey development. 3. Affected wood loggers may benefit from employment opportunities in the project. The experience of wood loggers in the project area will benefit the project. Former wood loggers may be recruited as forest patrol staff or other positions according to their job qualifications. Other positions could include public relations and community and development staff. 4. Wood loggers will be provided with training assistance and/or benefit from the revolving fund to develop agricultural livelihoods and other businesses.
Type of Benefit/Cost/Risk	Direct Benefit (predicted) = direct benefits obtained from the project activities implemented with affected groups and the general public. Some direct benefits are employment opportunities, increased income, training, and the revolving fund. Direct Cost (predicted) = the impact obtained is the loss of logging income in the project area due to the logging ban.
Change in Well-being	The estimated cost of lost income based on the average income of loggers in the project zone is IDR 1.6 million/month[133]. Some wood loggers may seek alternative sources of wood or they may shift livelihood since logging is considered as secondary or tertiary livelihood. The benefit of well-being is a new source of income from working in the company or from the alternative livelihoods program. It is estimated that the additional income will be at least 25% higher than the current average income from illegal logging.

[132] Hunting is not a main livelihood in the project zone.
[133] PUM Impacted Livelihood Report.

Community Group	Farmers (9 out of 13 villages)
Impact(s)	1. Farmers in villages with rice fields will benefit from increased agricultural processing capacity through training programs that are planned by the project. 2. Farmers benefit from project support for alternative livelihood activities. 3. Farmers also benefit from employment opportunities in the project, especially for young people from farmer families. 4. Another indirect impact is that the prevention of forest fires in the project area helps prevent fires in farmers' fields around the project area.
Type of Benefit/Cost/Risk	Direct Benefit (predicted) = direct benefits obtained from the project activities implemented with affected groups and the general public. Some direct benefits are employment opportunities, increased income, training, and the revolving fund. Indirect Benefit (predicted) = The indirect impact of forest fire prevention helps prevent fires in farmers' fields.
Change in Well-being	The benefits in terms of well-being will be diverse such as additional sources of income, increased knowledge, good agricultural practices, and adaptive capacity from the alternative livelihoods and agroforestry program.

Community Group	Fishermen (8 out of 13 villages)
Impact(s)	1. Fishermen will benefit from additional income from alternative livelihood activities that can be used to buy nets, fishing gear, and other fishing needs. 2. Fishermen also benefit from employment opportunities in the project, especially for young people.
Type of Benefit/Cost/Risk	Direct Benefit (predicted) = direct benefits obtained from the project activities implemented with affected groups and the general public. Some direct benefits are employment opportunities, increased income, training, and the revolving fund.
Change in Well-being	The benefits in terms of well-being are diverse such as diversification of sources of income from working in the company or from the alternative livelihoods program.

Community Group	Women's Groups
Impact(s)	1. Women receive business development training for alternative livelihoods through project assistance. 2. Women benefit from the revolving fund to help develop alternative livelihoods through project assistance. 3. Women benefit from employment opportunities in the project. 4. Women benefit from increased gender equality through training programs and increased women's involvement in village decision-making.

Type of Benefit/Cost/Risk	Direct Benefit (predicted) = direct benefits obtained from the project activities implemented with affected groups and the general public. Some direct benefits are employment opportunities, increased income, training, and revolving fund.
Change in Well-being	The benefits in terms of well-being for women are additional sources of income from the alternative livelihoods program, revolving fund, women's empowerment by strengthening women's groups and SMEs, and capacity development of women.

Community Group	Village communities in general
Impact(s)	In the villages, the project will implement assistance programs that will provide: 1. Improved access to health services through the village health service improvement program. 2. Improved access to higher education (for their children) through scholarship assistance programs and cooperation with universities. 3. Increased access to high quality education through education assistance programs in the village. 4. Increased access to clean water through village water supply programs. 5. Employment opportunities in the project through the company's recruitment program.
Type of Benefit/Cost/Risk	Direct benefits (predicted): direct benefits are obtained through the implementation of assistance programs for communities in the project.
Change in Well-being	Expected improvements: 1. Increased income through employment opportunities in the project. 2. Improved health services at Puskesmas with equipment and training for health workers. 3. Improved child nutrition through the Supplementary Food Program (*Pemberian Makanan Tambahan*, PMT) and improved child immunization through immunization assistance at Posyandu. 4. Increased levels of higher education in the village that can improve the family and village economy. 5. Improved quality of education in schools through school equipment assistance and capacity building training for teachers in schools. 6. Improved clean water quality and sanitation in the village.

4.2.2 Negative Community Impact Mitigation (CM2.2)

The project aims to provide net benefits for local populations. Nevertheless, potential negative community impacts could result from the project. Thus, it is necessary to design a plan to mitigate any negative impacts

on the well-being of community groups. The potential negative impacts as well as their mitigation include the following:

- **Illegal Loggers:** As a result of the project, the local people will no longer be able to log illegally. Hence, their income will be reduced. Community members who were conducting these activities for their subsistence or main livelihood will be offered opportunities to participate in the project's livelihood activities. They will also be considered for direct employment when opportunities emerge. Finally, they will benefit from the project's other community benefits such as increased health access, and training to help them transition away from illegal activity.
- **Local Community:** During the project implementation, conflicts may occur owing to envy from local communities toward people coming from outside of the project zone. To mitigate this, the project proponent will ensure that the employment of local people is prioritized. Furthermore, the compensation given to the local workers should not differ significantly from that given to a worker from outside the project zone. In addition, potential conflicts may arise between the community and the project proponent regarding land use. To address this, all activities and decisions involving the land and resources in the project area will involve affected groups and the local and traditional leaders.
- **Farmers:** Farmers in Sungai Rangkang from Satiruk Village have been identified as growing paddy rice in the western part of the project area, covering an area of approximately 10 ha. They grow rice for their subsistence and for additional income. In the eastern part, there are approximately 468 ha of rice paddy fields along the boundary of the concession, including the newly added areas under SIMURP. Based on the consultations with these farmers, it was decided to exclude these rice paddy areas from the project area so that the farmers can continue to cultivate their land.

4.2.3 Net Positive Community Well-Being (CM2.3, GL1.4)

All groups within the community are expected to benefit from the activities of the project. There are numerous types of well-being benefits, including natural capital, human capital, social capital, physical capital, and financial capital. The table below outlines the main expected benefits resulting from the project in comparison to the baseline scenario.

Table 4-10. Net positive community benefits

Criteria	Current situation	Baseline scenario	With project scenario	Activities/ mitigation
1. Natural Capital	Currently the natural capital in the project area is very high. Project areas provide important ecosystem services such as the availability of clean water, and reduce the	In the baseline scenario, there is a risk of exploitation of natural resources to fulfill short-term interests, mostly for the interests of certain groups and plantation companies. Although there are several community groups that benefit in the short term, in the long	In the project scenario, a large natural capital will be maintained and protected and the communities in the project zone will be assisted in the development of natural capital empowerment in accordance with the principle of	The project aims to increase the natural capital of the project area and thus contribute to the development of local natural resources that can be used sustainably.

Criteria	Current situation	Baseline scenario	With project scenario	Activities/ mitigation
	risk of forest fires	term it will affect the natural capital owned by the community.	sustainability where the benefits can be maintained locally. Communities will benefit from these natural resources for their agricultural crops (water availability), reduced incidence of fires, fishing, and harvesting of non-timber forest products such as honey.	
2. Human Capital	The project villages are difficult to reach by road and must be accessed by river, resulting in difficulties in accessing good health and education services. In the health sector, challenges include poor sanitation and difficulty in obtaining clean water for consumption.	In the baseline scenario, improvements in the quality of education and health are possible but will not occur in the long term. Employment opportunities will also be available but will not be matched by improvements in the quality of working conditions, resulting in low levels of income.	In the project scenario, people living in the project zone will be assisted in community empowerment programs so that they can improve economic welfare and increase knowledge through training. Public access to education and health will increase through close collaboration with local government and efforts will be focused on developing sustainable business opportunities that remove dependencies on the project area.	The project activities are designed to improve access to health care, education, training, and basic services. Employment opportunities for local communities will be provided by improving skills through job training. Economic improvement will be carried out through capital assistance programs and business management skills training. The quality of education and health will be improved by enhancing facilities and providing scholarships for students.
3. Social Capital	Social capital in the project zone is currently quite high. The	In the baseline scenario the social capital will be at risk. Differences in	Under the project scenario, social capital will be strengthened by the	Project activities will focus on strengthening social capital, including by

Criteria	Current situation	Baseline scenario	With project scenario	Activities/ mitigation
	local communities tend to have solid cohesiveness and still pay attention to the values and traditions, for example by participating in customary mantir at the village level in discussion forums and other activities.	acceptance of the presence of companies can erode the level of community cohesiveness. This can occur if the distribution of revenue sharing, labor etc. is unfair. The increasing need to acquire such commercial value can affect communities' social capital.	project working together with local communities to support social institutions within the project zone. Cooperation with existing institutions will be sought to respond to existing needs and so that benefits can be evenly distributed. Adaptive capacity of the communities to the impacts of climate change will be strengthened by supporting increased community organization and livelihood diversification, as explained in Section 3.4.3.	supporting and assisting community collaboration from the smallest level to the development planning process.
4. Physical capital	The physical capital condition in the project zone is inadequate. There is limited access to routes and means of transportation, and limited resources and communication system access (signal). This leads to limited logistic, production and/or market access.	In the baseline scenario, physical capital is likely to increase through local government programs or activities as well as the presence of companies. However, these activities often do not benefit local communities directly.	The project will work with all stakeholders in the project zone including local governments, companies, and local communities to support sustainable development. Through this, it will facilitate access to health services, markets, and technology to improve production and processing of agricultural products.	The project will support and collaborate with local governments and other entities in the project zone to support sustainable development.

Criteria	Current situation	Baseline scenario	With project scenario	Activities/ mitigation
5. Financial capital	Based on average monthly income, many residents are below the poverty line. The difficulty of access, which is only through the river, makes the prices of goods high while the selling prices of agricultural products, fisheries, and NTFP products are low.	In the baseline scenario, access to markets to obtain favorable prices for agricultural products will be difficult to obtain. While employment opportunities will be available, in the long term this may result in the loss of livelihoods due to changes in natural resources that have been exploited.	The project activities aim to provide financial benefits through sustainable economic development that is adaptive to climate change. This can be achieved through the provision of employment opportunities as employees or contractors of the company. In addition, economic empowerment for affected and unaffected livelihood groups will increase income from these livelihoods. The project will also provide capital assistance through a revolving fund mechanism.	All activities carried out by the project aim to increase the financial capital owned by the community. Various mechanisms will be carried out including improving the financial management capacity of the community, providing revolving fund, and improving community business units so that the community has strong financial capabilities.

4.2.4 High Conservation Values Protected (CM2.4)

The project will have no negative impacts on the HCV 4 and HCV 5 areas described in Section 4.1.3. On the contrary, the project will preserve and protect these HCV areas. As a result, no recognized HCV qualities connected to the community's fundamental needs would be harmed. If additional values are discovered in the future, the project will ensure that these values are not harmed. The following table summarizes the HCVs that will be safeguarded by the project activities, as documented in the preliminary evaluation of the project area.

Table 4-11. Net positive impact based on the high conservation value.

Criteria	Status	Baseline scenario	With project scenario	Activities/mitigation
1. Area with critical ecosystem services **(HCV 4)**	The project area plays an important role in maintaining hydrological function and	In the baseline scenario the hydrological function will be lost permanently. The loss of this	In the project scenario, the peat water level will be maintained, and the dry area will be hydrologically	One of the main objectives of the project is to protect and support the peat dome and the

Criteria	Status	Baseline scenario	With project scenario	Activities/mitigation
	water supply, preventing the risk of erosion and degradation due to peat oxidation, and reducing the risk of fire through maintenance of peat water level and forest cover.	hydrological function will lead to increased erosion, peat oxidation, loss of clean water supplies and an increased risk of saltwater intrusion (in the western part). The risk of fire will increase drastically from a periodic reduction in land cover.	restored. Remaining forest cover will be protected and deforested areas will be reforested so as to reduce the risk of forest fires.	existing natural conditions.
2. Areas fundamental to meeting the basic needs of local communities **(HCV 5)**	The project area is used by the community in the project zone to obtain non-timber forest products such as honey and fish, as well as wood to fulfill the needs of building ships and/or houses.	In the baseline scenario, most of the project area would be converted to plantation areas. This would have an impact on the increased drainability and will disturb the hydrological conditions of the area, and therefore would increase the risk of fires.	In the project scenario, the forests in the project area will be protected and degraded areas will be restored.	One of the main objectives of the project is to protect and improve ecosystem services and contribute to sustainable livelihoods.

4.3 Other Stakeholder Impacts

4.3.1 Impacts on Other Stakeholders (CM3.1)

The list of other stakeholders can be found in Section 2.1.9. For this project, no negative impacts on other stakeholders are expected.

4.3.2 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

As mentioned above, negative impacts on other stakeholders in this project are not expected and are unlikely to occur. No mitigation is required.

4.3.3 Net Impacts on Other Stakeholders (CM3.3)

No negative impacts on other stakeholders from the implementation of the project activities have been identified.

4.4 Community Impact Monitoring

4.4.1 Community Monitoring Plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

The project proponent will put in place a community monitoring plan to identify how the project affects the surrounding communities and other stakeholders. The community monitoring plan will help the project team understand how well each activity contributes to the project reaching its goals. Please refer to Section 4.2.1 regarding community impacts that will be monitored, including well-being impacts, risks for community members and impacts on women. These impacts are reflected in the monitoring indicators in Appendix 13: Monitoring Plan. The monitoring plan outlines the indicators to be monitored, monitoring frequency, and data collection method. It also includes indicators on climate change adaptation benefits as described in Section 3.4.3.

