# SECOND MONITORING REPORT

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| **Project title** | Kuamut Rainforest Conservation Project |
| **Project ID** | 2609 |
| **Crediting period** | 11 December 2015 to 10 December 2045 |
| **Monitoring period** | 01 January 2022 – 31 December 2023<br>Same for CCB and VCS |
| **(CCB) GHG accounting period** | 11 December 2015 to 10 December 2045; 30-year total period |
| **Original date of issue** | 17 September 2024 |
| **Most recent date of issue** | 24 July 2025 |
| **Version** | 4 |
| **VCS Standard version** | VCS Standard version 4.7 |
| **CCB Standards version** | CCB Standards version 3.1 |
| **Project location** | Malaysia, Sabah |
| **Project proponent(s)** | Permian Malaysia Sdn. Bhd<br>Level 21, Suite 21.01, The Gardens South Tower, Mid Valley City,<br>Lingkaran Syed Putra, 59200, Kuala Lumpur, Malaysia<br>Ivy Wong, ivy.wong@permianglobal.com |
| **Validation/verification body** | AENOR<br>José Luis Fuentes Pérez, jfuentes@aenor.com |
| **History of CCB Status** | CCB Validation Statement issued on 26 July 2022 |

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| | CCB Gold level for climate on 25 March 2024 (first verification) |
| Gold Level criteria | The Kuamut Rainforest Conservation Project has achieved *Climate Gold level* for effectively addressing climate change impacts through conserving and restoring the forest project area, improving water supply, and enhancing climate resilience to communities and biodiversity. Soil erosion mitigation reduces sediment accumulation in rivers, benefiting local communities and agriculture, which together with improved land management have led to better water quality and lower carbon losses. These actions enhance human health, economic growth, and biodiversity while bolstering climate resilience. Therefore, the project serves as a model for sustainable development in the face of climate change. Scaling up these strategies across Sabah and incorporating key elements like stakeholder engagement, particularly with farmers in the project zone, and robust monitoring, can amplify these benefits and contribute to a more sustainable and resilient future for the region.<br><br>The Project has achieved *Biodiversity Gold Level* for demonstrating exceptional biodiversity benefits that have been achieved by the effective protection and regeneration of critical forest habitats for a number of threatened species. Biodiversity monitoring has confirmed that the Project Area is a high-priority site for biodiversity conservation, meeting the CCB vulnerability criteria and the Key Biodiversity Area (KBA) qualifying conditions by identifying the presence of 'trigger' species. In our 2022-2023 monitoring, we identified three Critically Endangered (CR) and 11 Endangered (EN) fauna species, all classified as ‘trigger’ species. The Bornean orangutan is the project’s key trigger species because the survival and extent of the population supported at Kuamut is indicative of the overall ecological health of the Project Area. Aerial surveys of orangutan nests conducted in 2023 showed that the population remains stable, with no significant decline since the last monitoring period. The Project Area is therefore crucial for biodiversity conservation, as it supports populations of many globally threatened species, contributes to landscape level-connectivity in central Sabah and provides important ecosystem functions.<br><br>The Project has achieved *Community Gold Level* for delivering significant benefits to the local communities, particularly in terms of livelihoods, capacity building and employment for residents from the Kuamut and Karamuak areas. This achievement was made possible through the community development programs, which were co-created following extensive engagement and Free, Prior, and Informed Consent (FPIC) processes with local community members leading to signed MOU between the project and the 7 villages who have agreed to participate in the project in the current monitoring period.-Employment generated by the project in this reporting period |

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| | was 38 full-time positions as of 2023, of which 6 were from the local community. Additionally, the project has positively impacted the livelihoods of 257 people, including 76 women, by providing them with sustainable income-generating opportunities. Furthermore, the project has enhanced the overall well-being and understanding of this project, through capacity building activities of meetings, workshops, training and sports activity of more than 843 community members, with 293 women directly benefiting from these efforts.<br><br>These accomplishments, combined with the project's robust conservation and climate actions, underscore its success in meeting and exceeding the stringent criteria for Gold Level certification, demonstrating a profound commitment to fostering sustainable development and enhancing the quality of life for the communities involved. |
| **Prepared by** | Permian Global and Permian Malaysia |

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# 1 SUMMARY OF PROJECT BENEFITS

The Kuamut Rainforest Conservation Project (KRCP) is protecting and restoring the 83,381 ha Kuamut Forest Reserve, located in the Tongod and Kinabatangan districts of Sabah, Malaysia.

The project area had been repeatedly logged in the past and was designated for further exploitation in the future. Establishing the project has halted this and enabled the forest to regenerate.

The forest is a highly biodiverse habitat and an important ecological linkage to surrounding forests, providing refuge for many high conservation value species.

Meanwhile, the project is also providing support for communities living outside the project area, where it is delivering activities designed to improve well-being, health, and livelihood opportunities.

## 1.1 Unique Project Benefits

| Outcome or Impact | Achievements during the Monitoring Period | Section Reference | Achievements during the Project Lifetime |
|---|---|---|---|
| 1) Strengthened Community Governance and Decision-Making | 706 community members (256 women) participated in governance and decision-making workshops. The Kuamut Management Committee and Steering Committee structured governance processes, ensuring community input at multiple levels | 2.5.6 | 706 community members (256 women) participated in governance and decision-making workshops. The Kuamut Management Committee and Steering Committee structured governance processes, ensuring community input at multiple levels |
| 2) Increased Women's Leadership in Community Development | 36% of total participants in project engagement activities were women. 125 women gained improved access to clean water, reducing the burden of water collection. Women actively participated in | 4.3 | 36% of total participants in project engagement activities were women. 125 women gained improved access to clean water, reducing |

| | | | |
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| | governance committees and held leadership positions | | the burden of water collection. Women actively participated in governance committees and held leadership positions |
| 3) Climate Adaptation through Hydrological Resilience and Soil Conservation | Reduced soil erosion by preventing 14 to 20 Olympic pool-sized sediment discharges per year. Increased water supply through fog water interception by 620 to 1260 Olympic swimming pools annually | 3.10 | Reduced soil erosion by preventing 14 to 20 Olympic pool-sized sediment discharges per year. Increased water supply through fog water interception by 620 to 1260 Olympic swimming pools annually |
| 4) Improved Landscape Connectivity for Endangered Species | The project contributed to the regeneration of mixed dipterocarp forest enhancing habitat connectivity to the Danum Valley Conservation Area and surrounding forest areas. Monitoring during this reporting period confirmed the presence of 3 Critically Endangered (CR), 12 Endangered (EN) and 18 Vulnerable (VU) fauna species. | 5.3, 5.4 | The project contributed to the regeneration of mixed dipterocarp forest enhancing habitat connectivity to the Danum Valley Conservation Area and surrounding forest areas. Since the project's inception, 4 CR, 18 EN and 32 VU fauna species, along with 6 CR, 5 EN and 23 VU flora species have been identified within the project area. |

## 1.2 Standardized Benefit Metrics

| Category | Metric | Achievements during Monitoring Period | Section Reference | Achievements during the Project Lifetime |
|---|---|---|---|---|
| GHG emission reductions & removals | *Net estimated emission removals in the project area, measured against the without-project scenario* | 957,792.4 tCO2e (before buffer)<br>842,855 (after buffer) | 3.2.4 | 957,792.4 tCO2e (before buffer)<br>842,855 (after buffer) |
| | *Net estimated emission reductions in the project area, measured against the without-project scenario* | 731,958 tCO2e (after buffer) | 3.2.4 | 5,571,698.67 tCO2e<br>(4,839,740.67 MR1+731,958 MR2) |
| Forest[1] cover | *For REDD[2] projects: Number of hectares of reduced forest loss in the project area measured against the without-project scenario* | Not applicable, this is an IFM project | N/A | Not applicable, this is an IFM project |
| | *For ARR[3] projects: Number of hectares of forest cover increased in the project area measured against the without-project scenario* | Not applicable, this is an IFM project | N/A | Not applicable, this is an IFM project |
| Improved land management | *Number of hectares of existing production forest land in which IFM[4] practices have occurred as a result of the project's activities, measured against the without-project scenario* | 83,381 ha | 5.3, 5.4 | 83,381 ha |

[1] 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*)
[2] 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*)
[3] 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*)
[4] 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*)

| | | | | |
|---|---|---|---|---|
| | *Number of hectares of non-forest land in which improved land management has occurred as a result of the project's activities, measured against the without-project scenario* | N/A, | N/A | N/A |
| Training | *Total number of community members who have improved skills and/or knowledge resulting from training provided as part of project activities* | 91 | 4.1.3 | 206 |
| | *Number of female community members who have improved skills and/or knowledge resulting from training provided as part of project activities of project activities* | 31 | 4.1.3 | 105 |
| Employment | *Total number of people employed in of project activities,[5] expressed as number of full-time employees[6]* | 14 new FTE (existing from previous MR is 24) | 4.1.3 | 38 people employed as FTE including 6 from local community members |
| | *Number of women employed in project activities, expressed as number of full-time employees* | 3 new and 2 existing FTE | 4.1.3 | 10 women employed including 4 from local community members |
| Livelihoods | *Total number of people with improved livelihoods[7] or income generated as a result of project activities* | 257 | 4.1.3 | 392 |
| | *Number of women with improved livelihoods or income generated as a result of project activities* | 76 | 4.1.3 | 157 |
| Health | *Total number of people for whom health services were improved as a result of* | 1 Medical Officer in Kuamut Cluster | 4.1.3 | 245 |

[5] 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.
[6] 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 UN System of National Accounts (1993) paragraphs 17.14[15.102]; [17.28])
[7] 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.

| | | | | |
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| | *project activities, measured against the without-project scenario* | consulted on health services | | |
| | *Number of women for whom health services were improved as a result of project activities, measured against the without-project scenario* | No changes in the current monitoring period | 4.1.3 | 78 |
| Education | *Total number of people for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario* | 2 Teachers from SK Kuamut was engaged on educational opportunities | 4.1.3 | 44 |
| | *Number of women and girls for whom access to, or quality of, education was improved as a result of project activities, measured against the without-project scenario* | No changes in the current monitoring period | 4.1.3 | 13 |
| Water | *Total number of people who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario* | 245 are still having access to drinking water from Kg Karamuak; 30% construction completed in building access to clean water for Kg Kuamut & Kg Tangkuyan | 4.1.3 | 245 |
| | *Number of women who experienced increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario* | 78 are still having access to drinking water from Kg Karamuak; 30% construction completed in building access to clean water for Kg Kuamut & Kg Tangkuyan | 4.1.3 | 78 |

| | | | | |
|---|---|---|---|---|
| Well-being | *Total number of community members whose well-being8 was improved as a result of project activities* | 362 | 4.1.3 | 607 |
| | *Number of women whose well-being was improved as a result of project activities* | 110; And 4 community groups led by women on socio-economy | 4.1.3 | 188; And 4 community groups led by women on socio-economy |
| Biodiversity conservation | *Change in the number of hectares significantly better managed by the project for biodiversity conservation,[9] measured against the without-project scenario* | 83,381 ha | 5.3 & 5.4 | 83,381 ha |
| | *Number of globally Critically Endangered or Endangered species[10] benefiting from reduced threats as a result of project activities,[11] measured against the without-project scenario* | <u>Fauna:</u><br>3 Critically Endangered (CR) 12, Endangered (EN) and 18 Vulnerable (VU) species<br><br>Note that IUCN status' for fauna are reflective of April 2024 | 5.3 & 5.4 | <u>Fauna:</u><br>4 Critically Endangered (CR),<br>18 Endangered (EN) and 32 Vulnerable (VU) species, including:<br>26 mammals,<br>23 birds and<br>5 reptiles<br><br><u>Flora:</u><br>6 Critically Endangered (CR), 5 Endangered (EN) and 23 Vulnerable (VU) species<br>Note that IUCN status' are |