The preservation of HCV values as described in Sections 4.1.3 and 4.2.4 will be measured through the following indicators that are included in the monitoring plan: Output 1.3.2 Indicator 1) *Peat water level*, Output 1.2.2 Indicator 4) *Number of fire hotspots in the project area*, and Impact Indicator 2) *Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario*.

The community monitoring will apply both qualitative and quantitative approaches and will involve survey activities and Participatory Rural Appraisal (PRA) in Focus Group Discussions (FGDs) with community groups:

a. The qualitative method is carried out with Participatory Rural Appraisal (PRA) activities.

b. Quantitative method is carried out with survey activities, with the sampling technique chosen in this study being purposive sampling.

In addition, during FPIC a community monitoring team was established in each village consisting of community representatives that will monitor achievement of agreed project benefits in their village.

4.4.2 Monitoring Plan Dissemination (CM4.3)

The community monitoring plan will be disseminated to the communities and other stakeholders. The project-related plans will be available in Indonesian along with the other project documents as mentioned in Section 2.3.2. In addition, the project team will also provide project progress information and results of the monitoring which will be displayed on the project website and disseminated in village meetings and information boards.

4.5 Optional Criterion: Exceptional Community Benefits

4.5.1 Exceptional Community Criteria (GL2.1)

The project meets the CCB criteria for Exceptional Community Benefits as over 50% of villagers in the project zone are below the national poverty line of IDR 2,120,371/month per household[134]. Based on the

[134] In 2021, the national poverty line was set at a per capita expenditure of IDR 450,185/month (approx. USD 28/month) or IDR 2,120,371 (USD 132)/month per household (4.71 members per household).
Poverty Line (Rupiah/Kapita/Month) By Province and Area - BPS-Statistics Indonesia and Indonesia Poverty Profile - BPS-Statistics Indonesia (accessed Jan 30, 2024)

livelihoods assessment conducted by the project, the average income in the villages of the project zone ranges from IDR 266,667/month to IDR 2,900,862/month per household, with an average of 1,886,397/month per household. Six of the 13 villages in the project zone are underdeveloped villages (refer to Section 4.1.1.3). These six villages will be the main target of the project's community development activities.

4.5.2 Short-term and Long-term Community Benefits (GL2.2)

In the short term, the community benefits include:

1. Improved access to health services through the village health service improvement program.
2. Improved access to higher education (for their children) through scholarship assistance programs and cooperation with universities.
3. Increased access to high quality education through education assistance programs in the village.
4. Increased access to clean water through village water supply programs.
5. Employment opportunities in the project through the company's recruitment program.
6. Hydrology system improvement will help prevent fires and floods in plantations and residential areas.

In the long-term, the identified benefits are listed below:

1. Protection of air and water quality: The project restores degraded wetlands and maintains forests that play an important role in maintaining water and air quality. They can act as natural filters, maintain the sustainability of the water cycle, prevent/suppress land and forest fires which will reduce the negative health impacts of fire smoke/haze to local communities.
2. Improving the quality of life and resilience of the community through empowerment programs in education, health, and economy.

4.5.3 Community Participation Risks (GL2.3)

The project implementation started with an FPIC process that emphasized transparency, openness, and community participation. The FPIC process openly discussed risks for communities to participate in the project including potential impacts on livelihoods (see Appendix 5: FPIC Consultation Report). Village meetings will be held regularly as a medium for socialization and evaluation of the project with the community by promoting several principles such as:

1. Open dialog that provides opportunities for everyone to be actively involved.
2. Ensuring that all community groups are represented in each meeting, so that all groups have equal opportunities and involvement.
3. Ensuring that the decision-making process is carried out transparently and openly.

Furthermore, a grievance redress procedure was put in place to provide a formal process for community members to raise concerns and complaints related to the project.

4.5.4 Marginalized and/or Vulnerable Community Groups (GL2.4)

The following marginalized and vulnerable groups were identified in the project zone:

Community Group 1	Women
Net positive impacts	The project provides benefits of strengthening women's role and gender equality in households and villages through provision of training, capital and mentoring, alternative livelihood programs, and programs to involve women in decision-making.
Benefit access	Cultural barriers may prevent the project from fully engaging with women. Socialization will be conducted prior to the implementation of the program to explain the importance of gender equality in households and villages in decision-making.
Negative impacts	There is no expected negative impact on women from the project. The project will conduct regular community consultations to ensure that no negative impacts result from the project activities.

Community Group 2	Poor community members
Net positive impacts	Poor people in the villages will benefit from employment opportunities in the project. In addition, business development assistance will be provided through an alternative livelihood program that provides training, capital assistance and business mentoring.
Benefit access	Lack of accurate data and information may prevent the project from identifying vulnerable people, especially the poor. The project will closely involve the village government, community leaders and all community groups to identify the poor in the villages and provide targeted assistance.
Negative impacts	Poor people who previously worked in logging in the project area may be affected by the project. These groups will be identified in the community consultations and provided with alternative livelihood programs.

Community Group 3	Smallholder rice farmers
Net positive impacts	Smallholder groups will receive assistance through agricultural capacity building training programs and financial capital assistance for agricultural business development.
Benefit access	The project may face challenges in ensuring that poorer or more vulnerable smallholders equally benefit from the project. To prevent this, project planning and monitoring is carried out through the involvement of all village groups to ensure that the

	beneficiaries are selected fairly and that all smallholders have an equal opportunity to participate in the project.
Negative impacts	Smallholders are not negatively impacted by the project. The project will conduct regular community consultations to ensure that no negative impacts result from the project activities.

4.5.5 Net Impacts on Women (GL2.5)

One of the objectives of the project is to strengthen the role of women in the community. To achieve this, several activities will be dedicated specifically to women's groups in the community:

1. Alternative livelihood program that provides training and financial assistance for business development of women's groups.
2. Training program on the involvement of women in decision-making. This training provides socialization on the importance of involving women in decision-making that often ignores issues concerning women.
3. Women's involvement in all village meetings, such as in FPIC meetings, Village Forums, and others.

These activities are designed to promote the role of women in the villages. Based on social studies conducted at the village level, participation of women in decision-making is still low. Women-related issues such as domestic violence (DV) remain inadequately addressed in discussions at the village level. On the other hand, for some livelihoods, women are extensively involved in household income through trade, fisheries and wet-rice farming.

4.5.6 Benefit Sharing Mechanisms (GL2.6)

During the FPIC consultations, the project discussed project benefits and potential costs/impacts with the local communities, and identified community expectations related to the benefits from the project. In-principle agreements were reached on activities that will be implemented in each village to provide benefits to local communities. All community groups have been involved in the decision-making process as described in Appendix 5: FPIC Consultation Report. The project will continue to transparently discuss benefit sharing of the project with the local communities and plan and implement the project activities in a participatory manner.

The use and distribution of benefits agreed with the communities will be regulated through village meetings agreed upon by all community groups, in order to ensure transparency and fairness in the benefits provided. This process will be led and monitored by the project team and local community representatives.

4.5.7 Benefits, Costs, and Risks Communication (GL2.7)

During the FPIC process, the benefits, costs and risks of the project were openly and transparently discussed with all affected community groups, as described in Appendix 5: FPIC Consultation Report. Project information was delivered through methods that ensure that all community members know and understand the project.

To ensure that the information provided is understood by community members, several methods were used, namely:

1. Agreement through FPIC about the project and the benefits, costs and risks that will be faced by the communities. Ensure that FPIC is agreed by all community members through representatives of all groups in the villages.
2. Collaborative implementation of project monitoring and evaluation with community members through regular village meetings, evaluations, and implementation of the grievance redress procedure. Ensure that the community provides feedback on the implementation of the project and that this feedback is followed up to build a high level of community trust in the project.
3. Implementation of annual reporting on project achievements and benefit sharing as agreed. The meeting will be an annual communication event between the community and the project proponent. Reports will be submitted and received by all community members through group representatives throughout the community.

4.5.8 Governance and Implementation Structures (GL2.8)

The project will be implemented at the village level in collaboration with the village government and related institutions. Local community involvement in the project is developed through participatory planning, monitoring and evaluation and a grievance mechanism. By prioritizing the principles of FPIC, the project will ensure information disclosure and the involvement of all community groups in project planning and implementation.

Community members can also be fully involved in project implementation through the recruitment of local staff, so that project planning and implementation initiatives can be monitored in depth. Where possible and in line with their work capacity and capability, local staff can fill middle and senior management positions, thereby further increasing the involvement of local staff in project planning and implementation. In the future, the number of community members employed in the project should increase in line with the project's development of local human resources. Please also refer to Section 2.4.1 regarding the project's governance structure.

4.5.9 Smallholders/Community Members Capacity Development (GL2.9)

The project will develop a training and capacity building program for the local communities through training of local staff and community members. The training program for local staff employed in the project will seek to develop local staff to become more skilled so that they can advance their careers by occupying project management level positions.

Community members are provided with training for economic development through agricultural capacity building and alternative livelihood development. This training is provided specifically to affected communities in particular and community members in general. Women's groups will be trained on gender equality issues at the village level with a focus on increasing women's participation in village decision-making. Other training includes business development through alternative livelihood programs.

5 BIODIVERSITY

5.1 Without-Project Biodiversity Scenario

5.1.1 Existing Conditions (B1.1)

The eastern part of the PLUM project area is situated approximately 1.3 km south of Sebangau National Park (NP), a 568,700 ha[135] intact tropical peat swamp forest. The Sebangau NP is considered one of the best representatives of wetlands ecosystem and biodiversity richness in Borneo. A biodiversity survey conducted by Husson *et al.* (2018)[136] identified at least 65 mammals, 172 birds, 46 reptiles, 11 amphibians, and 307 flora species, of which 44 species are classified as threatened (Critically Endangered/CR, Endangered/EN, and Vulnerable/VU) by the International Union for Conservation of Nature (IUCN) Red List. The national park is also known to be home to the largest population of Bornean orangutan (*Pongo pygmaeus*) (5,826 individuals) in Central Kalimantan Province[137]. Approximately one km north of the western part of the project area is PT Rimba Makmur Utama (PT RMU)'s concession, a 149,800 ha ecosystem restoration concession which is a habitat for 67 mammals, 157 birds, 41 reptiles, eight amphibians, and 314 flora species[138]. Located within the same landscape with Sebangau NP and PT RMU, the PLUM project area possesses similarities in its ecological and biodiversity characteristics.

A biodiversity assessment conducted in 2022[139] identified two main ecosystem types in the project area, namely the peat swamp forest ecosystem that dominates the eastern part and mangrove forest ecosystem that is found primarily in the western part. These ecosystems are important habitat for at least 367 species identified during the biodiversity assessment, including 112 flora species and 255 fauna species (17 mammal species, 119 bird species, 28 herpetofauna species, and 91 fish species). The project area is also home to at least five Bornean endemic species, including the Bornean skink (*Dasia vittata*). The number of species found in the project area is high considering only 34% of the project area is still forested, while the rest of the area is already deforested and degraded due to past logging activities and historical forest fires.

Out of the 367 species recorded, 31 species are considered as threatened by the IUCN Red List, including the critically endangered Bornean Orangutan (*Pongo pygmaeus*) and Sunda Pangolin (*Manis javanica*) and the endangered Proboscis Monkey (*Nasalis larvatus*). 24 species are listed in Appendix I and II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), indicating that these species are prohibited or restricted from international trade. A total of 33 species are protected by the Government of Indonesia (MoEF Regulation No. P106/2018).

The following table shows the list of threatened species found in the project area, along with the CITES status and national protection status of each species. For a full list of species, please refer to the separate biodiversity survey report.

[135] Ministry of Environment and Forestry. 2019. Ministry of Environment and Forestry Statistics 2019.
[136] Husson, J., et al. 2018. Biodiversity of the Sebangau tropical peat swamp forest, Indonesian Borneo. Mires and Peat, Volume 22 (2018), Article 05, 1 –50.
[137] Utami-Atmoko, S., *et al.* (eds.) (2017). Orangutan Population and Habitat Viability Assessment: Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.
[138] PT Rimba Makmur Utama (2016). Katingan Peatland Restoration and Conservation Project Design Document v1.3.
[139] Remark Asia (2022). Laporan Survey Flora dan Fauna di PT Pagatan Usaha Makmur.

Table 5-1. List of threatened flora and fauna species recorded in the project area.

No	Family	Scientific Name	English Name	Conservation Status			
				IUCN	CITES	GoI	Endemic
Mammals							
1	Suidae	*Sus barbatus*	Bearded pig	VU	-	-	-
2	Cervidae	*Rusa unicolor*	Sambar Deer	VU	-	P	-
3	Mustelidae	*Lutrogale perspicillata*	Smooth-coated Otter	VU	I	-	-
4	Ursidae	*Helarctos malayanus*	Sun Bear	VU	I	P	-
5	Pongidae	*Pongo pygmaeus wurmbii*	Southwest Bornean Orangutan	CR	I	P	Endemic
6	Hylobatidae	*Hylobates albibarbis*	Bornean White-bearded Gibbon	EN	I	P	Endemic
7	Cercopithecidae	*Macaca fascicularis*	Long tailed Macaque	VU	II	-	-
8	Cercopithecidae	*Macaca nemestrina*	Southern Pig-tailed Macaque	VU	II	-	-
9	Cercopithecidae	*Presbytis rubicunda*	Red Langur	VU	II	P	Endemic
10	Cercopithecidae	*Trachypithecus cristatus*	Silvery Lutung	VU	II	P	
11	Cercopithecidae	*Nasalis larvatus*	Proboscis Monkey	EN	I	P	Endemic
12	Felidae	*Prionailurus planiceps*	Flat-headed Cat	EN	I	P	-
13	Manidae	*Manis javanica*	Sunda Pangolin	CR	I	P	-
Birds							
14	Ciconiidae	*Leptoptilos javanicus*	Lesser Adjutant	VU	-	P	-
15	Scolopacidae	*Numenius madagascariensis*	Far Eastern Curlew	EN	-	P	Migrant
16	Psittacidae	*Psittacula longicauda*	Long-tailed Parakeet	VU	II	P	-
17	Bucerotidae	*Buceros rhinoceros*	Rhinoceros Hornbill	VU	II	P	-
18	Chloropseidae	*Chloropsis sonnerati*	Greater Green Leafbird	EN	-	P	-
19	Zosteropidae	*Zosterops flavus*	Javan White-eye	EN	-	P	-
20	Sturnidae	*Acridotheres javanicus*	Javan Myna	VU	-	-	-
Herpetofauna							
21	Elapidae	*Ophiophagus hannah*	King Kobra	VU	II	-	-
Fish							
22	Aetobatidae	*Aetobatus ocellatus*	Spotted Eagle Ray	VU	-	-	-
23	Dasyatidae	*Maculabatis gerrardi*	Whitespotted Whipray	EN	-	-	-
24	Dasyatidae	*Brevitrygon imbricata*	Bengal Whipray	VU	-	-	-

No	Family	Scientific Name	English Name	Conservation Status			
				IUCN	CITES	GoI	Endemic
25	Gymnuridae	*Gymnura poecilura*	Longtail Butterfly Ray	VU	-	-	-
Flora							
26	Dipterocarpaceae	*Shorea balangeran*	Red Balau	VU	-	-	-
27	Dipterocarpaceae	*Shorea uliginosa*		VU	-	-	-
28	Dipterocarpaceae	*Shorea teysmanniana*		EN	-	-	-
29	Apocynaceae	*Dyera polyphylla*	Jelutung	VU	-	-	-
30	Tetrameristaceae	*Tetramerista glabra*	Punak	VU	-	-	-
31	Thymelaeaceae	*Gonystylus bancanus*	Ramin	CR	-	-	-

Note: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, P = Protected

5.1.1.1 Ecosystem Description

The PLUM project zone covers an area of 75,280.54 ha that includes the two parts of the PT PUM concession totalling 23,153 ha. At the start of the project, two ecosystem types were identified within the project zone, namely the mangrove ecosystem in the western part and the peat ecosystem in the eastern part of PT PUM's concession which is part of the Borneo Peat Swamp Forest ecoregion (Olson, *et al.*, 2001). The project zone is predominantly in a degraded condition due to historical logging, peatland drainage, and forest fires. Based on the land cover classification, the degraded condition was described as non-forest areas that consist of bare ground, open swamp, open water, paddy field, and wet shrub.

Non-forest area

In the non-forest areas, the plant species observed on-site were dominated by Kelakai (*Stenochlaena palustris*), Spikemoss (*Selaginella* sp.), Sword ferns (*Nephrolepis* sp.), *Pteridium* sp., and *Glechnium* spp. Species of grass (*Scleria purpurascens, Hymenachne acutiguma*) and elephant ear plants (*Alocasia* spp.) are also frequently found in non-forest areas. Several woody species such as Gelam (*Melaleuca* sp.), Tumih (*Combretocarpus rotundatus*), Pelantan (*Alstonia* sp.) and Jelutung (*Dyera costulata*) can also be found.

Gelam is known as a pioneer species that is able to grow on disturbed land. A number of Gelam aggregate stands can be found in the previously burnt areas, some of which reach a height of more than 10 meters. This condition describes the ongoing rate of natural ecosystem succession. In addition to improving peat deposits, with shade from the gelam community, woody species that require shade, such as those from the Meranti species (Dipterocarpaceae), may grow in the future.

Table 5-2. The vegetation structure composition on areas covered with non-forest.

Strata	Σ Species	Species Name	Density (#/ha)
Trees	5	*Alstonia scholaris*	12.62
		Dyera costulata	12.62
		Combretcarpus rotundatus	6.57
		Melaleuca sp.	5.44
		Cratoxylum arborescens	5.44
Poles	3	*Melaleuca* sp.	48.66

Strata	Σ Species	Species Name	Density (#/ha)
		Cratoxylum arborescens	12.62
		Dyera costulata	8.04
Seedlings/understory plants	5	*Stenochlaena palustris*	345,000
		Selaginella sp.	5,600
		Nephrolepis sp.	3,400
		Scleria purpurescens	2,300
		Alocasia sp.	1,200



Figure 5-1. Left: non-forest class with open swamp and wet shrubs. Right: domination of Gelam within the sampling plots on project area.

Peat swamp ecosystem

The peat swamp forest includes primary and secondary forest, part of which has been exploited but is still in good condition and has a dense canopy cover. Fallen trees can be found at a number of points therein and a fairly easy-to-pass trail which is suspected to be an earlier exploitation.

Plant species that dominate the peat swamp forest are Malam-malam (*Diospyros areolata*), Pisangpisang (*Mezzetia parviflora*), Bintangur (*Calophyllum inophyllum*), Katiau (*Madhuca motleyana*), and Jambu-jambu (*Syzygium* sp.). These species are generally found in the secondary forest and in abundance. In general, the forest is still in good condition with a dense canopy cover and trees of large diameters. Non-tree species that dominate the peat swamp forest include Snake fruits (*Salacca* sp.), Rotan-rotanan (*Calamus* spp. and *Korthalsia* spp.), and Talas-talasan (*Raphidophora* spp. and *Homalomena* spp.). Woody lianas such as Akar kuning (*Fibraurea tinctoria*), Bajakah (*Spatholobus* sp.) and Kelawit (*Uncaria gambir*) are also frequently found in the peat swamp forest.

Table 5-3. The vegetation structure composition on peat swamp ecosystem.

Strata	Σ Species	Species Name	Density (#/ha)
Trees	29	*Diospyros areolata*	22.63
		Calophyllum inophyllum	9.09
		Mezzetia parviflora	9.09
		Madhuca motleyana	9.09
		Syzygium sp.	6.81

Strata	Σ Species	Species Name	Density (#/ha)
Poles	15	*Xylopia malayana*	13.63
		Syzygium sp.	13.63
		Madhuca motleyana	9.09
		Combretocarpus rotundatus	6.81
		Campnosperma coriaceum	6.81
Seedlings/understory plants	5	*Stenochlaena palustris*	345,000
		Selaginella sp.	5,600
		Nephrolepis sp.	3,400
		Scleria purpurescens	2,300
		Alocasia sp.	1,200



Figure 5-2. Peat swamp forest on project area.

Mangrove ecosystem

In the western part of the project area, primary mangrove forest, beach forest and peatlands can be found. Cemeti mangrove forest landscape has reached a climax succession; the mangrove stands are dominated by *Rhizopora stylosa* which is even and dense, with trees up to 15 meters high and more than 20 centimeters in diameter. Other types of mangroves that can be found include *Sonneratia alba*, *Avicennia alba,* and *Avicennia marina*. A large population of Nipa palm (*Nypa fruticans*) can be found 500 meters from the estuary. Meanwhile, other mangrove associates such as *Cerbera odollam* and *Barringtonia asiatica* can also be found.

Table 5-4. The vegetation structure composition on mangrove ecosystem.

Strata	Σ Species	Species Name	Density (#/ha)
Trees	3	*Rhizopora stylosa*	325
		Avicennia alba	12.5
		Avicennia marina	12.5
Seedlings/understory plants	4	*Nypa fruticans*	25
		Rhizopora stylosa	25
		Avicennia marina	12.5
		Avicennia alba	12.5



Figure 5-3. Mangrove forest on project area.

Coastal ecosystem

The Cemeti beach forest area is dominated by Coastal She-oak (*Casuarina equisetifolia*). Some individual pine trees can reach two meters in diameter. Other coastal plant species such as Coconut (*Cocos nucifera*), Butun (*Barringtonia asiatica*) and Bintaro (*Cerbera odollam*) also contribute to the beach forest community in Cemeti. There is a peat ecosystem 100 meters from the shoreline of Cemeti, which is dominated by Gelam (*Melaleuca* sp.) and Nipa palm (*Nypa fruticans*), some of which are 50 centimeters in diameter and more than 10 meters high.

Table 5-5. The vegetation structure composition on coastal ecosystem.

Strata	Σ Species	Species Name	Density (#/ha)
Trees	4	*Casuarina equisetifolia*	75.4
		Melaleuca sp.	7.5
		Barringtonia asiatica	7.5
		Cerbera odollam	7.5
Poles	4	*Melaleuca* sp.	180.75
		Nypa fruticans	96.66
		Antidesma sp.	33.35
		Casuarina equisetifolia	33.35
Seedlings/ understory plants	7	*Melaleuca* sp.	1,250
		Melastoma malabathricum	1,250
		Clerodendrum sp.	1,000
		Nypa fruticans	1,000
		Elaeis guineensis	1,000



Figure 5-4. Costal ecosystem on project zone.

5.1.1.2 Biodiversity Description

5.1.1.2.1 Flora

Information related to the flora species is carried out based on field assessment in the project area (Remark Asia, 2022). Sampling locations were determined using stratified purposive sampling based on ecosystem types in the project area. The ecosystem types in the PT PUM area consist of Forest Areas and Non-Forest Areas. Forest Areas are divided into Peat Swamp Forests and Mangrove Forests. A total of 19 plots were sampled which consisted of 14 plots in forest areas (seven plots in peat swamp forest and seven plots in mangrove forest) and five plots in non-forest areas. The survey method used was nested plot sampling and the size of each plot was 400 m^2 (20 m x 20 m). The sub-plot size was 20 m x 20 m for the trees. The nested sub-plot of 10 m x 10 m was created for the poles, 5 m x 5 m for the saplings, and 2 m x 2 m for the seedlings.

The survey identified at least 112 plant species in the project area. Six of these species are listed as threatened by the IUCN Red List. Four species are categorized as Vulnerable, including Balangeran (*Shorea balangeran*), Jelutung (*Dyera polyphylla*), Meranti Batu (*Shorea uliginosa*), and Punak (*Tetramerista glabra*). Meanwhile, Meranti Bunga (*Shorea teysmaniana*) is listed as Endangered. The Ramin species (*Gonystylus bancanus*) has been designated as Critically Endangered by the IUCN Red List. Ramin, Meranti Bunga, and Punak trees were found in the eastern part of the project area in peat swamp forest. Jelutung trees were found in non-forest area of the eastern part of the project area.

5.1.1.2.2 Fauna

The fauna information in the project area is based on the field assessment in the project area. The sampling locations were determined using stratified purposive sampling based on the ecosystem types in the project area. Sampling locations were dominantly placed in the remaining natural habitats, namely forests and wet shrubs, since these land cover classes were the main habitats for fauna and hence would increase the probability of animal encounter/sighting. However, observations were also made on other land cover classes such as open swamps, bare grounds, and wetlands or aquatic habitats.

Standardized survey methods were used for each fauna taxon (e.g., line transect and reconnaissance walk for mammals, point count for birds, Virtual Encounter Survey for herpetofauna, and trapping for fish supplemented with fishermen interviews and fish market surveys). The survey identified at least 255 fauna species in the project area consisting of 17 species of mammals from 12 families, 119 species of birds from 45 families, 28 species of herpetofauna from 14 families, and 91 species of fish from 57 families. From the 255 fauna species identified in the project area, 25 species are classified as threatened by the IUCN Red List, seven species are categorized as CITES Appendix I, seven as CITES Appendix II, and 15 species are protected under Indonesian law (MoEF Regulation No. P106/2018).

Birds

Based on observations and identification of bird species in the project area, at least 119 bird species from 45 families have been identified. The Ardeidae (11 species), Scolopacidae (10 species), Nectariniidae (7 species), Alcedinidae, Cuculidae, Timaliidae families each had six species, and the Accipitridae, Campephagidae, and Columbidae families each had five species. The highest number of species was found in the peat swamp habitat with 32 species, followed by 23 species in beach forest habitat, and 21 species in the open swamp habitat.

Observations in the eastern part of the project area indicate that the mangrove forest is still in relatively good condition and is located adjacent to the Cemeti River estuary, where a stretch of mudflat is visible at low tide. There are at least 17 migratory species belonging to three distinct families: Scolopacidae, Laridae, and Charadriidae. These migratory bird species use the wetland habitat of Cemeti River estuary as a temporary stopover to recover and forage before continuing their migration journey or returning to their original breeding grounds.

Regarding global population status, seven bird species identified in the project zone are categorized as threatened on the IUCN Red List including the Endangered migratory Far Eastern Curlew (*Numenius madagascariencis*), Greater Green Leafbird (*Chloropsis sonnerati*), and Javan White-eye (*Zosterops flavus*) (please refer to Table 5-1). There are nine species categorized as Near Threatened while the remaining are Least Concern. In addition, 10 species are included in Appendix II of CITES which regulates international trade, and 24 species are protected under Indonesian law (MoEF Regulation No. P.106/2018).



Figure 5-5. Migratory birds in the Cemeti River estuary: Eurasian Curlew (*Numenius arquata*), Whimbrel (*Numenius phaeopus*), and Far Eastern Curlew (*Numenius madagascariencis*).

Mammals

At least 17 mammal species from 12 families were identified in the project area. The Cercopithecidae (monkey) family had the most encounters, including Long-tailed Monkeys (*Macaca fascicularis*), Red Langurs (*Presbytis rubicunda*), Silver Langurs (*Trachypithecus cristatus*), and Proboscis Monkeys (*Nasalis larvatus*). Apart from that, the Sciuridae family (squirrels) is the second most common mammal family, including Plantain Squirrels (*Callosciurus notatus*) and Horse-tailed Squirrels (*Sundasciurus hippurus*).

Under the global conservation status, two mammal species are categorized as Critically Endangered on the IUCN Red List of Threatened Species, namely the Southwest Bornean Orangutan (*Pongo pygmaeus wurmbii*) and the Sunda Pangolin (*Manis javanica*); three as Endangered, namely the Proboscis Monkey (*Nasalis larvatus*), Bornean White-bearded Gibbon (*Hylobates albibarbis*), and Flat-headed Cat (*Prionailurus planiceps*); and eight as Vulnerable. Furthermore, a total of seven different species of mammals are categorized under CITES Appendix I and II and a total of nine mammal species are protected under Indonesian law (MoEF Regulation No. P106/2018).