[8] 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, Health, Education, Water, etc.), but could also include other benefits such as empowerment of community groups, strengthened legal rights to resources, conservation of access to areas of cultural significance, etc.
[9] 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.
[10] Per IUCN's Red List of Threatened Species
[11] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

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| | | | | reflective of April 2024 for fauna and March 2024 for flora. |

# 2 PROJECT DETAILS

## 2.1 Summary Description of the Implementation Status of the Project

### 2.1.1 Summary Description of the Project (VCS, 2.1, 3.6; CCB, G1.2)

The Kuamut Rainforest Conservation Project (KRCP) has continued its implementation of conservation and sustainable development activities within the 83,381-hectare protected forest in Sabah, Malaysia. Key activities during this monitoring period include continuous forest patrols, biodiversity monitoring, job creation and *capacity-building initiatives for local communities.*

The project has integrated technologies and measures to enhance monitoring and conservation, including the deployment of camera traps, acoustic sensors, and satellite imagery to track biodiversity and forest health. Additionally, community development programs such as training in sustainable livelihoods, employment generation, and water infrastructure improvements have been implemented. The period *also marked the continued engagement with local stakeholders, reinforcing participatory governance and benefit-sharing mechanisms.*

During the monitoring period, the project achieved 731,958 $tCO_2e$ in total GHG emission reductions and 842,855 $tCO_2e$ removals (after buffer), contributing significantly to climate change mitigation. The protection of the forest area continues to prevent further emissions while supporting carbon sequestration through natural forest regrowth.

**Core objectives:**

Climate: The project mitigates emissions by halting deforestation, promoting forest regeneration, and enhancing carbon storage.

Community: The project improves livelihoods through employment (38 full-time jobs in 2023), training (91 *participants), continued access to clean water and building knowledge and capacity about the project, benefiting over 843 local residents.*

Biodiversity: The project safeguards habitats for 3 Critically Endangered (CR), 12 Endangered (EN), and 18 Vulnerable (VU) species, with ongoing monitoring to ensure species protection and *ecosystem resilience.*

By aligning conservation efforts with sustainable community development, the KRCP continues to demonstrate how forest protection contributes to long-term climate resilience, ecological restoration, and local well-being.

### 2.1.2 Audit History (VCS, 4.1)

| Audit Type | Period | Program | VVB Name | Number of years |
|---|---|---|---|---|
| Validation | 11 March 2023 | VCS and CCB | Earthood Services Pvt. Limited | One year |
| Verification | 11 December 2015-31 December 2021 | VCS and CCB | Earthood Services Pvt. Limited | Six years |
| Verification | 01 January 2022- 31 December 2023 | VCS and CCB | AENOR | Two years |

### 2.1.3 Sectoral Scope and Project Type (VCS, 3.2)

| | |
|---|---|
| **Sectoral Scope** | 14: Agriculture, forestry, and other land use |
| **AFOLU Project Category** | Improved Forest Management (IFM) |
| **Project Activity Type** | Logged to protected forest |

### 2.1.4 Project Proponent (VCS, 3.7; CCB, G1.1)

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|---|---|
| **Organization name** | Permian Malaysia Sdn. Bhd. |
| **Contact person** | Ivy Wong |
| **Title** | CEO |

| | |
|---|---|
| Address | Level 21, Suite 21.01, The Gardens South Tower, Mid Valley City, Lingkaran Syed Putra, 59200, Kuala Lumpur, Malaysia |
| Telephone | +44 20 3617 3310 |
| Email | ivy.wong@permianglobal.com |

### 2.1.5 Other Entities Involved in the Project

| | |
|---|---|
| Organization name | Permian Global |
| Role in the project | Project Developer, parent company of Permian Malaysia Sdn. Bhd. |
| Contact person | Gerry Elias |
| Title | Managing Partner |
| Address | 3 Cavendish Square, London, W1G 0LB, United Kingdom |
| Telephone | +44 20 3617 3310 |
| Email | gerry.elias@permianglobal.com |

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|---|---|
| Organization name | Yayasan Sabah and Rakyat Berjaya Sdn. Bh |
| Contact person | Project partner and patrolling activities |
| Title | Dr. Esther Li |
| Address | Group Manager – Forestry Division |
| Telephone | Rakyat Berjaya Sdn Bhd, Wisma Innoprise, Jalan Sulaiman Teluk Likas, 88817 Kota Kinabalu, Sabah, Malaysia |
| Email | + 60 (0)88 326 365 |
| | esther.rbj@gmail.com |

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|---|---|
| Organization name | Sabah Forestry Department |
| Contact person | Project partner |
| Title | Fred Kugan |

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|---|---|
| Address | Chief Conservator of Forests |
| Telephone | KM11 Jalan Utara, 90009, Sandakan, Sabah, Malaysia |
| Email | +60 (0) 89 242 800 |
| | Frederick.Kugan@sabah.gov.my |

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| Organization name | Partners of Community Organisation (PACOS) Trust |
| Contact person | Project implementation entity |
| Title | Anne Lasimbang |
| Address | Executive Director |
| Telephone | Taman Flash Gordon, Kg. Kivatu, KM18 Jalan Tambunan, 89507 Donggon, 89507 Penampang, Sabah, Malaysia |
| Email | +60 (0) 88 712 51 |
| | annelasimbang@gmail.com |

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|---|---|
| Organization name | South East Asia Rainforest Research Partnership (SEARRP) |
| Contact person | Project implementation entity |
| Title | Glen Reynolds |
| Address | Executive Director |
| Telephone | S10-S12, 1st Floor, Block B, The Peak Vista, Lorong Puncak 1, 88400 Kota Kinabalu, Sabah, Malaysia |
| Email | +60 (0) 88 201 727 |
| | glen.searrp@icloud.com |

### 2.1.6 Project Start Date (VCS, 3.8)

| | |
|---|---|
| Project start date | 11-December-2015 |
| Justification | Following the VCS 4.7 definition, the project start date is the date on which activities that lead to the generation of GHG emission |

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| | reductions or removals are implemented. The first step in the protection of the area has been the legal conversion of the land status into a Class 1 Forest reserve, thereby making it a protected conservation area ceasing logging operations right after that. This change was implemented by Sabah Forestry Department as a result of the development of the Kuamut Rainforest Conservation Project.<br><br>*Sabah Forestry Department converted the first 69,454 ha into a Class 1 Forest Reserve which sets the start date of the project* |

### 2.1.7 Benefits Assessment and Project Crediting Period (VCS, 3.9; CCB, G1.9)

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| **Crediting Period** | The crediting period is from 11 December 2015 to 10 December 2045. For conservativeness, the emission reductions and removals generated from 11 December 2015 to 31 December 2015 are not accounted for.<br><br>The project crediting period is the time period for which GHG emission reductions or carbon dioxide removals generated by the project are eligible for issuance as VCUs.<br><br>The 30-year crediting period of the project corresponds to the period that the project is protected from logging operations, thus generating emission reductions and removals. |
| **Start Date of First or Fixed Crediting Period** | 11 December 2015 to 10 December 2045. |
| **Total Number of Years of Crediting Period** | 30 years, renewable once (total 60 years). |
| **CCB Benefits Assessment Period** | 30 years, renewable once (total 60 years). |

### 2.1.8 Project Location (VCS, 3.11; CCB, G1.3)

The Kuamut Rainforest Conservation Project (KRCP) is located in the Tongod and Kinabatangan Districts of Sabah, Malaysia as shown in Figure 2.1. The project area, defined by the Sabah Forestry Department, encompasses 83,381 ha of land with a total perimeter of 244.99 km. The project area boundary delineates the area in which GHG emission reductions are quantified. The project area is located within these coordinates:5° 18’ 40.2”N 117° 11’ 8.69”E; 5° 18’ 40.2”N 117° 37’ 58.51”E, 4° 55’ 55.68”N 117° 37’ 58.51”E, 4° 55’ 55.68”N 117° 11’ 8.69”E.

To further explore the Kuamut project area and its surroundings, please visit the following Web-map app: https://ee-my-permianglobal-apps.projects.earthengine.app/view/kuamut-rainforest-conservation-project-area

☒ KML file has been provided

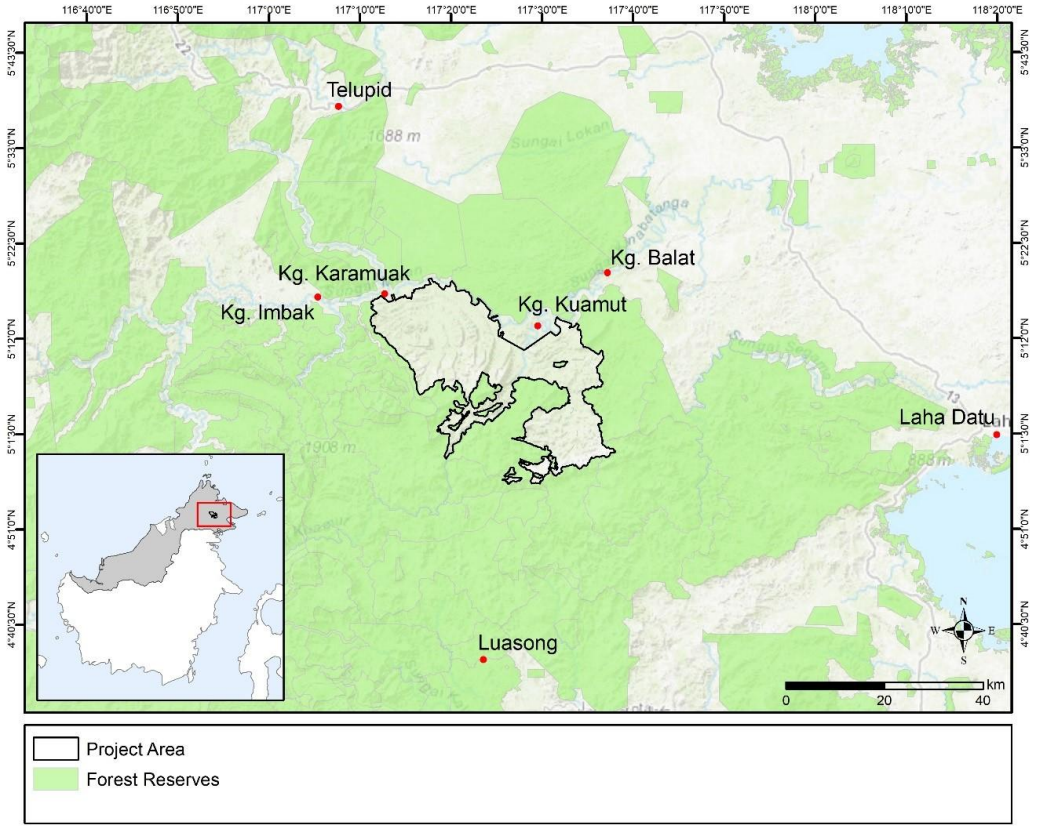



Figure 2.1. Reference map of the Kuamut Rainforest Conservation project area.