Four species were identified as endemic to Borneo, namely the Bornean White-bearded Gibbon (*Hylobates albibarbis*), Red Langur (*Presbytis rubicunda*), Proboscis Monkey (*Nasalis larvatus*), and Southwest Bornean Orangutan (*Pongo pygmaeus wurmbii*). A preliminary nest-count survey was conducted during the biodiversity assessment to estimate Orangutan population density in the eastern part of the project area. It was estimated that the Orangutan population density in the eastern part was 0.89 individual/km^2. As a comparison, a study between 2013 and 2015 estimated Orangutan population density of 1.19 individual/km^2 in Sebangau National Park[140]. Considering the project area was once designated for oil palm plantation, the Orangutan density in the project area was an important finding for the project. Hence, the

[140] https://www.tnsebangau.com/persentase-peningkatan-populasi-orangutan

project activities that will monitor Orangutan population, reduce threats to the habitat and species, and restore the habitat are vital to maintain and increase the biodiversity values within the project area.



Figure 5-6. Mammals found in the project area: [left figure] Proboscis Monkey (*Nasalis larvatus*), [middle figure] Bornean White-bearded Gibbon (*Hylobates albibarbis*), and [right figure] Southwest Bornean Orangutan (*Pongo pygmaeus wurmbii*).

Herpetofauna

Kalimantan is an island with a very distinctive biodiversity and is known to have high endemic species including herpetofauna. At least 28 species of herpetofauna from 14 families were recorded in the project area. The amphibians were from the order Anura (frogs and toads), while the reptiles discovered are from the order Squamata (lizards and snakes). One of the endemic species found in the project area is the Borneo Skink (*Dasia vittata*). The project also recorded several species that are commonly found in peat ecosystem including Suck Toad (*Pseudobufo subasper*), Baram River Frog (*Pulchrana baramica*), Blackwater Mud Snake (*Phytolopsis punctata*), Reticulated Python (*Malayopython reticulatus*) and King Cobra (*Ophiophagus hannah*). King Cobra is categorized as Vulnerable under the IUCN Red List. Two species are also listed in CITES Appendix II, namely King Cobra and Common Water Monitor (*Varanus salvator*).



Figure 5-7. Photo of Reticulated Phyton (*Malayopython reticulatus*) recorded in the project area.

Fish

From observations within and around the study area, 91 fish species from 57 families were identified. 31 fish species from 12 families were recorded in the eastern part of the Katingan River System, which is dominated by peat swamp, freshwater swamp, and tributaries. Meanwhile, 46 species of fish from 40 families were discovered in the western part of the project area (southwest side of the Katingan River System), which contains estuary microhabitat types, mangrove swamps, creeks, and freshwater swamps.

Out of 91 fish species, four stingray species are categorized as Endangered and Vulnerable species under the IUCN Red List. Whitespotted Whipray (*Maculabatis gerrardi*) was categorized as Endangered, while three other species Spotted Eagle Ray (*Aetobatus ocellatus*), Bengal Whipray (*Brevitrygon imbricata*), and Longtail Butterfly Ray (*Gymnura poecilura*) were categorized as Vulnerable. These stingray species were usually found in the estuary or the river downstream during storms or high tides. Furthermore, six peat-swamp affiliated species were all categorized as Near Threatened including *Channa pleurophthalma, Sphaerichthys selatanensis, Paedocypris carbunculus, Kryptopterus macrocephalus, Ompok fumidus,* and *Silurichthys cf. phaiosoma.*

5.1.1.3 Threats to biodiversity

The biggest threat to biodiversity in the project area is the threat of conversion to oil palm plantations. Based on the history of land management, the project area has received an oil palm plantation permit. This can also be seen from the current conditions in the project zone where there are already operating oil palm plantations. If land use changes occur, the habitat for most of the existing biodiversity will be lost.

Other threats to biodiversity in the project area originate from the livelihoods of communities in the project zone. The livelihoods of the people living in the project zone are still based on the use of land and natural resources. The main livelihoods of the community include rice farmers (69.1%), vegetable farmers (12.1%), fishermen (10.1%), fish farmers (3.5%), loggers (1.8%), and NTFPs collectors (3.3%)[141]. Community livelihoods that are still land-based can have an impact on the condition of existing biodiversity. With farming representing the largest proportion of livelihoods, the expansion of agricultural areas could pose a threat to the project area which is a biodiversity habitat.

[141] Report for Preparation of an Empowerment Program for Livelihood Groups Affected by the Ecosystem Restoration Project PT PUM (Yayasan Puter, 2022)

Regarding fish populations in the project area and project zone, the application of unsustainable fishing methods has potential negative impacts on fish populations. In the project zone, at least four species of fish were found that were included in the HCV category, including the Spotter Eagle Ray (*Aetobatus ocellatus*), Whitespotted Whipray (*Maculabatis gerrardi*), Bengal Whipray (*Brevitrygon imbricata*), and Longtail Butterfly Ray (*Gymnura poecilura*). Project interviews indicated the use of electric generators and fish poison in several areas of the Katingan River System. This has the potential to reduce population fitness in the affected area. Fish larvae and microscopic fish are likely to be disturbed because they are more vulnerable to the use of destructive fishing gear. Overfishing may reduce the population of a species. However, there is no data available on the fishing methods used by fishermen in the area. A precautionary approach is taken to determine overfishing as a threat.

Another livelihood activity in the project zone that may affect biodiversity is logging. Based on the results of a study by Yayasan Puter (2022) in the project zone, loggers' activities are driven by demand for wood at the community level. Loggers look for wood in the peat swamp forest area of the project zone. This logging activity in peat swamp forests disturbs the habitat of protected animals that are highly dependent on forest canopy covers, such as Bornean Orangutans (*Pongo pygmaeus*), Bornean white-bearded Gibbons (*Hylobates albibarbis*), and Proboscis Monkeys (*Nasalis larvatus*).

The types of wood sought by the loggers include wood from the Meranti group (Dipterocarpaceae family), Balangeran (*Shorea balangeran*), Punak (*Tetramerista glabra*), Gelam (*Melaleuca* sp.), and Ramin (*Gonystylus bancanus*). From the list of types of wood sought, only Gelam is not included in the rare, threatened and endangered (RTE) category. Balangeran and Punak are included in the Vulnerable category according to the IUCN Red List while Ramin is Critically Endangered. Several Meranti species in the project area are also considered Endangered, such as Meranti bunga (*Shorea tesymaniana*), and several others are in the Vulnerable category, such as Meranti batu (*Shorea uliginosa*).

5.1.2 High Conservation Values (B1.2)

5.1.2.1 HCV 1: Species Diversity

The area containing HCV 1, which relates to species diversity, has been identified in the project area and the project zone. The following is a summary of HCV 1 found in the area:

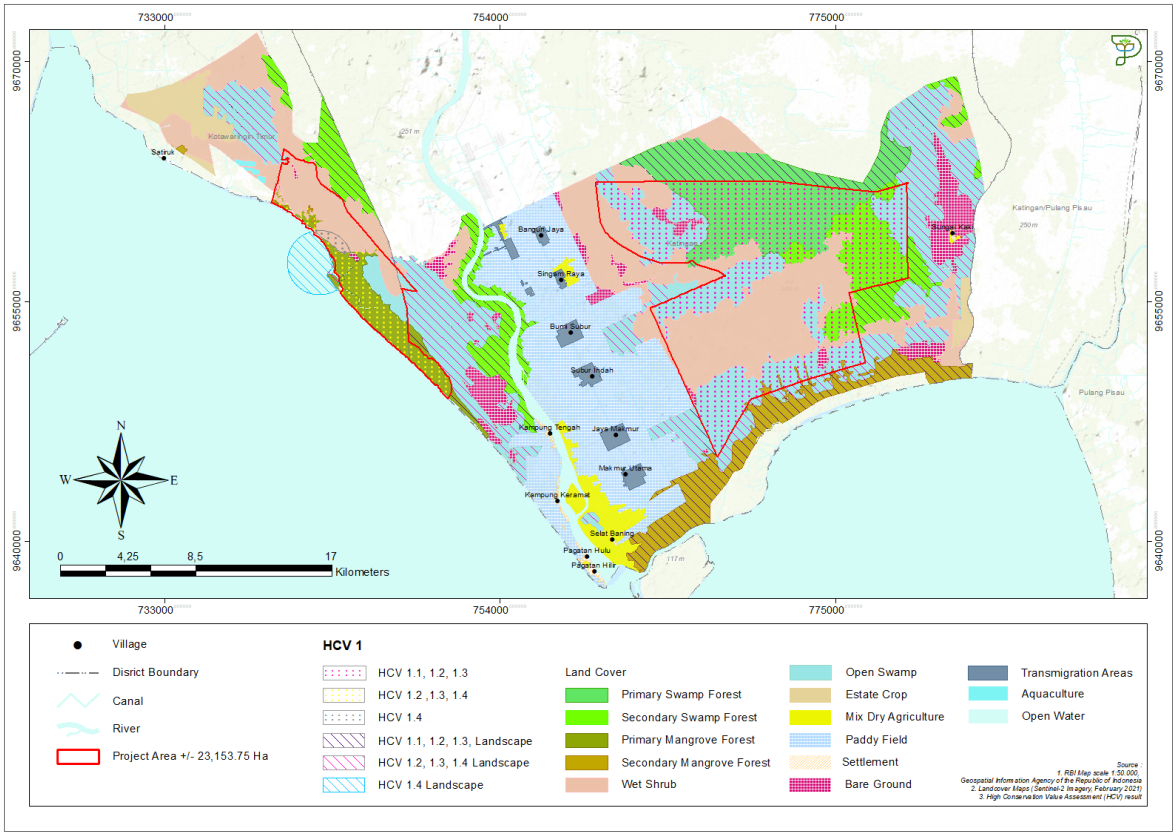
High Conservation Value	HCV 1: Rare, threatened, and endangered species
Qualifying Attribute	The project area of PT PUM is a habitat of the critically endangered, endangered, and vulnerable species according to the IUCN Red List. There are two species of mammals classified as Critically Endangered, i.e., Southwest Bornean orangutan (*Pongo pygmaeus wurmbii*) and Sunda pangolin (*Manis javanica*), three species listed as Endangered, i.e., Bornean white-bearded gibbon (*Hylobates albibarbis*), Proboscis monkey (*Nasalis larvatus*), and Flat-headed cat (*Prionailurus planiceps*), and eight mammal species with Vulnerable status. Three species of birds are classified as Endangered, i.e., Greater green leafbird (*Chloropsis sonnerati*), Far eastern curlews (*Numenius madagascariencis*), and Javan white-eyes (*Zosterops flavus*), and four species of birds are listed as Vulnerable. One species of herpetofauna is included in the Vulnerable category, i.e., King cobra (*Ophiophagus*

	hannah). One species of fish is categorized as Endangered, i.e., Whitespotted whiprays (*Maculabatis gerrardi*), and three species are categorized as Vulnerable. There is one plant species categorized as Critically Endangered (CR), one species as Endangered (EN), and four species as Vulnerable (VU).
Focal Area	Both the eastern and the western parts of the project area

High Conservation Value	HCV 1: Endemic species
Qualifying Attribute	The project area provides habitat for endemic species, such as the Southwest Bornean orangutan (*Pongo pygmaeus*), the Bornean white-bearded gibbon (*Hylobates albibarbis*), Red langur (*Presbytis rubicunda*), Proboscis monkey (*Nasalis larvatus*), and Borneo skink (*Dasia vittata*).
Focal Area	Both the eastern and the western parts of the project area

High Conservation Value	HCV 1: Areas that contain habitat for viable populations of endangered, restricted-range or protected species.
Qualifying Attribute	Both the eastern and the western parts of the project area are habitat for viable populations of endangered, restricted-range or protected species. Three species of animals with critically endangered (CR) status are found in the project area, as well as eight species listed as endangered (EN) and 20 species classified as vulnerable (VU). Seven of these species are listed in CITES Appendix I, and seven other species are listed in CITES Appendix II. In addition, the laws, and regulations of the Republic of Indonesia, namely MoEF Regulation P.106 of 2018, protect a number of species present in the project area.
Focal Area	Both the eastern and the western parts of the project area

High Conservation Value	HCV 1: Areas that contain habitat of temporary use by species or congregations of species
Qualifying Attribute	The migratory birds are found in the western part of the project area. The estuary of Cemeti River is part of the migration route for at least 17 species of migratory shorebirds and migratory seabirds.
Focal Area	Western part of the project area (estuary of Cemeti River).



Map 5-1 HCV 1 at the project zone

5.1.2.2 HCV 2: Ecosystems and Mosaic Ecosystems at the Landscape Level

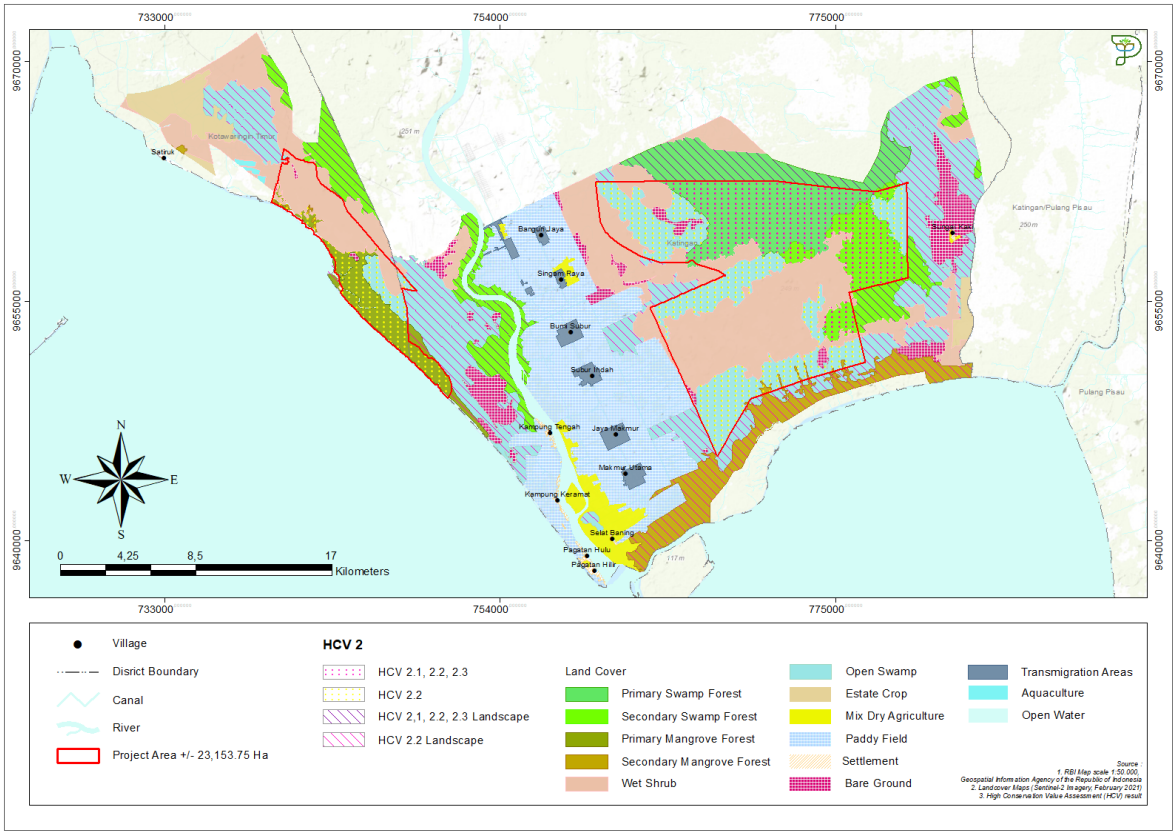
The area containing HCV 2, which relates to the ecosystems and mosaic ecosystems at the landscape level, has been identified in the project area. The following is a summary of HCV 2 found in the area:

High Conservation Value	HCV 2: Large natural landscapes with capacity to maintain natural ecological processes and dynamics.
Qualifying Attribute	The peat swamp forests in the project area and the project zone are ecologically connected with the Sebangau National Park landscape which covers a total area of 568,700 hectares. In addition to its vast integrity, preservation of this area is secure because it is a conservation area whose forest cover will be preserved, which is important to support the movement of wild animals.
Focal Area	The peat swamp forest in the project area and the project zone.

High Conservation Value	HCV 2: Areas that contain two or more contiguous ecosystems
Qualifying Attribute	The project area's ecosystems are divided into four types: peat wetlands, freshwater swamps, beach forests, mangrove forests, and saltwater swamps. There are regions bordering the two remaining forested and sustainable ecosystems, namely the peat and freshwater

	swamp ecosystem in the eastern part and the beach forest, mangrove forest, and saltwater swamp ecosystem in the western part. Although some of the land cover in the eastern part of the region has turned into shrubs, there are still areas of forest and shrubs that are interconnected between the two types of ecosystems.
Focal Area	The project area and the project zone.

High Conservation Value	HCV 2: Areas that contain representative populations of most naturally occurring species
Qualifying Attribute	The project area is a habitat for fauna and flora species. There are 17 mammal species from 12 families, 119 bird species from 45 families, 28 herpetofauna species from 14 families, and 91 fish species from 57 families in the project region. In addition, 112 plant species from 53 families were also found. Based on these results, it appears that there are representative populations of flora and fauna in the project area. Aside from the large number of identified species, there are also a large number of individuals or abundances of different kinds of flora and fauna, representing a high degree of biodiversity.
Focal Area	The project area and the project zone.

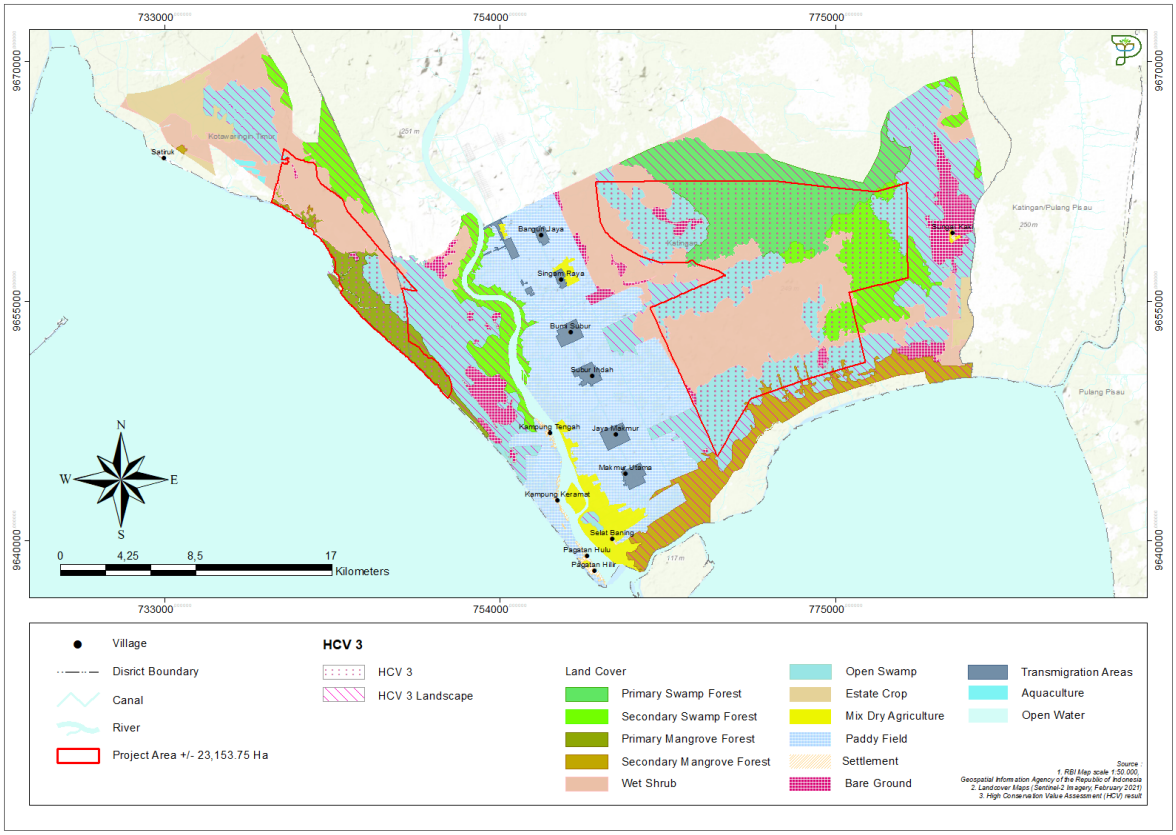


Map 5-2. HCV 2 at the project zone

5.1.2.3 HCV 3: Ecosystem and Habitat

The area containing HCV 3, which relates to forest areas that are in or contain rare, threatened or endangered ecosystems, has been identified in the project area. The following is a summary of HCV 3 found in the area:

High Conservation Value	HCV 3: Rare and endangered ecosystem
Qualifying Attribute	There are indications of the existence of rare and endangered ecosystems within the project area and the landscape boundary, i.e., the peat swamp ecosystem [consisting of Gambut (GBT) and Mendawai (MDW) land systems], the freshwater swamp ecosystem [consisting of Kahayan (KHY) land systems], the beach forest ecosystem [consisting of Puting (PTG) land systems], and the mangrove and intertidal swamp ecosystem [consisting of Kajapah (KJP) land system]. The state of these rare and endangered ecosystems is mixed. Some are still secondary forests and shrubs, while others have become shrubs and open land. Based on the WWF's Biophysiogeographic Map, PT PUM's area is included in the Borneo Peat Swamp Forest.
Focal Area	The project area and the project zone.

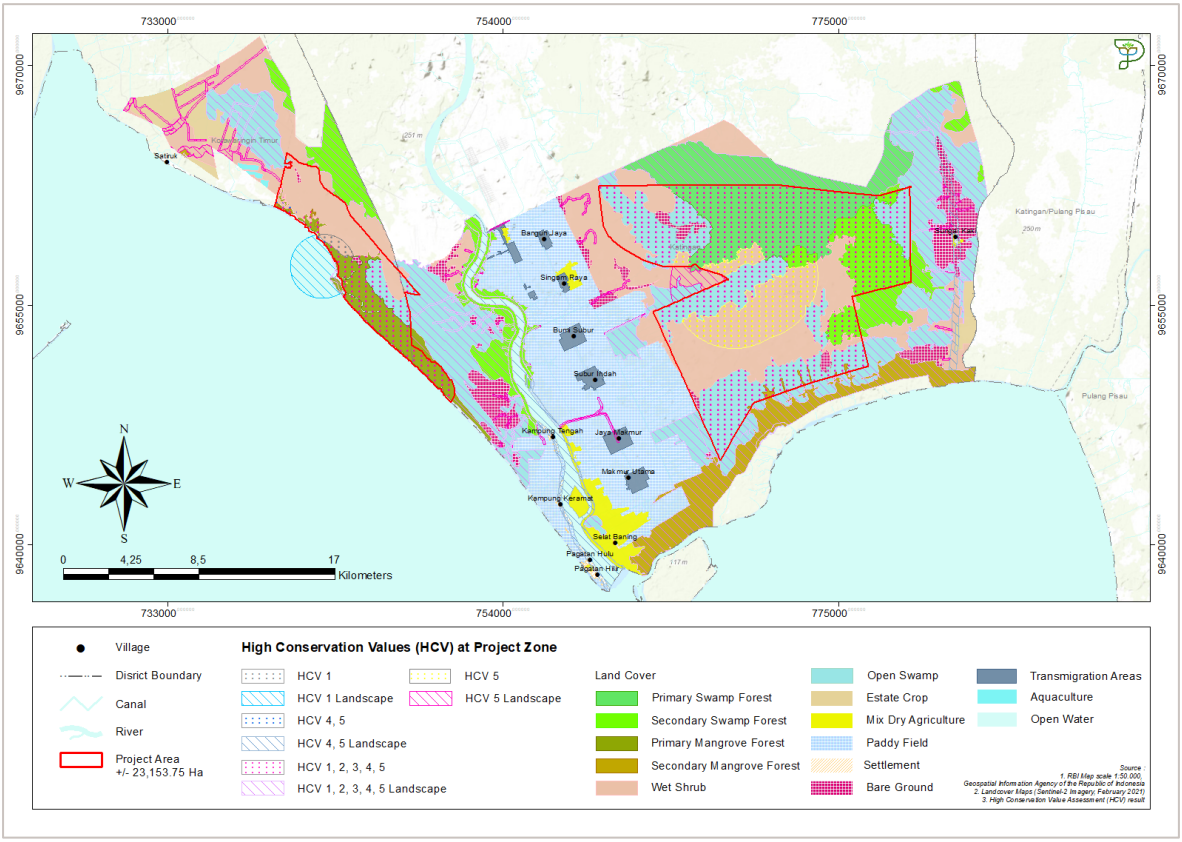


Map 5-3. HCV 3 at the project zone

The following table provides a summary of the size of the area of each HCV found within the project proponent's area:

Table 5-6. Summary of HCV areas in PLUM project area.

HCV	HCV areas (ha)		
	Eastern Part	Western Part	Total
HCV 1. Concentration of biodiversity	12,399.30	2,272.05	14,671.35
HCV 2. Ecosystems at the broad landscape level and ecosystem mosaics.	12,399.30	2,141.57	14,540.87
HCV 3. Ecosystems and habitats.	12,399.30	2,141.57	14,540.87
HCV 4. Ecosystem services	12,399.30	2,191.37	14,590.67
HCV 5. Basic needs for communities.	15,015.70	2,191.95	17,207.65
Total HCV Area (net)			**17,157.27**



Map 5-4. Identified High Conservation Value (HCV) areas in the project zone

5.1.3 Without-project Scenario: Biodiversity (B1.3)

The without-project scenario would have an impact on both the flora and fauna and the communities living around the project area. The project area is a supporting area for the Sebangau National Park that still has

rich biodiversity, being home to 17 mammal species, 119 bird species, 28 herpetofauna species, and 112 plant species. A number of these species are classified as vulnerable, endangered, or critically endangered.

If the without-project scenario is put in place, both the eastern and western parts of the project area would be turned into oil palm plantations. Land clearing would occur as the initial stage of the plantation activities. As a result, the value of the biodiversity of the forest would be lost, and the habitat of different animals and plants would be turned into monoculture plants or oil palm plantations. This would cause the value of biodiversity to decline or be completely lost.

5.2 Net Positive Biodiversity Impacts

5.2.1 Expected Biodiversity Changes (B2.1)

Under the project scenario, the forest in the project area will be protected from the threat of planned deforestation and forest degradation. The expected biodiversity changes as a result of project implementation are summarized below:

Biodiversity Element	Natural Ecosystem
Estimated Change	Reduced factors that contribute to species extinction and biodiversity loss
Justification of Change	As a part of the project, there will be forest protection initiatives, which include several programs as listed in Section 2.1.11. These programs are expected to have a significant positive impact on the ecosystem within the nearby project area, which will create a positive domino effect for the biodiversity in the area due to improved habitat conditions and connectivity.

Biodiversity Element	Flora and Fauna
Estimated Change	Gradual dispersal and increase of flora and fauna species in the project area.
Justification of Change	It is anticipated that the abundance of flora and fauna in the project area will increase due to the project activities. The positive impact of the project can be determined by comparing the abundance of threatened plants and animals in the project area to the number previously identified. This will be accomplished by a regular patrol team that will patrol the project area. In addition, monitoring of fauna will be conducted to monitor the populations of threatened species.