### 2.1.9 Title and Reference of Methodology (VCS, 3.1)

| Type (methodology, tool, module) | Reference ID (if applicable) | Title | Version |
|---|---|---|---|
| Methodology | VM0010 | VM0010 improved Forest Management: conversion from logged to protected forest | 1.4 |
| Tool | N/A | Tool for AFOLU Non-Permanence Risk Analysis | 4.2 |

### 2.1.10 Double Counting and Participation under Other GHG Programs (VCS, 3.23; CCB, G5.9)

#### 2.1.10.1 No Double Issuance

Is the project receiving or seeking credit for reductions and removals from a project activity under another GHG program, or any other form of community, social, or biodiversity unit or credit?

☐ Yes ☒ No

*If yes, provide required evidence of no double issuance as outlined by the VCS Standard and the CCB Standard. Include all relevant information about the community, social, or biodiversity credit.*

#### 2.1.10.2 Registration in Other GHG Programs

Was the project registered or seeking registration under any other GHG programs?

☐ Yes ☒ No

*If yes, provide the registration number and all relevant details, including the date of project inactivity in the other GHG program.[12] Specify how double counting is avoided.*

#### 2.1.10.3 Projects Rejected by Other GHG Programs

Has the project been rejected by any other GHG programs?

☐ Yes ☒ No

*If yes, provide the program name(s), reason(s) and date for the rejection, justification of eligibility under the VCS Program, and any other relevant information.*

### 2.1.11 Double Claiming, Other Forms of Credit, and Scope 3 Emissions (VCS, 3.24)

#### 2.1.11.1 No Double Claiming with Emissions Trading Programs or Binding Emission Limits

Are project reductions and removals or project activities also included in an emissions trading program or binding emission limit? See the VCS Program Definitions for definitions of emissions trading program and binding emission limit.

☐ Yes ☒ No

*If yes, provide all required evidence of no double claiming as outlined by the VCS Standard.*

[12] The requirement to provide the date of project inactivity only applies to projects which request registration or crediting period renewal under the VCS Program on or after 1 January 2025.

#### 2.1.11.2 No Double Claiming with Other Forms of Environmental Credit

Has the project activity sought, received, or is planning to receive credit from another GHG-related environmental credit system? See the VCS Program Definitions for definition of GHG-related environmental credit system.

☐ Yes ☒ No

*If yes, provide all required evidence of no double claiming as outlined by the VCS Standard.*

#### 2.1.11.3 Supply Chain (Scope 3) Emissions

Do the project activities affect the emissions footprint of any product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

*If yes:*

Is the project proponent(s) or authorized representative a buyer or seller of the product(s) (goods or services) that are part of a supply chain?

☐ Yes ☒ No

### 2.1.12 Sustainable Development Contributions (VCS, 3.17)

During the monitoring period, the KRCP implemented activities that contributed to sustainable development (SD) by enhancing local livelihoods, improving access to basic services, and supporting environmental conservation. These activities, including job creation, clean water provision, improved access to health care, and forest and biodiversity protection, align with national sustainable development priorities, particularly poverty reduction and environmental sustainability. The contributions directly support specific United Nations Sustainable Development Goal (SDG) targets, as outlined in the table below.

These initiatives align with national priorities, supporting goals for better living conditions, access to clean water, climate action, and biodiversity protection. The report provides evidence of these contributions, and monitoring provisions ensure alignment with the project's goals, SDG targets, and national priorities.

Table 2.1: Sustainable Development Contributions

| Row number | SDG target | SDG indicator | Net impact on SDG indicator | Current project contributions | Contributions over project lifetime |
|---|---|---|---|---|---|
| 1) | 1.1 | 1.1.1 Proportion of population below the international poverty line[1] | Implemented activities to increase income | 244 people increased their income above the USD 2.15 daily rate. This includes 173 people from local communities earning as casual workers, 33 part-time staff and 38 full-time staff. | 244 people elevated above the USD 2.15 daily income rate through project activities (it is the same value as the current project contributions because this was not required to be monitored in the previous monitoring period) |
| 2) | 1.2 | 1.2.1 Proportion of population living below the national poverty line[2] | Implemented activities to create employment | 38 people employed full-time compared to the previous period who earn more than RM 1198 per month. | 38 participants, including 6 local community members (4 women), now earn more than RM 1198 per month through project activities. |
| 3) | 1.4 | 1.4.1 Proportion of population living in households with access to basic services | Implemented activities to increase access | Ongoing project activity with 30% completion | 245 local community members have access to basic water services. |
| 4) | 6.1 | Proportion of the rural population with access to safe water supply | Implemented activities to increase access | Ongoing project activity with 30% completion | 245 local community members now have access to basic water services. |

| | | | | | |
|---|---|---|---|---|---|
| 5) | 13.0 | Tonnes of greenhouse gas emissions avoided or removed | Implemented conservation activities | The project has prevented the release of 731,958 tCO2e and sequestered 842,855 tCO2e during this period (after buffer). | Prevented the release of 5,571,698.67 tCO2e of carbon into the atmosphere and sequestered 842,855 tCO2e (after buffer) |
| 6) | 15.2 | 15.2.1 Progress towards sustainable forest management | Implemented activities to protect and restore forests | Patrolling and surveillance of 83, 381 ha tropical rainforest on a monthly basis. | 83,381 ha of tropical rainforest in Kuamut protected. |
| 7) | 15.5 | 15.5.1 Red List Index | Implemented activities to protect biodiversity | 30 threatened fauna species (3 CR, 12 EN, 18 VU) detected in the Kuamut Project Area during this period. | 54 threatened fauna species (4 CR, 18 EN, 32 VU) and 34 threatened flora species (6 CR, 5 EN, 23 VU) have been recorded in the Kuamut Project Area. |

(1) The latest international poverty line based on low-income countries is updated $2.15 per day using the 2017 PPP by the World Bank

*(2) The food PLI refers to the minimum income required by a household to meet basic food needs. Department of Statistic Malaysia's report on Poverty in Malaysia (2022), page 37 states "households with incomes below the food PLI are categorized as hardcore poverty". The average food PLI in Malaysia is RM1,198 (2022) as compared to RM1,169 (2019), an increase of RM29 with a compounded annual growth rate of 0.8 per cent.*

## 2.2 Project Implementation Status

### 2.2.1 Implementation Schedule (VCS, 3.2; CCB, G1.9)

**Climate Initiatives:**

The project implemented an extensive remeasure of all forest inventory plots, including updated botanical work of all the trees in the field plots between 2022 and 2023. While this field survey was started at the end of the previous monitoring period, most field plots were measured during this period (in 2022). Additionally, continuous forest monitoring and patrolling was conducted during the monitoring period.

Reporting of carbon losses:

A single non-fire natural disturbance was identified in the project area during the monitoring period in July 2023. This forest disturbance was identified during regular monitoring tasks performed with high-resolution optical satellite imagery and subsequently verified by the field teams. Additional information and evidence on this event have been provided during the verification. Both the field visit report and the investigation of the satellite imagery archives confirmed that this area has experienced flooding for several years. However, we observed that sustained rainfall during the 2023 wet season caused the flooded area to expand significantly, so we decided to conservatively include it as a natural disturbance as it exceeded the minimum area (2.5 ha) we established for this type of event. Since the automatic land cover classification analysis classified this event as 'water', it was decided to perform a manual digitization of the total area affected by the flood event. 3.42 hectares were lost due to this flood, and we account for this using our high-resolution biomass maps. In total, 1,952.8 tCO2e were lost – please see the climate section for further details.

**Community Engagement:**

In 2022 and 2023, the KRCP project carried out a total of 22 community engagement sessions including workshops, meetings and training covering the topics of Free prior Inform Consent (FPIC) of local community participation, co-development of the Community Development Plan, Benefit Sharing Mechanism, Gravity Feed Water System Installation, 6 training sessions and one Kuamut Solidarity Sports event. The FPIC workshops were held in six locations where two locations had 2 villages combined and subsequent meetings with local community members were held at each cluster level.

A total of 843 individuals participated in all the 22 community sessions with 293 of them, women. There were 15 workshops/meetings with local community where a total of 509 individuals participated with 180 of them women. Six training sessions of which 91 local community participated with 31 female participants. The Solidarity Sports event saw a total of 197 local community participation with 76 of them women. The list of activities is as the table below and all the report of each activities are in the Evidence Folder CL#5 item3.