Biodiversity Element	Forest Cover
Estimated Change	Reduced deforestation and forest degradation
Justification of Change	The project prevents the land use change that will lead to deforestation and forest degradation in the project area. This is accomplished by avoiding the conversion of the forest area to oil palm plantation, by restoring mangrove forests, by planting degraded peat forests and other activities to protect the forests. Over time, the restoration efforts will result in greater forest cover.

5.2.2 Mitigation Measures (B2.3)

Based on the assessment conducted by the project team, there are no expected negative impacts of the project on biodiversity and ecosystems. Therefore, no mitigation measures are required.

5.2.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

Compared with the conditions under the without-project land-use scenario, the project scenario will provide high net positive biodiversity impacts. There are three main components of biodiversity in the project area that will be secured and sustained during the project implementation, namely (i) ecosystems, (ii) the species of flora and fauna especially those that are critically endangered, endangered, and vulnerable, and (iii) forest cover.

The remaining forest in both parts of the project area are critical to ensuring the viability of flora and fauna diversity, particularly protected species. Furthermore, some ecosystems serve multiple functions, such as the peat forest, which not only provides habitat for protected species but also serves as a water cycle regulator and carbon store. Mangrove forests also provide ecosystem services by filtering sediment into the sea while preserving the island's physical integrity. Even though the existing forest in the project area is degraded and fragmented, it has the potential to be restored, providing more habitat for flora and fauna. Restoration efforts will focus on protecting, restoring, and connecting fragmented forest patches, as well as biodiversity quality as measured by population density/nest of Orangutans and Proboscis monkeys within 60 years of the project's inception. Proboscis monkeys, unlike orangutans, prefer specific habitats, such as large rivers in coastal areas that have been extensively converted into cultivated and residential areas. Severe fires in 1997-1998 destroyed much of the habitat and hunting for this species is also a contributing factor to its population decline (IUCN, 2021).

The net benefits and impacts on biodiversity are expected to be positive as a result of restoration activities that will be implemented in the project area. The project's biodiversity impact goal includes activities to significantly increase forest cover area (expressed in ha) by planting local (native) tree species combined with natural regeneration in shrubs and bushes. Planned protection efforts are another important activity, with regular patrols to minimize or, if possible, eliminate disturbances (habitat encroachment, fires, and hunting) to the existence of threatened species. Furthermore, the project will implement peatland rewetting activities to keep the average groundwater level in a year at about 0.4 meters below the peat land surface. One of the activities is the construction of canal blocks (dams) to slow the rate of subsidence and maintain the peat water level. This rewetting program will be critical in maintaining the physical stability and productivity of peatlands, allowing restoration efforts to proceed. All of these efforts will provide a habitat extension and enhance connectivity of the project area to the larger forest areas in the project zone (e.g., Sebangau National Park to the north) which will be beneficial for the long-term viability of threatened species population.

5.2.4 High Conservation Values Protected (B2.4)

Four categories of biodiversity-related HCV areas were identified in the project area, as described in Section 5.1.2. They are namely:

- HCV1: Species Diversity
    - Rare, threatened, and endangered species

  - Endemic species
  - Areas that contain habitat for viable populations of endangered, restricted-range or protected species.
  - Areas that contain habitat of temporary use by species or congregations of species
- HCV2: Ecosystems and mosaic ecosystems at the landscape level
  - Large natural landscapes with capacity to maintain natural ecological processes and dynamics.
  - Areas that contain two or more contiguous ecosystems
  - Areas that contain representative populations of most naturally occurring species
- HCV3: Ecosystem and habitat
  - Rare and endangered ecosystem
- HCV4: Ecosystem services
  - Protection of Water Catchments
  - Areas that function as natural barriers to the spread of forest or ground fire

Protecting biodiversity is a key focus in the project activities. The project contributes to preserving and improving the area and quality of forests and natural ecosystems, as well as connecting each HCV area. This emphasis on preserving and improving forests and natural ecosystems to protect them will have a significant positive impact on HCVs 1-4. Infrastructure such as basecamps, guard posts, fire towers, and nurseries will be built outside of the critical ecosystems.

5.2.5 Species Used (B2.5)

The project's restoration activities, which include planting and reforestation in the project area, will utilize native species. No non-native species will be used in the project area. The species used in these activities are mentioned in Section 2.1.11.

5.2.6 Invasive Species (B2.5)

Project activities will not result in the introduction of invasive species.

5.2.7 Impacts of Non-native Species (B2.6)

No non-native species will be used in the project area. Therefore, there will be no impact of non-native species on the project areas.

5.2.8 GMO Exclusion (B2.7)

No genetically modified organisms (GMOs) will be used in the project. In addition, planting activities do not make use of seeds derived from GMOs.

5.2.9 Inputs Justification (B2.8)

No fertilizers, chemical pesticides, biological control agents nor other similar inputs will be used in the project's restoration efforts.

5.2.10 Waste Products (B2.9)

There are some potential waste products from the project activities. Thus, it is necessary to reduce the waste products that are generated. Waste generated by human activities (domestic waste) in field offices, basecamps, and guard posts is one example of potential waste generated by project activities. Domestic waste includes solid waste such as plastic waste, used cans, used plastic packaging, Styrofoam, paper, i and food waste, as well as liquid waste such as soapy water, detergent water, oil, and faeces. Moreover, there is the possibility of waste from operational activities such as used generator oil, used vehicle or engine oil, gasoline or diesel spills, and used batteries. In line with the company's Environmental Management and Monitoring Plan (UKL/UPL), the project will develop a Standard Operating Procedure (SOP) for waste management. The project will apply the 3R concept (Reduce, Reuse, Recycle), which involves reusing waste that can still be used or has other functions, reducing everything that causes or generates waste, and recycling waste into a product or item that can be useful.

5.3 Offsite Biodiversity Impacts

5.3.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Measures (B3.2)

The project is designed to have no negative impacts on biodiversity outside the project zone as described under Section 5.2.1.

5.3.2 Net Offsite Biodiversity Benefits (B3.3)

Net offsite biodiversity benefits are expected to be positive due to the connectivity with the surrounding landscape, in particular Sebangau National Park. The project focuses on the protection of biodiversity and improvement of biodiversity habitat, especially habitat for key-species such as Orangutan, Proboscis monkey, and Bornean white-bearded gibbon.

Compared to the without-project scenario, the project scenario is deemed to provide positive biodiversity impacts in the project area and its surroundings. Considering the project activities in patrol and monitoring species and habitat, the project will provide more favourable conditions for species and habitat conservation.

5.4 Biodiversity Impact Monitoring

5.4.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

The project intends to meet the Gold Level for exceptional biodiversity benefits (GL3), hence the indicators of the population threats of each trigger species are monitored through the Spatial Monitoring and Reporting Tool (SMART)[142]. Furthermore, the relative density of the species population will be monitored through permanent transects and regular monitoring.

The project has developed a monitoring plan with aims to provide biodiversity net benefits. The coverage of monitoring activities includes protection of remaining forests through regular patrols and biodiversity

[142] www.smartconservationtool.org

monitoring. The detailed monitoring indicators for biodiversity impacts, including climate change adaptation benefits as described in Section 3.4.3, are reflected in Appendix 13: Monitoring Plan.

5.4.1.1 Protection of remaining forest

Monitoring Location	In the project area
Activities	SMART patrol data collection to assess threats to biodiversity (e.g., illegal logging, hunting, destructive fishing, etc.) and field observation activities.
Means of Verification	• SMART Patrol report

5.4.1.2 Monitoring of trigger species: Southwest Bornean Orangutan

Monitoring Location	In the project area
Activities	Monitoring of Southwest Bornean orangutan (*Pongo pygmaeus*) through permanent monitoring transects design using nest count parameters. Bi-annual monitoring on permanent monitoring transects.
Means of Verification	• Biodiversity monitoring report • SMART Patrol report (sighting/encounter records)

5.4.1.3 Monitoring of trigger species: Bornean White-bearded Gibbon

Monitoring Location	In the project area
Activities	Monitoring of the Bornean white-bearded gibbon (*Hylobates albibarbis*) through permanent monitoring transects using echo-triangulation parameters. Annual monitoring on permanent monitoring transects.
Means of Verification	• Biodiversity monitoring report • SMART Patrol report (sighting/encounter records)

5.4.1.4 Monitoring of trigger species: Proboscis Monkey

Monitoring Location	In the project area
Activities	Monitoring of Proboscis monkey (*Nasalis larvatus*) populations through systematic river route using encountered individual parameters. Annual monitoring on river route.
Means of Verification	• Biodiversity monitoring report • SMART Patrol report (sighting/encounter records)

5.4.1.5 Monitoring of biodiversity

Monitoring Location	In the project area
Activities	Biodiversity assessment on mammals, birds, vegetation. The project will use camera trapping method to estimate terrestrial mammals' diversity and abundance, point count survey method for birds, and permanent vegetation monitoring plots for vegetation. Annual monitoring.

Means of Verification	• Biodiversity monitoring report • SMART Patrol report (sighting/encounter records)

5.4.2 Biodiversity Monitoring Plan Dissemination (B4.3)

The results of biodiversity monitoring are disseminated in two ways. First, by distributing annual reports to relevant government stakeholders (MoEF, BKSDA[143], the Provincial Forestry Agency, and Environmental Agency). Second, by consistently sharing information via social media and the project's website. In addition, to reach the village community, the project proponent team will regularly publish information sheets and display them on the village information boards. Information will also be disseminated orally in community meetings and in local schools. Sharing information with stakeholders is one of the mitigation efforts; the data will be useful for the stakeholders to be able to guide the implementation of appropriate mitigation measures.

5.5 Optional Criterion: Exceptional Biodiversity Benefits

The project aims to achieve exceptional biodiversity benefits and be validated to the Gold Level based on the presence of ecologically important IUCN Red List species (GL3) in the project area.

5.5.1 High Biodiversity Conservation Priority Status (GL3.1)

There are 31 species categorized as threatened by the IUCN Red List in the project area. Overall, there are three species with the status of Critically Endangered (CR), eight species listed as Endangered (EN), and 20 species with Vulnerable (VU) status. Besides, seven species are included in CITES Appendix I, and seven in CITES Appendix II. In addition, 15 protected species according to Ministry of Environment and Forestry Regulation No. 106/2018, four endemic mammal species and one endemic bird species to Borneo inhabit the area. A list of priority species can be seen in Table 5-1.

5.5.2 Trigger Species Population Trends (GL3.2, GL3.3)

As defined in the CCB Standards, trigger species must meet the criteria of "vulnerability" or "irreplaceability". Vulnerability is defined as regular occurrence of IUCN Red List of threatened species (species listed as CR, EN, or VU) in the project area, while irreplaceability is defined as the presence of 1-5% of a species' global population (at any stage of the species' life cycle) in the project area. The project's initial biodiversity survey identified at least 31 species (13 mammals, seven birds, one reptile, four fish, and six plants) that are classified as threatened by the IUCN Red List in the project area and therefore meet the vulnerability criteria and are considered as trigger species (Table 5-1). The project selected three trigger species that are endemic to Borneo to be monitored more intensively (to population density level), namely the Southwest Bornean orangutan (*Pongo pygmaeus wurmbii*), Proboscis monkey (*Nasalis larvatus*), and the Bornean white-bearded gibbon (*Hylobates albibarbis*). The remaining 28 species will also be monitored regularly using standardized protocols (e.g., point transect surveys for birds, camera trap surveys for mammals, permanent vegetation plots for plants, etc.) to determine species occurrence and abundance in the project area.

[143] Central Kalimantan Natural Resources Conservation Agency.

Southwest Bornean orangutan (*Pongo pygmaeus wurmbii*)

The Bornean orangutan is classified as CR on the IUCN Red List. Bornean orangutans have a large home range (>560 ha for adult males and 250-300 ha for adult females in peat swamp forest[144] and require relatively intact forest for survival, hence they are considered as umbrella species for other smaller-ranged species in peat swamp forest ecosystem. Initial population density estimate from orangutan nest survey in the eastern part of the project area is 0.89 individual/km^2.

Proboscis monkey (*Nasalis larvatus*)

The Proboscis monkey is classified as EN on the IUCN Red List. Proboscis monkeys primarily reside in mangrove forest and riverine/riparian forest ecosystems[145], therefore monitoring the species could represent other species that inhabit the same ecosystems. The initial survey identified at least 16 individuals in the western part of the project area. However, the baseline population assessment has not been conducted, therefore the project will assess the population of the species at the beginning of the project.

Bornean white-bearded gibbon (*Hylobates albibarbis*)

The Bornean white-bearded gibbon is classified as EN on the IUCN Red List. This species has similar habitat requirements as the Bornean orangutan but has smaller home ranges (39-52 ha in Sebangau peat swamp forest[146]), which makes them more vulnerable to habitat disturbances. Gibbons also have a faster life history compared to orangutans[147], enabling faster increase in population size. Consequently, gibbons would show faster positive or negative responses to habitat disturbances. The initial biodiversity survey has not estimated the population or population density of this species, but they were encountered in peat swamp forest ecosystem.

All three species face threats of habitat loss from deforestation and forest fires. Management of these three species will represent other trigger species that inhabit similar ecosystems or face similar threats.

Trigger Species	Southwest Bornean Orangutan (*Pongo pygmaeus wurmbii*)
Population Trend at Start of Project	The species is endemic to Borneo and classified as Critically Endangered by the IUCN Red List. The initial survey estimated a population of 0.89 individuals/km^2 in the eastern part of the project area. According to the IUCN Red List, the population trend of this species is decreasing due to deforestation (e.g., agricultural areas, settlements, roads and infrastructure), human-wildlife conflicts, poaching, habitat fragmentation, and forest fires.