Table 2.2. Community Engagement Activities organized

| No | Activities | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | Training – Community Organizing and Leadership training | 9 May – 11 August 2022 | 2 | 2 | 4 |
| 2 | FPIC Workshop on KRCP at Kg Kuamut and Kg Tangkuyan | 28 Sept 2022 | 36 | 34 | 70 |
| 3 | FPIC Workshop on KRCP for Kg Desa Permai and Kg Tulang Tulang | 28 Sept 2022 | 9 | 5 | 14 |
| 4 | FPIC Workshop on KRCP for Kg Tamoi (It is now known as Kg Kenang Kenangan) | 29 Sept 2022 | 22 | 8 | 30 |
| 5 | FPIC Workshop on KRCP for Kg Keramuak Luar | 11 Oct 2022 | 30 | 18 | 48 |
| 6 | FPIC Workshop on KRCP for Kg Kermuak Dalam | 12 Oct 2022 | 17 | 13 | 30 |
| 7 | FPIC Workshop on KRCP for Kg Tenaga Baru | 13 Oct 2022 | 33 | 7 | 40 |
| 8 | Training – 1st Aid | 13-15 Oct 2022 | 29 | 3 | 32 |
| 9 | CDP Workshop for KRCP for Kuamut Cluster | 22 Nov 2022 | 17 | 20 | 37 |
| 10 | CDP Workshop for KCRP for Karamuak cluster | 23 Nov 2022 | 9 | 10 | 19 |
| 11 | Workshop - Biodiversity Data and Analysis | 14 – 19 Jan 2023 | 15 | 5 | 20 |
| 12 | CDP Presentation Workshop for KRCP Overall with Kuamut and Karamuak cluster | 25 Jan 2023 | 26 | 20 | 46 |
| 13 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Karamuak cluster | 23 May 2023 | 20 | 12 | 32 |
| 14 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Kuamut Cluster | 24 May 2023 | 33 | 12 | 45 |
| 15 | Training – Socio Economic Data collection | 21 – 24 June 2023 | 28 | 19 | 47 |
| 16 | Meeting with Local Community from Kg Kuamut and Kg Tangkuyan on gravity feed water system installation | 19 July 2023 | 15 | 5 | 20 |
| 17 | Meeting with KRCP Community for Gravity Feed Water System at Kg Kuamut and Kg Tangkuyan | 23 Aug 2023 | 17 | 7 | 24 |

| | | | | | |
|---|---|---|---|---|---|
| 18 | Meeting and MOA signing for installation of gravity feed water system for Kg Kuamut and Kg Tangkuyan with KRCP AJK Community Committee | 13 Sept 2023 | 21 | 1 | 22 |
| 19 | Training – Community Field Staff | 23 – 26 Oct 2023 | 4 | 5 | 9 |
| 20 | Training – 1st Aid | 26 – 28 Oct 2023 | 22 | 3 | 25 |
| 21 | Progress Meeting with local communities of Kuamut Cluster on Gravity Feed Water System | 29 Nov 2023 | 24 | 8 | 32 |
| 22 | Kuamut Rainforest Conservation Solidarity Sports event | 15 – 17 Dec 2023 | 121 | 76 | 197 |
| | **TOTAL** | | **550** | **293** | **843** |

The KRCP project conducted feasibility studies on the water source and electricity post the priority setting identification by the local communities of both cluster in this monitoring period. A consensus was reached by the communities to prioritize gravity feed water system installation for Kg Kuamut and Kg Tangkuyan.

Overall, these activities in 2022 and 2023 laid a strong foundation for community engagement and development in the Kuamut region. Continuous support and involvement from both the community and project partners are crucial for addressing basic needs, enhancing socio-economic conditions, and ensuring sustainable management of natural resources.

**Biodiversity Monitoring**

Table 2.3. 2022 and 2023 biodiversity monitoring activities, for a summary of these activities, please see Biodiversity section 5.3.1 and the supporting evidence files.

| Monitoring Activity | Timeline | Actions Taken |
|---|---|---|
| **Camera Trapping** | August 2022 | Purchased camera traps and conducted inventory; Initial team training on camera trap methodology and deployment. This was informal team training that took place from 26 – 28th August 2022 with the SEARRP team and led by Dr Sunarto from the Permian Global Team and Sui Peng Heon from SEARRP. Details of this training, including a list of the 20 participants can be found in the 'Kuamut Biodiversity Monitoring Implementation Planning 20220909.pptx' in the 'Other documents' supporting evidence folder. |

| | | |
|---|---|---|
| | September – November 2022 | Pilot survey along accessible riparian areas; 49 camera traps deployed in the field to provide data on species presences and test the methodology. See 'Kuamut Project MR2 - Camera Trapping Report.docx' report in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023' folders in the supporting evidence for full details of this pilot survey. |
| | January 23 | Field team training on biodiversity monitoring, including camera trapping and data analysis. This team training took place between 14th – 19th January 2023. The full details along with a list of the 14 participants can be found in the 'Kuamut Biodiversity Data Analyses Workshop - Report 20230117.docx' file in the 'Other documents' supporting evidence folder. |
| | January – April 2023 | Initial analysis of 2022 camera trap data; Re-assessment of biodiversity monitoring plot locations. See 'Kuamut Project MR2 - Camera Trapping Report.docx' report in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023' folders in the supporting evidence for full details of the 2022 pilot survey analysis and see 'Scriven 202303 Representative Points for BioD Sampling.pdf' in the 'Other documents' folder for details of the re-assessment of sampling plots. |
| | May – October 2023 | Deployment and regular checking of 31 camera traps (18 sites in new locations further into the Project Area) to provide data on RTE species presences. See 'Kuamut Project MR2 - Camera Trapping Report.docx' report in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023' folders in the supporting evidence for full details of the 2023 camera trap surveys. |
| | October 2023 – July 2024 | Analysis and evaluation of 2022-2023 camera trap data. See 'Kuamut Project MR2 - Camera Trapping Report.docx' report in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023' folders in the supporting evidence for full details. |
| **Bioacoustic Monitoring** | August 2022 | Purchased acoustic recorders and conducted inventory; Initial team training on bioacoustic methodology and deployment. Details of this training, including a list of the 20 participants can be found in the 'Kuamut Biodiversity Monitoring Implementation Planning |

| | | |
|---|---|---|
| | | 20220909.pptx' in the 'Other documents' supporting evidence folder. |
| | September – November 2022 | Bioacoustic monitoring pilot survey along accessible riparian areas; 49 recorders deployed in the field to record species vocalizations and test the methodology. For full details of the bioacoustic methods and results see 'D021-04-01_Kuamut_bioacoustics_report_final.pdf' Phase 1 report by Social Environment CIC in the 'Presence of HCV 1 species: Bioacoustics 2022 and 2023' supporting evidence folders. |
| | January 2023 | Field team training on biodiversity monitoring, including bioacoustics and data analysis. This team training took place between 14th – 19th January 2023. The full details along with a list of the 14 participants can be found in the 'Kuamut Biodiversity Data Analyses Workshop - Report 20230117.docx' file in the 'Other documents' supporting evidence folder. |
| | January – April 2023 | Selection of 20 species/species groups of interest; Exploration of classifier models to identify these species from their vocalizations (in collaboration with Dr. Joshua Taylor); Re-assessment of biodiversity monitoring plot locations. For full details of the bioacoustic analysis see 'D021-04-01_Kuamut_bioacoustics_report_final.pdf' Phase 1 report by Social Environment CIC in the 'Presence of HCV 1 species: Bioacoustics 2022 and 2023' supporting evidence folders. |
| | May – October 2023 | Deployment and regular checking of 31 acoustic recorders (18 sites in new locations further into the Project Area) to provide data on species/species groups of interest. . For full details of the acoustic recorder deployment in 2023 see 'D021-04-01_Kuamut_bioacoustics_report_final.pdf' Phase 1 report by Social Environment CIC in the 'Presence of HCV 1 species: Bioacoustics 2022 and 2023' supporting evidence folders. |
| | October 2023 – July 2024 | Provisional analysis and evaluation of 2022 bioacoustic data; Selection and development of appropriate classifier models. See the 'D021-04-01_Kuamut_bioacoustics_report_final.pdf' Phase 1 report by Social Environment CIC in the 'Presence of HCV 1 species: Bioacoustics 2022 and 2023' supporting evidence folders. |

| | | |
|---|---|---|
| **Dung Beetle Community Monitoring** | August 2022 | Initial training on dung beetle community monitoring and pitfall-trap deployment. Details of this training, including a list of the 20 participants can be found in the 'Kuamut Biodiversity Monitoring Implementation Planning 20220909.pptx' in the 'Other documents' supporting evidence folder. |
| | September 22 | Dung beetle monitoring; 49 ground pitfall traps and five arboreal traps deployed within the Project Area as part of a pilot survey. For full details see 'Kuamut Project MR2 - Dung Beetle Report.docx' report in 'Presence of HCV 1 species: Dung beetle surveys 2022' folders. Raw dung beetle survey results are also provided in these supporting files. |
| | January 23 | Field team training on biodiversity monitoring, including dung beetle monitoring and data analysis. Full training details along with a list of the 14 participants can be found in the 'Kuamut Biodiversity Data Analyses Workshop - Report 20230117.docx' file in the 'Other documents' supporting evidence folder. |
| | 2023 | Dung beetle specimens identified by Drs. Eleanor Slade, Chiew Li Yuen, Marx Yim (Nanyang Technological University Singapore); Dung beetle identification workshop planned for August 2024. |
| | 2024 | Analysis and evaluation of 2022 dung beetle data. For full details see 'Kuamut Project MR2 - Dung Beetle Report.docx' report in 'Presence of HCV 1 species: Dung beetle surveys 2022' folders. Raw dung beetle survey results are also provided in these supporting files. |
| **Forest Integrity Assessments (FIAs)** | August 2022 | Initial team training on forest integrity assessments (FIAs). Details of this training, including a list of the 20 participants can be found in the 'Kuamut Biodiversity Monitoring Implementation Planning 20220909.pptx' in the 'Other documents' supporting evidence folder. |
| | September 2022 | FIAs conducted at 49 biodiversity monitoring sites. For full details of the FIA methods and results see 'Kuamut Project MR2 - FIA Report.docx' report and supporting data in the 'Vegetation quality: FIA surveys 2022' supporting evidence folders. |
| | 2024 | Analysis and evaluation of 2022 FIA data. For full details of the analysis and evaluation of the FIA results, see the 'Kuamut Project MR2 - FIA Report.docx' report. |

| | | |
|---|---|---|
| **Orangutan Population Monitoring** | November 2023 | Helicopter surveys of orangutan nests carried out by Dr. Felicity Oram and Pravind Segaran over the Project Area. See reports in the 'Presence of HCV 1 species: Orangutan monitoring 2023: Final reports by Dr Felicity Oram' supporting evidence folders for full details of the orangutan helicopter surveys. |
| | 2024 | Analysis and evaluation of 2023 aerial orangutan nest data, including calculations of orangutan population size within the Project Area. See reports in the 'Presence of HCV 1 species: Orangutan monitoring 2023: Final reports by Dr Felicity Oram' supporting evidence folders for full details of the analysis and evaluation of results. |
| **Threat Monitoring** | Throughout 2022 and 2023 | Regular security patrols carried out by project partners RBJ; Illegal activities (hunting, logging) reported and summarized; Near real-time satellite imagery used by the Permian technic See reports in the 'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023' supporting evidence folders for details al team to monitor forest disturbances (see Climate section). |

### 2.2.2 Baseline Reassessment (VCS, 3.2.6, 3.2.7)

Did the project undergo baseline reassessment during the monitoring period?

☐ Yes ☒ No

### 2.2.3 Methodology Deviations (VCS, 3.20)

We present the same methodology deviation as approved during the first monitoring period. The VM0010 methodology provides specific calculations that work on the basis of trees measured in field plots. It is assumed that field plots alone are sufficient, however, the methodology specifically states that "a multi-temporal set of remotely sensed data can be used to detect changes in the structure of the forest canopy" and "SAR or LiDAR, can be used under this approach". We have therefore followed this approach, as for the previous monitoring report, providing here a detailed description of how the approach, which uses up-to-date science, is more conservative and accurate than the prescribed method.

***Deviation justification***

The existing VM0010 methodology recommends that field plots are established at random locations across the project area to generate a representative sample of the forest biomass across ecological gradients and forest strata. The observed biomass values should then be averaged across the entire area for the relevant strata. This plot averaging approach, where sampling is truly representative and a sufficient number of field plots exist, provides an effective way to estimate biomass stock and change across a large area. However, forests are highly dynamic in both space and time, undergoing continual change in response to complex ecological and anthropogenic processes. These processes often do not occur uniformly across large areas but rather they are heterogeneous, driving diverse spatiotemporal changes in forest biomass/structure.

Page 44 of Version 1.3 of VM0010 states "*technology is developing rapidly, including techniques such as RADAR, SAR, or LiDAR.*" and "*For example, a multi-temporal set of remotely sensed data can be used to detect changes in the structure of the forest canopy. A variety of techniques, such as Spectral Mixture Analysis (Souza et al. 2005), SAR or LiDAR, can be used under this approach but no specific technology is prescribed here. Some of the newer technologies can estimate carbon contents of forest types, if supported by field information such as sample plots to calibrate the technology and fieldwork leading to allometric equations of key species. The project proponent should use techniques that are suitable to their specific situation and that have been published in peer-reviewed papers*". In order to account for variability in forest dynamics in both space and time, we have therefore followed the suggestion of the methodology by creating high-resolution biomass and timber volume maps.

This approach is now widely used and accepted in scientific literature (Asner et al. 2018; Baccini and Asner 2013; Jucker et al. 2018; Jha et al. 2021; Johnson et al. 2022). This approach uses the field-derived measurements of forest biomass, airborne Light Detection and Ranging (LiDAR), Landsat 8 multi-spectral optical satellite imagery and Sentinel-1 SAR data in combination with statistical and machine learning approaches to build continuous carbon density and timber volume maps for the entire project area.

From these data, we calculate project-scenario growth rates (from biomass maps) and timber volume for the project start. To derive the growth rates, we used all data from the biomass maps over a 8-year period from 2016-2024 to fit a linear regression through time to estimate the rate of change. By adopting this approach, we substantially increase the number of observations used to estimate the growth rates, thus improving overall accuracy and reducing the variance of biomass growth estimates. Further, in order to account for protected species that would not have been harvested under the baseline scenario, we applied a species conservation factor (SCF) to the growth estimate. This SCF was calculated based on the proportion of protected tree species that were present within the forest plots in the respective management strata. This proportion was deducted from the calculated growth rate. The same SCFs were used to reduce the estimates of extracted timber volume under the baseline scenario.

**Comparative Analysis - Conservativeness and Accuracy**

The details of the methods are presented in the monitoring report (MR) document and corresponding html workbook. The purpose of this analysis is to provide justification for the adopted method and demonstrate its efficacy. Below we present the results of our methods alongside the field-plot-only methods:

In order to demonstrate that the methods are comparable we calculated the total above ground carbon stock, the mean above ground carbon density (ACD) and the total timber volume of the project area using both methods. For the field-plot-only method, plot level values were scaled by the forest area of the project.

The results are presented in the table below. Note that all of the metrics generated with our adopted method are more conservative than methods using only the field plot data. We suggest that this is because the wall-to-wall approach that we have used measures vastly more forest and trees affording the ability to capture patchy natural forest disturbance that was not evident in the plot network.

Table 2.4. Comparison of biomass estimates from the VM0010 methodology (field plots) and the methods adopted for the Kuamut project i.e. combined plot and remote-sensing machine learning (plot-RS ML). Note that carbon stock, ACD and timber volume consider all trees with a diameter at breast height (DBH) > 10 cm. This analysis was performed using the most up-to-date plot data from 2021-2022.

| Metric | Field Plots | Plot-RS ML | % Difference |
|---|---|---|---|
| **Total Carbon (Mg C)** | 6,609,688 | 6,054,169 | -8.40% |
| **Mean ACD (Mg C ha^-1)** | 78 | 71 | -8.30% |
| **Total Timber Volume (m^3 ha^-1)** | 6,870,475 | 6,813,318 | -0.80% |
| **Annual Growth Rate (Mg C ha^-1 yr^-1)** | 2.96 | 2.87 | -3.00% |

Therefore, this methodology deviation does not negatively impact the conservativeness of the quantification of reductions or removals in any way, on the contrary, it increases the accuracy of the quantification provided.

### References


- Asner, Gregory P., Philip G. Brodrick, Christopher Philipson, Nicolas R. Vaughn, Roberta E. Martin, David E. Knapp, Joseph Heckler, et al. 2018. “Mapped Aboveground Carbon Stocks to Advance Forest Conservation and Recovery in Malaysian Borneo.” Biological Conservation 217 (January): 289–310. https://doi.org/10.1016/j.biocon.2017.10.020.

- Baccini, Alessandro, and Gregory P Asner. 2013. “Improving Pantropical Forest Carbon Maps with Airborne LiDAR Sampling.” Carbon Management 4 (6): 591–600. https://doi.org/10.4155/cmt.13.66.

- Jha, Nidhi, Nitin Kumar Tripathi, Nicolas Barbier, Salvatore G. P. Virdis, Wirong Chanthorn, Gaëlle Viennois, Warren Y. Brockelman, et al. 2021. "The Real Potential of Current Passive Satellite Data to Map Aboveground Biomass in Tropical Forests." Remote Sensing in Ecology and Conservation 7 (3): 504–20.https://doi.org/10.1002/rse2.203.

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- Jucker, Tommaso, Gregory P. Asner, Michele Dalponte, Philip G. Brodrick, Christopher D. Philipson, Nicholas R. Vaughn, Yit Arn Teh, et al. 2018. "Estimating Aboveground Carbon Density and Its Uncertainty in Borneo's Structurally Complex Tropical Forests Using Airborne Laser Scanning." Biogeosciences 15 (12): 3811–30. https://doi.org/10.5194/bg-15-3811-2018.

### 2.2.4 Minor Changes to Project Description (CCB Program Rules, 3.5.6)

The following minor changes to Project Description were made in the current monitoring report:

- Table in section 1.1 was updated to reflect only benefits not included in section 1.2, These include Strengthened community governance and decision-making, increased Women's Leadership in Community Development, Climate adaptation through hydrological resilience and soil conservation and improved landscape connectivity for endangered species.
- In section 4.4.2, the community group identified as marginalized and/or vulnerable is described as "Women and Youth in Karamuak and Kuamut Cluster" to also include youth population which was not covered in the PD.
- The project has introduced monitoring of additional indicators related to training programs and employment opportunities that were not explicitly included in the validated Project Description (PD) or prior Monitoring Report (MR). Specifically:
  - Number of training programs conducted
  - Number of participants trained
  - Number of local community members trained
  - Number of women trained
  - Number of part-time jobs
  - Number of casual workers
  - Number of women employed
  - Incidences of hunting activities recorded (replacing changes in wildlife population)

These additions reflect an enhanced approach to measuring and reporting project outcomes that improve transparency and responsiveness to community priorities.

These changes do not represent any changes in the design of the project neither deviate from the project description. These changes were made to ensure conformance with CCB requirements (program rules 3.5.6).

### 2.2.5 Project Description Deviations (VCS, 3.21; CCB Program Rules, 3.5.7 – 3.5.10)

We present the same project description deviation as approved during the first monitoring period. The approach for biomass mapping has been updated with new more accurate and up-to-date datasets (see section 3.1.3 'Monitoring Plan' for more details). This constitutes a change in the procedures for more accurate measurement and monitoring, so this deviation does not impact the applicability of the methodology, additionality or appropriateness of the baseline scenario. The specific input data changes are:

1) New more accurate GPS locations for the field plots.
2) An updated Digital Terrain Model (DTM) based on a composite of geoid-corrected LiDAR DTM and Copernicus GLO-30 Digital Elevation Model (DEM).
3) Gaps in our LiDAR-derived Tree Canopy Height Model (CHM) are no longer filled with the Asner CHM model; instead, we use a continuous and consistent estimate of tree canopy height constructed using a machine learning approach where the Lidar-derived CHM was used as training data.
4) Since the completion of the PD, forest plots have been remeasured; this more recent data provides more information that describes the relationship between Biomass and the earth observation data used to train our Biomass and Merchantable Volume models, the inclusion of these data in the machine learning process improves the accuracy of predictions both after the year of remeasurement but also for preceding years.

All assumptions on the appropriateness of the baseline scenario remain the same, and the project conforms with the applied methodology. However, with the use of the up-to-date datasets, the biomass and timber volume maps are now more accurate. These more accurate maps have been used to update the 2016 timber volume maps. As these volume maps are used to produce the timber harvest plan and estimate the Mean volume of extracted timber under the baseline ($VEX_{j,i|BSL}$), this value all subsequent calculations have changed slightly. The resulting calculations of 'Baseline emissions or removals ($tCO_2e$)', are slightly reduced (more conservative) from those in the PD.

The following deviations from the PD were also implemented:

- Under the project scenario, ongoing forest growth is only accounted for from the date a parcel is to be harvested under the baseline scenario.
- The species conservation factors have been updated with more accurate and updated information on protected species from the Sabah Forest Department Herbarium.
- The same species conservation factors have been applied to restrict the accounting of ongoing forest growth to trees that would have been harvested under the baseline.
- Additional data and parameters for monitoring GHG emission reductions and removals were included in the previous MR that was approved by VERRA and the

VVB. These were also included in the current MR in addition to those available at validation in the PD, these include:

- Residual Stand Damage Factor,
- Merchantable volume for tree l of species j in sample plots p in stratum l,
- Allometric equation(s) for species j linking measured tree variable(s) to aboveground biomass of living trees,
- Fraction of wood products that will be emitted to the atmosphere between 3 and 100years after production,
- Fraction of wood products that will be emitted to the atmosphere within 3 years of production,
- Fraction of extracted biomass effectively emitted to the atmosphere during production,
- Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type,
- Forest regrowth rate post timber harvest for stratum l,
- Mean volume of extracted timber per unit area for species j in stratum l,
- Number of years since timber harvest in stratum i in land parcel p,
- The area of stratum i in land parcel p that was harvested 1 year ago,
- The area of stratum i in land parcel p that was harvested between 2 and 10 year ago,
- The area of stratum i in land parcel p that was harvested between 11 and 20 years ago,
- Cumulative area harvested until time t*,
- Area of sample plots p,

These PD deviations remain aligned with the methodology and increase the accuracy of the calculations.

**Outcome of Deviations**

The incorporation of more accurate datasets and updated calculation methods has led to slight changes in the baseline emissions or removals (tCO2e), making the estimates more conservative. These deviations have improved the precision of biomass and timber volume maps, resulting in more accurate timber harvest plans and volume estimates under the baseline scenario.
The outcome of these deviations is an overall enhancement in the accuracy of the project's monitoring and reporting processes, ensuring better alignment with the actual environmental impacts and conservation goals.

In addition, the crediting period indicated in the PD differs from the Verra registry. The MR now aligns to the Verra registry crediting period, which is the correct value. Similarly, the contact person in section 2.1.4 from Permian Malaysia was also updated in the MR since a CEO for Permian Malaysia was hired by the time of submitting the current MR.