[144] Campbell-Smith G., *et al*. (2011). Apes in Space: Saving an Imperilled Orangutan Population in Sumatra. PLoS ONE 6(2): e17210. https://doi.org/10.1371/journal.pone.0017210
[145] Bismark, M. (2010). Proboscis Monkey (*Nasalis larvatus*): Bio-ecology and Conservation. In: Gursky, S., Supriatna, J. (eds) Indonesian Primates. Developments in Primatology: Progress and Prospects. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-1560-3_12
[146] Cheyne, S.M. (2010). Behavioural Ecology of Gibbons (*Hylobates albibarbis*) in a Degraded Peat-Swamp Forest. In: Gursky, S., Supriatna, J. (eds) Indonesian Primates. Developments in Primatology: Progress and Prospects. Springer, New York, NY. https://doi.org/10.1007/978-1-4419-1560-3_8
[147] Wich, S., *et al*. (2005). Life history of wild Sumatran orangutans (*Pongo abelii*). Journal of human evolution. 47. 385-98. 10.1016/j.jhevol.2004.08.006

Without-project Scenario	It is probable that the population will decrease without the project as existing threats still remain. In the baseline scenario, the area will be converted to an oil palm plantation which will reduce the natural habitat of the species.
With-project Scenario	The eastern part of the project area is situated adjacent to the Sebangau NP where the 2016 PHVA[148] estimated a population of 5,683-5,826 orangutan individuals. Therefore, protecting the remaining forest from conversion to oil palm plantation and restoring deforested areas in the project area will provide a habitat extension and enhance connectivity to the NP which will be beneficial for the long-term viability of the population. It is expected that with the project, the population will remain stable or increase.
Monitoring Plan	Once every two years, the orangutan population in the project area will be monitored using the orangutan nest count survey method. Permanent monitoring transects will be established in the beginning of the project. Any direct or indirect encounter with the species during regular patrols will also be recorded.

Trigger Species	Proboscis Monkey (*Nasalis larvatus*)
Population Trend at Start of Project	The species is endemic to Borneo and classified as Endangered by the IUCN Red List. The initial survey recorded at least 16 individuals in the mangrove forest in the western part of the project area. According to IUCN Red List, the population trend of the proboscis monkey is decreasing due to deforestation (e.g., agricultural areas, settlements, roads and infrastructure) and forest fires.
Without-project Scenario	It is probable that the population will decrease without the project as existing threats still remain. In the baseline scenario, the area will be converted to an oil palm plantation which will reduce the natural habitat of the species.
With-project Scenario	Proboscis monkeys inhabit the mangrove and riverine forests in the project area. Protection of the remaining mangrove forest and mangrove restoration in the project area will benefit the species from protected and improved habitat conditions (increased forest cover and food sources). Therefore, we expect that the population will remain stable or increase with the project.
Monitoring Plan	Annually, the population of proboscis monkey in the project area will be monitored using the river survey method along the river and tributaries. Permanent monitoring routes will be established at the beginning of the project. Any direct or indirect encounter with the species during regular patrols will also be recorded.

Trigger Species	Bornean White-bearded Gibbon (*Hylobates albibarbis*)
Population Trend at Start of Project	The species is endemic to Borneo and classified as Endangered by the IUCN Red List. The project has not estimated the population density of the species but the initial biodiversity survey identified the species occurrence in the peat swamp

[148] Utami-Atmoko, S., *et al.* (eds.) (2017). Orangutan Population and Habitat Viability Assessment: Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.

	forest in the eastern part of the project area. According to IUCN Red List, the population trend of the species is decreasing due deforestation (forest conversion to non-forests e.g., agricultural areas, settlements, roads and infrastructure), poaching, and forest fires.
Without-project Scenario	It is probable that the population will decrease without the project as existing threats still remain. In the baseline scenario, the area will be converted to an oil palm plantation which will reduce the natural habitat of the species.
With-project Scenario	The eastern part of the project area is situated adjacent to the Sebangau NP, therefore protecting the remaining forest and restoring deforested areas in the project area will provide a habitat extension and enhance connectivity to the NP which will be beneficial for the long-term viability of the population. It is expected that with the project, the population will remain stable or increase.
Monitoring Plan	Annually, the population of Bornean white-bearded gibbon will be monitored using the triangulation survey method. Permanent monitoring transects will be established in the beginning of the project. Any direct or indirect encounter with the species during regular patrols will also be recorded.

6 APPENDICES

Appendix 1: Remote Sensing Approach and Land Cover Classification Reports

Appendix 2: Biomass Report

Appendix 3: Proxy Deforestation Report

Appendix 4: NPV Calculation

Appendix 5: FPIC Consultation Report

Appendix 6: SOC Tidal Wetland Calculation

Appendix 7: AFOLU Non-permanence Risk Report

Appendix 8: Baseline Emissions Calculation

Appendix 9: Project Emissions Calculation

Appendix 10: Net VCU Calculation

Appendix 11: Uncertainty Analysis

Appendix 12: List of SOPs

No	SOP Number	SOP Title	Status
1	SOP-SMM-PUM-013	Forest Protection Patrol	Available
2	SOP-SMM-PUM-014	Reforestation	Available
3	SOP-SMM-PUM-015	Community Development	Available
4	SOP-SMM-PUM-016	Procedures for Handling Work Accidents	Available
5	SOP-SMM-PUM-017	Prevention and Suppression of Land and Forest Fires	Available
6	SOP-SMM-PUM-018	Measurement of Fire Danger Risk	Available
7	SOP-SMM-PUM-019	Biodiversity Monitoring	Available
8	SOP-SMM-PUM-020	Image/Video Documentation	Available
9	SOP-SMM-PUM-021	Grievance Mechanism	Available
10	SOP-SMM-PUM-022	Hydrology and Peat Subsidence Monitoring	Available
11	SOP-SMM-PUM-023	SMART Patrol	In Progress
12	SOP-SMM-PUM-024	Drone Operation	Available
13	SOP-SMM-PUM-026	BGB Mangrove Sampling	Available
14	SOP-SMM-PUM-027	Camera Trap Data Management	Available
15	-	Waste Management	Planned
16	-	Permanent Vegetation Plot Monitoring	Planned
17	-	Shoreline Change Monitoring	Planned

Appendix 13: Monitoring Plan

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
1. Climate							
***Impact Indicator 1:* GHG emission reductions or removals**		*Net estimated emission removals in the project area, measured against the without-project scenario (tCO_2e)*	***2,991,232 tCO_2e over project lifetime (60 years)*** *See PD section 3. Climate and 1.1.1 below*	*See 1.1.1*		*13.2 Integrate climate change measures into national policies, strategies and planning*	*Tonnes of greenhouse gas emissions avoided or removed*
		Net estimated emission reductions in the project area, measured against the without-project scenario (tCO_2e)	***43,463,904 tCO_2e over project lifetime (60 years)*** *See PD section 3. Climate and 1.1.1 below*	*See 1.1.1*			
***Impact Indicator 2:* Forest[149] cover**		*For REDD projects: Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario*	***Total 5,523 ha over project lifetime*** *See PD section 3. Climate and 1.1.1 below*	*See 1.1.1*		*15.2 By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally*	*Area of forests and wetlands conserved and restored*
		For ARR projects: Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario	***Total 15,088 ha over project lifetime**, composed of:* *• Fire break see 1.2.3 (227 ha)* *• Mangrove see 1.4.2 (424 ha)* *• Peatland see 1.4.4 (14,437 ha, of which 1,079 ha peat ARR and 13,358 ha ANR)*	*See 1.2.3, 1.4.2 and 1.4.4*			
1.1. Transparent GHG emissions accounting and monitoring	**1.1.1** Monitoring GHG emissions on peatlands	1. Availability of GHG measurement equipment/system 2. Availability of GHG flux data (CO_2, CH_4, etc.)	1. GHG measurement equipment/system is installed and in use 2. Long-term data on GHG flux on peatlands is available	Daily (for GHG data)	Internal report, data compilation		
	1.1.2 Burnt area monitoring	1. Availability of data on burnt area 2. Total area burnt (in hectares)	1. Annual data on burnt area in the project area is available 2. No areas (or decreased areas) are burnt	Annually	Drone photos/ satellite images, remote sensing analysis and groundtruthing		
	1.1.3 Land cover change monitoring	1. Frequency of land cover monitoring 2. Total area deforested/ degraded (in hectares) 3. Forested area (in hectares)	1. Land cover monitoring (via drone/satellite images) is conducted annually	Annually	Drone photos/ satellite images, remote sensing analysis and groundtruthing		

[149] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
			2. No areas (or decreased areas) are deforested/ degraded 3. Increased forest cover (from restoration activities)				
1.2. Incidence of fires is reduced through enhanced fire prevention and management	**1.2.1** Development of Automatic Weather Station (AWS) and Fire Danger Rating System (FDRS)	1. Availability and use of AWS and FDRS 2. Availability of climate data (precipitation, temperature, soil moisture, water table depth) for the project area	1. AWS and FDRS are established and monitored daily 2. Long-term climate data of the project area is available and monitored regularly	Daily	Internal report, data compilation		
	1.2.2 Establishment of fire patrol team and fire patrol activities	1. Number of people (m/f) employed in fire patrol activities 2. Availability of fire patrol team 3. Number of fire patrol activities conducted 4. Number of fire hotspots in the project area	1. 50 people (approx. 10% women) annually[150] 2. A fire patrol team is established 3. Daily during dry season[151] 4. No fires or decreased number of fires	Every 6 months	1. Employee contracts from HR 2. Internal fire patrols report (from SMART Patrol system) 3. Data compilation from MODIS/VIIRS		
	1.2.3 Planting of firebreak along project boundary	1. Boundary areas planted 2. Number of seedlings planted on the boundary (per species) 3. Visual ARR area change (images) 4. Average survival rate of planted seedlings 5. Average growth rate of planted seedlings (DBH and height)	1. 227 ha of project boundaries are planted with firebreak plants 2. Monitored 3. Monitored 4. Monitored 5. Monitored	Annually	1. Internal reforestation report 2. Drone photos/ satellite images of reforested areas Unit: 1. ha 2. # seedlings/ha 3. - 4. %/ha 5. cm/year		
	1.2.4 Provision of fire fighting equipment and fire watch tower infrastructure	1. Availability and condition of equipment and infrastructure	1. Standard fire fighting and protective equipment and infrastructure is available and in good condition	Annually	Internal report		

[150] Full time equivalent (FTE). Assuming same individuals for 10 years.
[151] Depending on the fire danger rating. There are fire prevention patrols mostly in the dry season.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
1.3. Peat ecosystems are restored and GHG emissions from degraded peat ecosystems reduced	**1.3.1** Canal blocking and peat rewetting	1. Availability and condition of canal blocks 2. Canal water table data	1. Canal blocks are constructed and maintained 2. Canal water table level increases or is maintained	1. Annually 2. Daily	Internal report, data compilation Unit: 1. - 2. cm		
	1.3.2 Peat water level and subsidence monitoring	1. Peat water level 2. Peat subsidence rate	1. Monitored 2. Monitored	1. Daily 2. Every 3 months	Internal report, data compilation Unit: 1. cm 2. cm/year		
1.4. Deforested and degraded areas are restored	**1.4.1** Mangrove nursery establishment	1. Number of mangrove nurseries constructed 2. Number of people employed (m/f) in nursery 3. Number of seedlings produced annually (per species)	1. One (1) 2. 20 (at least 50% women) annually[152] 3. Monitored	Annually	1. Nursery internal report 2. Employee contracts from HR Unit: #		
	1.4.2 Mangrove planting and prevention of coastal abrasion	1. Deforested/degraded mangrove area planted or undergoing restoration (in hectares) 2. Number of seedlings planted in deforested/ degraded mangrove areas (per species) 3. Visual ARR area change (images) 4. Survival rate of planted seedlings 5. Average growth rate of planted seedlings (DBH and height) 6. Number of people (m/f) involved in planting[153] 7. Coastal abrasion rate	1. 424 ha 2. Monitored 3. Monitored 4. Monitored 5. Monitored 6. 20 (approx. 40% women) annually[154] 7. Monitored	Annually	1. Internal reforestation report 2. Drone photos/ satellite images of reforested areas 3. Participants lists Unit: 1. ha 2. # seedlings/ha 3. - 4. %/ha 5. cm/year 6. # 7. m/year	14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	Area of mangroves conserved/ restored
	1.4.3 Peat nursery establishment	1. Number of peat nurseries constructed	1. One (1)	Annually	1. Nursery internal report 2. Employee		

[152] Full time equivalent (FTE). Assuming same individuals for 10 years.
[153] In addition to people employed in nursery, see 1.4.1.
[154] Assuming same individuals for 10 years.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
		2. Number of people (m/f) employed in nursery 3. Number of seedlings produced annually (per species)	2. 20 (approx. 20% women[155]) annually[156] 3. Monitored		contracts from HR		
	1.4.4 Planting and assisted natural regeneration of degraded peatland	1. Degraded peatland areas planted or undergoing restoration (hectares) 2. Number of seedlings planted in deforested/ degraded peatland areas (per species) 3. Visual ARR area change (images) 4. Average survival rate of planted seedlings 5. Average growth rate of planted seedlings (DBH and height) 6. Number of people (m/f) involved in planting[157]	1. 14,437 ha, of which 1,079 ha peat ARR and 13,358 ha ANR) 2. Monitored 3. Monitored 4. Monitored 5. Monitored 6. 20 (approx. 20% women) annually[158]	Annually	1. Internal reforestation report 2. Drone photos/ satellite images of reforested areas 3. Participants lists Unit: 1. ha 2. # seedlings/ha 3. - 4. %/ha 5. cm/year 6. #	6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes	Area of peatland under restoration and/or rewetting
2. Biodiversity							
***Impact Indicator 3:* Biodiversity conservation**	*Expected change in the number of hectares managed significantly better by the project for biodiversity conservation,[159] measured against the without-project scenario*	***23,153.75 ha over project lifetime** (from 2.1.2 below)*	*See 2.1.2*				
	Expected number of globally Critically Endangered or Endangered species[160] benefiting from reduced threats as a result of project	***31 over project lifetime** (see PD section 5. Biodiversity and 2.1.3 below)*	*See 2.1.3*		*15.5 Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and,*	*Population density estimate of three trigger species (orangutan, gibbon,*	