### 2.2.6 Grouped Projects (VCS, 3.6; CCB, G1.13-G1.15, G4.1)

Not applicable. The project is not a grouped project.

### 2.2.7 Risks to the Project (CCB, G1.10)

| Identified Risk | Potential impact of risk on climate, community and/or biodiversity benefits | Actions needed and designed to mitigate the risk |
|---|---|---|
| Illegal logging, forest encroachment, agricultural expansion | Pressure on forest caused by human activities could lead to deforestation and degradation, increasing carbon emissions. | The project has strengthened law enforcement and patrols to combat illegal logging and encroachment, supported by community monitoring programs. These efforts are complemented by the reclassification of the area to a protection forest, which legally prohibits any commercial exploitation |
| Community disengagement or conflict due to inadequate involvement or perceived inequities in benefit sharing | This could arise from misunderstandings or lack of trust between the project stakeholders and local communities, resulting in lack of support from communities to the project and hindering the benefits provided by the project to communities. | Continuous community engagement through FPIC processes and collaboration with local NGOs ensures that the community is actively involved in decision-making. To prevent conflicts, the project includes equitable benefit-sharing mechanisms, capacity-building initiatives, and alternative livelihood programs, such as sustainable agriculture and eco-tourism, which align with conservation goals |
| illegal hunting and poaching, driven by local or external pressures | Threatens endangered species and reduce biodiversity. Additionally, human-induced fires, whether accidental or deliberate, pose a significant risk to both biodiversity and carbon storage | The project has implemented anti-poaching patrols and established wildlife monitoring programs to protect endangered species. Educational campaigns and community-based conservation programs are also in place to raise awareness about the importance of biodiversity and to reduce hunting pressures. Fire prevention and control measures, including firebreaks and community training on fire management, are crucial to preventing human-induced wildfires |

| | | |
|---|---|---|
| Natural disturbances, such as floods, landslides, wildfires, droughts | Extreme weather conditions could potentially generate negative impacts on biodiversity as well as looses in forest carbon stocks, resulting in increased emissions. | The project has implemented a real-time monitoring system that not only serves to identify potential illegal activities but also risks of fires caused by human activities or naturally originated. Since the start of the project, there have been any fires recorded. For a single flood incident during the monitoring period, see section 3.2.2. |

### 2.2.8 Benefit Permanence (CCB, G1.11)

**Climate Benefits**

- Protection of Forest Status: The Kuamut Rainforest Conservation Project has maintained the protection status of the forest throughout the monitoring period. This ensures that the project area remains safeguarded against deforestation and degradation, thereby preserving its carbon sequestration capacity.
- Regrowth Monitoring: The project utilizes a combination of field surveys and remote sensing technologies to measure and monitor forest regrowth. This approach helps in assessing the health and recovery of the forest, ensuring it becomes more resilient to environmental threats such as fires.
- Fire Resilience: By promoting forest regrowth, the project enhances the forest's resilience to fire. Healthy and dense forest areas are less likely to suffer extensive damage from wildfires, contributing to long-term carbon sequestration.

**Community Benefits**

- Community Engagement and Capacity Building: A total of 91 community members (including 31 women) have improved their skills and knowledge through training programs provided as part of project activities. Over the project's lifetime, 355 individuals (113 women) have benefited from capacity-building initiatives.
- Sustainable Livelihoods: The project has provided improved livelihoods or income to 257 people (76 women) during the monitoring period, with a cumulative impact on 531 people (158 women) over the project's lifetime. Additionally, 14 new full-time jobs (3 held by women) were supported during this period, contributing to a total of 38 jobs (5 held by women) throughout the project's duration.
- Community Well-being: The project has improved the well-being of 362 community members (110 women) during this period, contributing to a lifetime total of 607 individuals (188 women).

**Biodiversity Benefits**

- Biodiversity Monitoring: The project conducts regular biodiversity assessments using camera traps, acoustic recorders and other monitoring tools to track the presence and/or abundance of endangered species as well as the vegetation quality (see section 5.3). This helps in understanding the impact of conservation efforts and making necessary adjustments to enhance biodiversity protection.

- Wildlife Protection Measures: The reclassification of the Project Area from a Class II (Production) Forest Reserve to a Class I (Protection) Forest Reserve in 2015/2016 has provided immediate and substantive mitigation of potential negative impacts on biodiversity, which includes the cessation of logging operations and the avoidance of mosaic plantings. Near real-time satellite monitoring and security patrols also continuously monitor the area for any anthropogenic threats (i.e., logging or hunting activities; see section 5.3) and these measures are crucial in safeguarding endangered species and maintaining ecological functioning of the forest habitat within the Project Area.

- Biodiversity Conservation Impact: The project has significantly improved the management of 83,381 hectares for biodiversity conservation. During this monitoring period, it has benefited 3 Critically Endangered (CR), 12 Endangered (EN), and 18 Vulnerable (VU) species. Over the lifetime of the project, the impact has extended to 6 CR, 18 EN, and 32 VU species, including 26 mammals, 23 birds, and 5 reptiles.

**Long-term Impact and Sustainability**

- Sustainable Land Use Management: The KRCP serves as a model for sustainable land use management in the region. By demonstrating the economic and ecological benefits of conservation, the project encourages wider adoption of its practices.

- Policy Influence: The project's success can influence local and regional policies towards more sustainable and conservation-friendly practices. Engaging with policymakers and stakeholders ensures that the project's principles are integrated into broader land use and development plans. This influence has already been demonstrated by the support and active involvement of public sector project partners.

- Indefinite Extension of License Agreement: While the project is based on a 30-year initial license agreement, it is designed to be extendable indefinitely. This ensures that the benefits of the project can continue to accrue well beyond the initial timeframe, providing long-term climate, community, and biodiversity benefits.

By implementing these measures, the KRCP not only addresses immediate conservation, and community needs but also sets a foundation for sustained environmental and social benefits that can last well beyond the project's official duration.

## 2.3 Stakeholder Engagement & Safeguards

### 2.3.1 Stakeholder Identification (VCS, 3.18, 3.19; CCB, G1.5)

No changes in stakeholder identification were recorded since validation. The communities participating in the current monitoring period as well as all relevant stakeholders were identified at time of validation.

### 2.3.2 Stakeholder Access to Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

The full project documentation for the KRCP and summarized sections have been made accessible to communities and other stakeholders through a range of approaches, pitched at differing levels of comprehension and literacy. Here is an overview of the processes and methodologies implemented from 2022 to 2023:

Throughout 2022 to 2023, the project team engaged with the communities through a blend of traditional and digital communication platforms. This included:

Workshops and meetings: Regularly scheduled workshops and community meetings were held to discuss project plans, explain project processes, answer questions, obtain feedback, and provide updates. Detailed minutes and reports documenting the proceedings and outcomes of these meetings were later circulated.

Reports: Periodic progress reports detailing project activities, expenditures, and achievements were provided to project stakeholders. Reports, including progress updates, stakeholder engagement plans, FPIC guidelines and social/environmental assessments, were provided to community members and community leaders, and made available online at: https://permianglobal.com/projects/kuamut-rainforest-conservation-project/.

Community committees: The formation of KRCP Community committees (AJK) at village level helped to facilitate local involvement and ensure continuous communication between the project team and the community. This greatly helped to strengthen governance and transparency between the project and the community members. Documentation of committee meetings and decisions was maintained as evidence.

Grievance mechanisms: Established procedures for community members to raise concerns and provide feedback on the project.

Translation and Accessibility: The project has ensured that all materials shared with stakeholders have been translated into Bahasa Malaysia, the primary language spoken in Sabah, to guarantee accessibility and comprehension.

Dissemination Methods: To disseminate information, materials were shared via village leaders, WhatsApp groups, flyers, posters, bulletin boards, and direct community gatherings.

Documentation: All meetings were documented, with attendance records, photos, meeting minutes, and reports available as evidence.

### 2.3.3 Dissemination of Summary Project Documents (VCS, 3.18, 3.19; CCB, G3.1)

Summary project documentation and information on monitoring results have been actively disseminated to the communities involved in the KRCP through a structured communication system. This system emphasizes community participation and the transparent flow of information, facilitated by several key strategies:

**Community meetings:** Regular meetings have been held in the Kuamut and Karamuak clusters, involving all eight villages. These meetings are crucial for disseminating the findings from project monitoring and updates on ongoing activities. They provide a platform for community members to receive information directly from project coordinators and community organizers, ask questions, and provide feedback.

**Community Committee:** The communities elected representatives from seven villages to this committee, which plays a pivotal role in communication. This committee acts as a liaison, ensuring that the voices of the community members are represented in project discussions and that the information from the project team is relayed back to the communities effectively.

**Involvement of local community organizers:** Community organisers representing community members are involved in the project to disseminate project related information to the wider community in the villages. Their dual role as staff and community members facilitates trust and clarity in communication.

**Documentation and reports**: Detailed project reports are prepared in English, with an executive summary translated into the local language. These reports are shared with community leaders, the Community Executive Committee, and the community at large. The translated summaries are distributed in physical copies at the local level and made available on the project's website (https://permianglobal.com/projects/kuamut-rainforest-conservation-project/), ensuring that all stakeholders and community members are well-informed about the project's progress and findings. This approach promotes transparency and keeps everyone involved and aware of the developments.

During this monitoring period, a total of 22 meetings, workshops, training courses and community engagement activities were carried out. These engagements were widely publicized through local village leaders, WhatsApp groups, flyers, posters, community bulletin boards, and word-of-mouth announcements.

All meetings were conducted in Bahasa Malaysia, ensuring accessibility for local communities. The information shared included project updates, FPIC processes, benefit-sharing mechanisms, and community development planning.

As per CCB requirements, summary documents and key project updates were translated and disseminated to communities through local governance structures, including the Community Executive Committee and village committees. Hard copies were distributed at meetings, and digital versions were made available on the project website.

### 2.3.4 Informational Meetings with Stakeholders (VCS, 3.18, 3.19; CCB, G3.1)

During this reporting period, the KRCP Project conducted multiple informational meetings and consultations with communities and local stakeholders (as identified in the PD section 2.18) to ensure transparency and engagement in the project's implementation. The details of these meetings, including dates, participant numbers, and outcomes, are outlined below. Supporting evidence, including minutes, reports, and photographs, are available in the evidence folder as referenced.

Northern Kuamut Management Committee (NKMC) Meetings

The KRCP Project participated in two meetings of the Northern Kuamut Management Committee (NKMC), the highest governing body overseeing the project's progress. The meetings served as platforms to brief stakeholders on project developments and address key concerns.

- 29 September 2022: The 1st meeting of the NKMC where the Forest Rules (2016) regarding the establishment of the committee, its membership and the Terms of Reference, Objective, powers and function of the NKMC were presented. The KRCP project was also presented to the NKMC committee including aspect of field monitoring and protection efforts and scientific monitoring activities.
- 25 August 2023: The 2nd meeting of the NKMC, saw the approval of the application by research scientist Dr. Chiew Li Yuen on "Effects of Habitat Modification and Fragmentation: A re-survey of Dung beetles of lowland tropical forest of Sabah" in the Kuamut Forest Reserve, project update on the carbon project field reports by RBJ Sdn Bhd and a presentation on the biodiversity monitoring including the orang utan survey and community engagement by SEARRP.