[155] Lower percentage of women due to remote location of the peat nursery (in the forest area).
[156] Full time equivalent (FTE). Assuming same individuals for 10 years.
[157] In addition to people employed in nursery, see 1.4.3.
[158] Assuming same individuals for 10 years.
[159] Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g. enhancing the status of endangered species
[160] Per IUCN's Red List of Threatened Species

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
		activities,[161] measured against the without-project scenario				*by 2020, protect and prevent the extinction of threatened species*	*proboscis monkey)*
2.1. Factors that lead to species extinction and loss of biodiversity are addressed	**2.1.1** Building Patrol Teams and SMART Patrol System	1. Availability of forest protection patrol teams 2. Number of people (m/f) employed as forest protection patrol team 3. Availability and use of SMART Patrol system 4. Number of trainings in SMART Patrol system 5. Number of people trained (m/f)	1. Forest protection patrol teams are established and trained 2. 50 people (approx. 10% women) annually[162] – same individuals as fire patrol 3. SMART Patrol System is established and in use 4. At least 1 training annually 5. Monitored (estimated same as 2. above)	Annually	1. Employee contracts from HR 2. SMART Patrol System 3. Internal training report		
	2.1.2 Carrying out periodic patrols for the prevention of illegal activities and other threats to biodiversity	1. Number of forest protection patrol days conducted per month per guard post (10 posts/shelters) 2. Total project area covered by patrols (in hectares) 3. Number of illegal activities recorded per month	1. At least 12 2. 23,153.75 ha 3. Decreased number of illegal activities	Monthly	Internal forest protection patrols report (from SMART Patrol system) Unit: 1. # of patrols 2. ha 3. # of illegal activities		
	2.1.3 Regular biodiversity monitoring	1. Availability of permanent biodiversity monitoring transects/plots	1. Permanent biodiversity monitoring transects/plots are established	Annually	Internal report		
		2. Population density estimate of three trigger species (orangutan, gibbon, proboscis monkey)	2. Population of trigger species is stable or increases	1. Orangutan (every two years) 2. Bornean white-bearded gibbon (annually) 3. Proboscis	1. Nest count survey 2. Triangulation survey 3. River survey Unit: individuals/km2		

[161] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit
[162] Full time equivalent (FTE). Assuming same individuals for 10 years.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
				monkey (annually)			
		3. Other fauna species (terrestrial mammals and birds) • Diversity Index (per taxon) • Richness Index (per taxon) • Evenness Index (per taxon) • Relative Abundance Index (mammal trigger species) • Occupancy (for mammal trigger species)	3. Monitored	Annually	1. Point count survey (birds) 2. Camera trap survey (mammals)		
		4. Flora species • Diversity Index • Richness Index • Evenness Index • DBH	4. Monitored	Annually	Permanent vegetation plots		
		5. Number of species recorded	5. Number of species found in the project area is stable or increases	Annually	1. Internal forest protection patrols report (sighting records) from SMART Patrol System 2. Biodiversity surveys report		
	2.1.4 Construction of guard posts for forest security	1. Number of guard posts constructed 2. Number of sign boards installed (on project boundary and fire prevention)	1. Six (6) within first five years 2. Twenty (20)	Annually	Internal report Unit: #		
2.2 Project area becomes a conservation and research location for biodiversity and peatland and mangrove restoration	**2.2.1** Implementation of orangutan conservation measures	1. Orangutan conservation measures are developed and implemented; area may serve as an orangutan release location	1. Targets tbd	Annually	1. Internal report		
	2.2.2 Collaboration with universities/ research institutes to conduct research on biodiversity and peatland and mangrove restoration in project area	1. Number of research activities undertaken by partner institutes/ universities or students in the project area	1. At least 1 per year	Annually	MoUs with research institutes or universities or students Unit: #		

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
3. Community							
***Impact Indicator 4:* Training**		*Number of community members (m/f) who are expected to have improved skills and/or knowledge resulting from training provided as part of project activities*	***Total 240 (50 women) per year**, composed of:* *• 50 people annually (10% women) for forest protection patrol team (see 2.1.1)* *• 50 people annually (30% women) for alternative livelihoods (see 3.1.1)* *• 100 people (10% women) annually for community fire care/MPA (see 3.2.1)* *• 40 people (50% women) annually for sustainable agricultural practices) (see 3.2.2)* ***Total 3,225 (1,193 women) over project lifetime (60 years)***	*See 2.1.1, 3.1.1, 3.2.1 and 3.2.2*	*Refer to 2.1.1, 3.1.1, 3.2.1 and 3.2.2*		
***Impact Indicator 5:* Employment**		*Number of people (m/f) expected to be employed in project activities,[163] expressed as number of full-time employees[164]*	***Total 90 (17 women) each year**, composed of:* *• 50 people (10% women) annually for fire and forest protection patrol (see 1.2.2 and 2.1.1)* *• 20 people (40% women) annually for mangrove nursery (see 1.4.1)* *• 20 people (20% women) annually for peat nursery (see 1.4.3)* ***Total 405 (77 women) over project lifetime (60 years)***	*See 1.2.2, 2.1.1, 1.4.1 and 1.4.3*	*Refer to 1.2.2, 2.1.1, 1.4.1 and 1.4.3*	*1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions*	*Number of jobs created*
***Impact Indicator 6:* Livelihoods**		*Number of people (m/f) expected to have improved livelihoods[165] or income*	***Total 57 (25 women) per year**, composed of:*	*See 3.1.1 and 3.2.2*	*Refer to 3.1.1 and 3.2.2*	*1.2 By 2030, reduce at least by half the proportion*	*Number of villagers (m/f) with alternative*

[163] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.
[164] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])
[165] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
		generated as a result of project activities	*• 50 people (30% women) every 3 years implementing alternative livelihood activities (see 3.1.1)* *• 40 farmers (50% women) every year adopting sustainable agricultural practices (see 3.2.2, in combination with 3.1.3 marketing of products)* ***Total 2,550 (1,125 women) over project lifetime (60 years)***			*of men, women and children of all ages living in poverty in all its dimensions according to national definitions*	*livelihoods as a result of the project*
***Impact Indicator 7:* Health**		*Number of people (m/f) for whom health services are expected to improve as a result of project activities, measured against the without-project scenario*	***Total 1,500 (850 women) per year**, composed of:* *• 500 children (50% girls) visiting posyandu per year* *• 1,000 people (60% women) receiving mobile health services per year (see 3.3.1)* ***Total 13,500 (7,650 women) over project lifetime (60 years)***	*See 3.3.1*	*Refer to 3.3.1*		
***Impact Indicator 8:* Education**		*Number of people (m/f) for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario*	***Total 217 (109 women) per year** (see 3.4.1)* ***Total 3,465 (1,733 women) over project lifetime (60 years)***	*See 3.4.1*	*Refer to 3.4.1*		
***Impact Indicator 9:* Water**		*Number of people (m/f) who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario*	***Total 800 (400 women) every 3 years** (see 3.3.1)* ***Total 12,000 (6,000 women) over project lifetime (60 years)***	*See 3.3.1*	*Refer to 3.3.1*		
***Impact Indicator 10:* Well-being**		*Number of community members (m/f) whose well-being[166] is expected to*	***Total 1,713 (912 women) per year**, composed of:*	*See Impact Indicators*	*Refer to Impact Indicators 4-9*		

[166] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Livelihoods, Health, Education and Water), and may also include other benefits such as strengthened legal rights to resources, increased food security, etc.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
		improve as a result of project activities	*• Total of categories above on Employment, Livelihoods, Health*[167] *• Plus 200 people (30% women) benefiting from the revolving fund every 3 years (3.1.2)* ***Total 19,455 (9,752 women) over project lifetime (60 years)***	*4-9 above and 3.1.2 below*	*above and 3.1.2 below*		
3.1. Local communities attain improved livelihoods and economic development	**3.1.1** Development of alternative livelihoods for affected communities	1. Number of alternative livelihood groups/MSMEs (with minimum of 10 members) established and assisted by the project (and qualitative description of activities implemented) 2. Number of featured products created and marketed 3. Number of women's groups established and assisted by the project (and qualitative description of activities implemented) 4. Number of people (m/f) trained every year 5. Number of people (m/f) implementing alternative livelihood activities	1. At least 1 per engaged village 2. At least 1 per engaged village 3. At least 1 per engaged village 4. 50 people (50% women) per year[168] 5. 50 people (50% women) per 3 years	Annually	1. Participatory survey with community with questionnaire, FGD and interview 2. Internal training report Unit: #	5.5 Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life	Number of women's groups created to improve women's participation in economic opportunities
	3.1.2 Revolving Fund Development	1. Number of livelihood groups that benefit from the revolving fund per 3 years 2. Number of people (m/f) benefiting from the revolving fund per 3 years	1. Four (4) every three years 2. 200 people (30% women) every 3 years	Annually	1. Participatory survey with community with questionnaire, FGD and interview Unit: #	1.2 By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	Number of villagers (m/f) with increased access to loans

[167] Not including Training, Education and Water to avoid double-counting of the same individuals.
[168] Assuming same individuals for 3 years.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
	3.1.3 Increasing Access to Marketing of Agricultural Products	1. Number of agricultural product marketing channels developed 2. Volume and price of products sold to offtakers	1. One (1) per engaged village 2. Monitored	Annually	1. participatory survey with community with questionnaire, FGD and interview Unit: #		
3.2. Local communities participate in efforts for sustainable land management	**3.2.1** Increasing the Role of Fire Care Communities / Masyarakat Peduli Api (MPA) in preventing and fighting forest fires	1. Number of MPAs re-established 2. Number of trainings implemented 3. Number of communities involved in MPA and fire patrol activities every year	1. One (1) per engaged village 2. At least one (1) training annually 3. 100 people (approx. 10% women) annually[169]	Annually	1. participatory survey with community with questionnaire, FGD and interview 2. internal training report Unit: #		
	3.2.2 Promoting sustainable agricultural practices	1. Number of farmers groups receiving technical assistance for sustainable agricultural practices (and qualitative description of activities implemented) 2. Number of farmers (m/f) that have adopted sustainable agricultural practices (and qualitative description of activities implemented) 3. Number of trainings implemented 4. Occurrence of pest and disease in agricultural activities	1. At least 4 (1 per village in approx. 4 villages) 2. 40 people (50% women) every year 3. At least 4 per year per farmer group 4. Monitored	Annually	1. participatory survey with community with questionnaire, FGD and interview 2. internal training report Unit: #	12.2 By 2030, achieve the sustainable management and efficient use of natural resources	Number of farmers (m/f) that have adopted sustainable agricultural practices
3.3. Local communities benefit from improved health and sanitation	**3.3.1** Improving and supporting public health through health service programs and	1. Number of households that have adopted PHBS[170] 2. Number of facilities for clean water constructed 3. Number of toilets/septic tanks at household level	1. Two hundred (200) households per engaged village every 3 years[172] 2. One (1) community facility 3. At least 20 every 3 years	Annually	1. participatory survey with community with questionnaire, FGD and interview	2.2 By 2030, end all forms of malnutrition, incl. achieving, by 2025, the internationally	2.2.1 Prevalence of stunting among children under 5 years of age

[169] Assuming same individuals for 10 years.
[170] Perilaku Hidup Bersih dan Sehat (PHBS): Clean and Healthy Behavior
[172] Duration of the PHBS program is 3 years.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
	community-based sanitation programs	supported by the project 4. Number of people (m/f) with increased water quality and/or improved access to drinking water 5. Number of children (m/f) visiting posyandu (community health center) per year 6. Number of people (m/f) receiving mobile health services per year[171] 7. Prevalence of stunting among children under 5 years of age 8. Under-5 mortality rate	4. 800 people (50% women) every 3 years[173] 5. 500 (50% girls) annually[174] 6. 1,000 (60% women) annually[175] 7. Monitored 8. Monitored		Unit: #	agreed targets on stunting and wasting in children under 5 years of age 3.2 By 2030, end preventable deaths of newborns and children under 5 years of age 6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all 6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations	3.2.1 Under-5 mortality rate Number of people (m/f) with increased water quality and/or improved access to drinking water Number of households that have adopted PHBS (Clean and Healthy Behavior)
3.4. Local communities benefit from enhanced	**3.4.1** Environmental education program development	1. Number of elementary and middle school students (m/f) participating in Environmental Education Program	1. 200 students (50% female) per year[177] 2. Ten (10) teachers (50% women) per year[178]	Annually	1. Internal report 2. Data compilation Unit:	12.8 By 2030, ensure that people everywhere have the relevant information and	Number of participants (m/f) in Environmental Education Program

[171] Mobile health services are conducted monthly in every village for at least 5 years.
[173] Average of 4 people per household x 200 households.
[174] Assuming same individuals for 5 years.
[175] Assuming same individuals for 5 years.
[177] Assuming same individuals for 3 years.
[178] Assuming same individuals for 3 years.

Outcome	Output	Monitoring Indicator	Target	Monitoring Frequency	Data Collection Method	Relevant SDG Target	Relevant SDG Indicator
access to education	and partial scholarships for students	2. Number of teachers benefiting from capacity building for Environmental Education Program 3. Number of students (m/f) receiving partial education scholarships[176] 4. Number of senior high school students being provided with internship opportunities by the project	3. Five (5) students (average 50% women) per year 4. Two (2) per year (average 50% women)		#	awareness for sustainable development and lifestyles in harmony with nature	

[176] Partial scholarships are provided for students from poor families who are accepted at state universities.