The NKMC comprises of representatives from the Sabah Forestry Department, Yayasan Sabah, Sabah Wildlife Department, University Malaysia Sabah, Ministry of Tourism Culture and Environment, Tongod District Office, Environment Protection Department Sabah, Permian Global, and the South East Asia Rainforest Research Partnership. Minutes of both meetings can be found in the Evidence Folder CL#5, Item 8.

### Community Consultation and FPIC Workshops

The project facilitated a series of Free, Prior, and Informed Consent (FPIC) workshops across local communities to introduce the project and obtain consent for participation. These workshops culminated in the signing of MOUs with 7 out of 8 villages, while Kg Tenaga Baru opted out but continued to receive project updates through its village headman.

FPIC Workshops Conducted:

| No | Activity | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | FPIC Workshop at Kg Kuamut & Kg Tangkuyan | 28-Sep-22 | 36 | 34 | 70 |
| 2 | FPIC Workshop for Kg Desa Permai & Kg Tulang Tulang | 28-Sep-22 | 9 | 5 | 14 |
| 3 | FPIC Workshop for Kg Tamoi (Kg Kenang Kenangan) | 29-Sep-22 | 22 | 8 | 30 |
| 4 | FPIC Workshop for Kg Keramuak Luar | 11-Oct-22 | 30 | 18 | 48 |
| 5 | FPIC Workshop for Kg Keramuak Dalam | 12-Oct-22 | 17 | 13 | 30 |
| 6 | FPIC Workshop for Kg Tenaga Baru | 13-Oct-22 | 33 | 7 | 40 |

The FPIC workshop reports are available in the Evidence Folder CL#5, Item 3.

### Community Engagement & Progress Meetings

Throughout the project's implementation, 16 sessions of meetings, workshops, and briefings were held with community members to discuss progress, address concerns, and coordinate project activities.

| No | Activity | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 7 | CDP Workshop for KRCP (Kuamut Cluster) | 22 Nov 2022 | 17 | 20 | 37 |
| 8 | CDP Workshop for KRCP (Karamuak Cluster) | 23 Nov 2022 | 9 | 10 | 19 |

| | | | | | |
|---|---|---|---|---|---|
| 9 | CDP Presentation Workshop (Overall) | 25 Jan 2023 | 26 | 20 | 46 |
| 10 | KRCP Benefit Sharing Mechanism Workshop (Karamuak) | 23 May 2023 | 20 | 12 | 32 |
| 11 | KRCP Benefit Sharing Mechanism Workshop (Kuamut) | 24 May 2023 | 33 | 12 | 45 |
| 12 | Meeting on Gravity Feed Water System Installation (Kg Kuamut & Kg Tangkuyan) | 19 July 2023 | 15 | 5 | 20 |
| 13 | Meeting with KRCP Community on Gravity Feed Water System | 23 Aug 2023 | 17 | 7 | 24 |
| 14 | MOA Signing for Gravity Feed Water System Installation | 13 Sept 2023 | 21 | 1 | 22 |
| 15 | Progress Meeting on Gravity Feed Water System (Kuamut Cluster) | 29 Nov 2023 | 24 | 8 | 32 |
| 16 | Kuamut Rainforest Conservation Solidarity Sports Event | 15-17 Dec 2023 | 121 | 76 | 197 |

Total community engagement: 450 male, 256 female, 706 participants.

**Community Training Sessions**

To build capacity and enhance community participation, six training sessions were organized, covering various project-related aspects.

| No | Activity | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | Community Organizing & Leadership Training | 9 May – 11 Aug 2022 | 2 | 2 | 4 |
| 2 | First Aid Training | 13-15 Oct 2022 | 29 | 3 | 32 |
| 3 | Biodiversity Data & Analysis Workshop | 14-19 Jan 2023 | 15 | 5 | 20 |
| 4 | Socio-Economic Data Collection Training | 21-24 June 2023 | 28 | 19 | 47 |
| 5 | Community Field Staff Training | 23-26 Oct 2023 | 4 | 5 | 9 |
| 6 | First Aid Training | 26-28 Oct 2023 | 22 | 3 | 25 |

Total training participation: 100 male, 37 female, 137 participants. Training reports are available in the Evidence Folder CL#5, Item 7.

**Publicity and Communication Efforts**

The meetings and workshops were publicized through:

- Announcements via local village headmen and community networks.
- Printed materials such as posters and brochures distributed in villages.
- Direct invitations to stakeholders and community representatives.
- Collaboration with local government offices for information dissemination.

**Supporting Evidence**

- Meeting minutes and reports are documented in the Evidence Folder under the referenced items.
- Photographs and signed attendance sheets are included as supporting documentation.
- Reports on training and FPIC workshops provide details on community engagement outcomes.

### 2.3.5 Risks from the Project and No Net Harm (VCS, 3.18, 3.19)

See Appendix 2.

### 2.3.6 Community Costs, Risks, and Benefits (CCB, G3.2)

The Kuamut Rainforest Conservation Project (KRCP), implemented under the Climate, Community & Biodiversity (CCB) framework, prioritized a participatory and transparent approach to community engagement. The main implementer of the community component, PACOS Trust, played a critical role in ensuring that indigenous communities were well-informed about the project's potential costs, risks, and benefits before making any decisions regarding their participation.

From the beginning of the community engagement via the Free, Prior, and Informed Consent (FPIC) process, PACOS Trust provided clear explanations about the project, its partners, and its objectives. Communities received comprehensive and understandable information through structured workshops, breakout groups, and Q&A sessions conducted in local languages. To minimize miscommunication, PACOS avoided complex technical terms and instead used clear, relatable explanations. For instance, instead of stating, "The project aims to mitigate carbon emissions through forest conservation," facilitators explained, "Protecting the forest helps keep the air clean and the weather stable, which benefits farming and daily life."

**Identified Costs, Risks, and Benefits**

a) Potential Costs to Communities:

- Restricted Land Use: Some traditional forest-use practices, such as shifting cultivation, hunting, and logging, were identified as activities that may be affected due to conservation restrictions.
- Time Commitment: Participation in community meetings, training programs, and governance structures required time investment from community members, which could impact their daily livelihoods.
- Expectation Management: Initial discussions highlighted concerns about whether conservation benefits would be equitably distributed and how long they would take to materialize.

b) Potential Risks to Communities:

- Economic Uncertainty: Some community members expressed concern about losing access to forest-based income-generating activities and whether alternative livelihood options would be sufficient to compensate.
- Conflict Over Resource Use: With conservation measures in place, there was a risk of disputes over land rights and access to natural resources among different community groups.
- Project Dependency: The risk of over-reliance on project-led interventions for community development was acknowledged, requiring a strong focus on capacity-building and sustainable governance structures.

c) Potential Benefits to Communities:

- Improved Livelihoods: Employment opportunities such as constructing gravity-fed water systems, participating in ecotourism initiatives, and working in sustainable agroforestry projects helped provide alternative sources of income.
- Enhanced Water Security: The benefit-sharing mechanism included initiatives such as the community-driven construction of a gravity-fed water system, directly addressing a key need in participating villages.
- Strengthened Governance and Rights: The establishment of the KRCP Community Committee empowered local communities by giving them a structured role in decision-making and project oversight.

- Environmental Sustainability: Protection of forest resources led to improved biodiversity conservation, soil stabilization, and climate resilience, which benefited local agriculture and water sources.
- Capacity Building: Training programs equipped local leaders and community members with skills in project management, governance, and sustainable livelihood practices, fostering long-term self-sufficiency.

**Community Engagement and Governance**

PACOS Trust facilitated open dialogue, allowing community members to actively participate, ask questions, and voice concerns. Role-playing activities, real-life examples, and visual aids such as posters, maps, and illustrations were used to enhance understanding. This interactive process ensured that communities internalized the implications of their involvement in the project.

Beyond FPIC, PACOS strengthened community governance structures through the KRCP Community Committee, with representation from each participating village. These committees played a crucial role in maintaining clear communication channels and monitoring the distribution of project benefits. Additionally, documentation of all meetings, including attendance records, photographs, and meeting minutes, provided transparency and accountability.

**Co-Development of Community Development Plans**

During consultations, PACOS facilitated discussions to co-develop a Community Development Plan, ensuring that community priorities were incorporated. For example, the decision to allocate project resources to construct a gravity-fed water system was a direct outcome of this process. The participation of local villagers in building the system further reinforced community ownership and economic benefits.

**Sustainability and Long-Term Community Involvement**

A fundamental principle of PACOS' approach was fostering long-term community engagement and ownership. By building trust and ensuring that indigenous rights and priorities were respected, PACOS created an inclusive model where conservation was collaboratively developed rather than imposed. This participatory process guaranteed that communities were fully aware of the potential costs, risks, and benefits before committing to the KRCP.

### 2.3.7 Information to Stakeholder on Verification Process (VCS, 3.18.6, 3.19; CCB, G3.3)

The communities and stakeholders were informed about the verification by an independent validation/verification body through a combination of centralized workshops, localized meetings, and direct communication methods. The goal was to ensure preparedness and active participation of all relevant stakeholders, including the KRCP Communities Committee, field staff, village heads, and community members in the process.

**Activities and Processes Implemented**
**Centralized Workshops**

Two centralized workshops were conducted to brief key stakeholders on the upcoming auditor visit on 25 Oct 2024 in the Karamuak cluster and on the 26 Oct 2024 in the Kuamut cluster. These workshops provided an opportunity to discuss the verification process, clarify expectations, and address any concerns from community representatives.

**Field Staff Coordination and Village-Level Meetings**

In January 2025, a preparatory meeting was conducted with the community field staff to ensure they were well-equipped to engage with community representatives regarding the verification process. Following this meeting, each community field staff member conducted individual or group meetings with the KRCP Community Committee and village heads within their respective clusters. This step ensured that all villages received direct, clear communication about the verification process and their roles within it.

**Communication Methods Used**

**Formal Invitation Letters**

The Project issued formal letters to all the Village Head and KRCP Community Committee regarding the Audit Process and invited them to the session with the Auditor. A letter of invitation was distributed to the KRCP Community Committee and community representatives, ensuring a formal and documented approach to reach the community.

**WhatsApp Messages**

The Project through PACOS also use short messages through WhatsApp to inform the communities of the pending auditing visit. The WA message was blasted through the WA community groups that was created by the project to reach the wider communities in the project. Screenshot of an invitation text message shared in the community WhatsApp group indicates that digital messaging was used to inform community members efficiently and in real-time. This method ensured wide dissemination of information and allowed for immediate feedback or clarification if needed.

These combined efforts helped ensure that the verification process was communicated effectively, allowing for thorough coordination, stakeholder engagement, and transparency in the validation process.

### 2.3.8 Site Visit Information and Opportunities to Communicate with Auditor (VCS, 3.18.6, 3.19; CCB, G3.3)

Once the external auditor confirmed the audit visit dates, the project promptly informed the local communities across all eight villages. Notifications were delivered through formal letters sent via Community Field Staff, followed by short messages via WhatsApp to ensure widespread and timely dissemination of information.

The notifications not only communicated the exact dates of the visit but also invited volunteers from within the villages who were willing to engage directly with the auditor. This approach reinforced the significance of the verification process while ensuring a documented and structured engagement plan. As a result, several volunteers, representing various stakeholder groups within both clusters, came forward to participate in interviews with the auditor.

**Facilitating Direct and Independent Communication with the Verification Body**

A key priority of the process was to provide community members with opportunities to communicate freely and independently with the validation/verification body. To facilitate this, the following measures were implemented:

- Individual and Group Meetings with the Auditor: Community members, village heads, and other stakeholders were given the opportunity to meet with the verification team, either privately or in groups, to share their perspectives, concerns, and feedback without external influence.
- Accompanying the Auditor on Site Visits: Community representatives were encouraged to join the auditor during site inspections, offering firsthand insights into project activities, local conditions, and relevant community considerations.
- Private Sessions for Open Dialogue: Arrangements were made to allow stakeholders to communicate directly with the verification body in confidential settings, ensuring they could speak freely and openly.

These efforts ensured transparency, inclusivity, and meaningful stakeholder engagement, allowing the verification team to gain a comprehensive understanding of community perspectives while maintaining an independent evaluation process.

### 2.3.9 Stakeholder Consultation (VCS, 3.18; CCB, G3.4)

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|---|---|
| **Ongoing consultation** | The project proponent organized multiple FPIC (Free, Prior and Informed Consent) workshops across different villages, including Kg. Tulang-Tulang, Kg. Desa Permai, Kg. Tamoi, Kg. Karamuak Dalam, Kg. Kuamut, and Kg. Tangkuyan. These workshops involved detailed presentations on the Kuamut Rainforest Conservation Project (KRC), obtaining community consent, establishing Village Implementing Committees, and signing Memorandums of Understanding (MoUs). |

| | |
|---|---|
| | Community Development Plan (CDP) co-development was conducted at a cluster level (Keramuak and Kuamut cluster) with a meeting/workshop in each cluster<br><br>Benefit Sharing Mechanism (BSM) and Priority Setting briefing sessions with the local communities at a cluster level I,e. one each at Kuamut cluster and Keramuak cluster.<br><br>Gravity Feed Water System as the 1st BSM was discussed with the communities in Kg. Kuamut and Kg Tangkuyan before an agreement was reached on its 3rd meeting. A progress meeting was held on this activity with the larger community group 2 months after it started. |
| Date(s) of stakeholder consultation | 2022<br><br>FPIC Workshops: Held on 28 September, 29 September, 11 October, and 13 October 2022 across multiple villages (Kg. Tulang-Tulang, Kg. Desa Permai, Kg. Kenang-kenangan, Kg. Karamuak Dalam, Kg. Karamuak Luar, Kg. Kuamut, and Kg. Tangkuyan).<br><br>Community Development Workshops: Conducted on 22 November and 23 November 2022 to discuss community development plans and governance structures.<br><br>2023<br><br>Workshops:<br><br>25 January: Presentation of the Draft Community Development Plan (CDP) for Kuamut and Karamuak Clusters.<br><br>23 & 24 May: Briefings on Benefit Sharing Mechanisms and Implementation Activities for Karamuak and Kuamut Clusters.<br><br>Meetings:<br><br>19 July, 23 August, 13 September, and 29 November: Focused discussions on the Gravity Pipe System, including feasibility assessments, signing of agreements, and implementation updates. |
| Communication of monitored results | Monitoring results and project progress were communicated through regular community meetings, progress reports, and detailed feasibility studies. These were shared with the community to ensure transparency and inclusion in the decision-making process |

| | |
|---|---|
| Consultation records | The outcomes of stakeholder consultations were documented through meeting minutes, attendance records, and written feedback from community members. Reports on community meetings included details on discussions, decisions made, and follow-up actions |
| Stakeholder input | Community input played a crucial role in shaping project activities:<br><br>During FPIC workshops, villagers raised concerns about potential land-use restrictions and were assured of their continued access to traditional resources.<br><br>Community Development workshops helped refine livelihood initiatives, with community members advocating for additional training in sustainable agriculture and eco-tourism.<br><br>In Gravity Pipe System meetings, stakeholders requested adjustments to the location of pipelines, leading to modifications in the design. Issues related to labor payments and land access were resolved through consultation with village representatives. |

### 2.3.10 Continued Consultation and Adaptive Management (VCS, 3.18; CCB, G3.4)

The KRCP implemented a robust communication and consultation process with communities and stakeholders, which evolved and adapted based on ongoing feedback. This process was structured through a series of FPIC workshops, community meetings, and continuous engagement with local leaders and community members across various villages within the project area.

**Communication Processes**

- Workshops and meetings: The project team conducted workshops in villages such as Kg. Tamo/Kg Kenang Kenagan, Kg. Tulang-Tulang, Kg. Kuamut, and others. These workshops served as platforms for informing the communities about the project, obtaining their consent, discussing their concerns, and forming local implementation committees. The workshops included detailed presentations on the project's objectives, the expected benefits, and the roles of the community members.
    - For example, during the workshop held in Kg. Keramuak Luar in January 2023, the team presented the draft CDP, which was developed with significant input from the community during previous workshops. The presentation was followed by a Q&A session where community members voiced their opinions and provided feedback on the plan.

- Formation of committees: In each village, project community committees were established, consisting of local community members who act as a communication bridge between the community and the project team. These committees are integral in coordinating project activities and ensuring that community concerns are addressed promptly. These committees also play a crucial role in the grievance mechanism, where they are the first point of contact for any complaints raised by the community.

- Grievance mechanism: The project has implemented a structured grievance mechanism that allows community members to raise concerns or complaints. The proposed mechanisms were that complaints are first addressed by the local KRCP committee. If unresolved, the issue is escalated to the PACOS Trust and then to the Permian team as necessary. This mechanism ensures that the community's concerns are addressed systematically and transparently.

- Ongoing socioeconomic studies: The project team has also engaged in continuous socioeconomic studies to better understand the needs and challenges of the communities. These studies involve detailed data collection on household incomes, resource management, and community needs, which are then used to refine project activities and ensure they are aligned with the community's priorities (KRCP Socio Economic Baseline Report).

**Consideration of Input and Adaptive Management**

The input gathered from the community through these consultations has been instrumental in shaping the project. The feedback has led to several adaptive management actions:

- Project design adjustments: Community feedback regarding the need for improved infrastructure, such as access to clean water and road repairs, has been incorporated into the project's planning. For instance, in response to concerns about clean water access in Kg. Tulang-Tulang and Kg. Desa Permai, the project team-initiated feasibility studies (KRCP Access to Clean Water Pre-Feasibility Report) and planned infrastructure improvements to ensure a reliable water supply.

- Economic development initiatives: The project has also adapted its activities to include ones more focus on economic development, starting in 2024 as requested by the communities. This includes developing cottage industries, eco-tourism, and providing training for improved agricultural practices. These initiatives aim to enhance the livelihoods of the community members and ensure that the benefits of the project are shared equitably (CDP Draf presentation workshop Report).

- Customized community development plans: Each village will develop a customized CDP that reflects the specific needs and priorities of that community. These plans were developed based on extensive consultations and are regularly updated to reflect the evolving needs and circumstances of the communities. This approach ensures that the project remains relevant and responsive to the community's needs.

| Summary of comments received | Actions taken |
|---|---|
| On 28 Sept2022, during the FPIC workshop with communities from Kg Desa Permai and Kg Tulang Tulang, they expressed support for the project but express the need for hiring local villagers for wood planting activities. | On 23 Nov 2022 and 25 Jan 2023, during the Community Development Plan (CDP) development and presentation back to the local communities respectively, the project team responded with the commitment to employing local villagers for project activities and exploring economic opportunities such as eco-tourism. |
| On 29 Sept2022, during the FPIC workshop with the local Communities of Kg Tamoi, now known as Kg Kenang Kenangan, a community member highlighted concerns on clean water supply issues, customary land rights and economic activities for women. | On 23 Nov2022 and 25 Jan 2023, during the Community Development Plan (CDP) development and presentation back to the local communities respectively, the project clarified the process for customary land rights being that of areas outside Kuamut Forest Reserve, initiated a feasibility studies to examine the current water quality of the current water sources and included activities for gravity feed water supply improvements and planned activities for socio economic with women inclusion. |
| On 28 Sept2022, during the FPIC workshop with local community members of Kg Kuamut & Kg Tangkuyan, a request for improved infrastructure and clean water supply, and concerns about the protection of forest reserves. | On 22 Nov 2022 and 25 Jan 2023, during the Community Development Plan (CDP) development and presentation back to the local communities respectively, the project team responded by including the concerns into a proposed community development plan including improving infrastructure development and water supply, including initiated a feasibility studies to examine the current water quality and potential source of clean water through gravity feed water supply and introducing activities to reinforce the protection of reserves. |
| On 11 Oct 2022, during an FPIC session with Kg Keramuak Luar, the communities raised questions about logging permits and concerns about MoU effectiveness if logging occurs, water supply issues. | The Project team responded at the same session that the MoU's purpose was to document community's participation in the KRCP project and that no logging permit has been given for the areas of Kuamut Forest Reserve. The project will begin exploring clean water supply solutions, emphasized community's role in protection of the area, as it is now a Protected area, upon implementation of the project, with the community's involvement, as captured in the MOU. |
| On 11 Oct 2022, during the FPIC session with Kg Keramuak Luar, the communities expressed interest in understanding the project, and raise concerns about the involvement of relevant agencies like Yayasan Sabah. | The Project team responded at the same session that the KRCP project will engage with relevant agencies and planned further workshops especially during the CDP and BSM workshop to ensure comprehensive understanding of the project and allow for participation of all community groups. |

| | |
|---|---|
| On 25 Jan2023, a comment was raised during the CDP Presentation back to the communities, on the need for improved water and road infrastructure, socio-economic development, and better coordination among villages. | At the same session, the Project team responded on mobilizing prioritized projects set by communities as this has been included in the CDP, with specific focus on water supply, road improvements, and socio-economic training |
| On 1 Oct 2024 (outside the public comment period) a comment was received questioning the uncertainty calculation of ex-ante estimations in the Project Description using Wikipedia as reference | On 05 Set 2024 a response was provided clarifying that the estimates of baseline uncertainty were re-calculated at time of first MR and further explaining in detail the source of literature applied, which is more robust than the reference mentioned in the comment received. |

### 2.3.11 Stakeholder Consultation Channels (CCB, G3.5)

The consultations and participatory processes for the KRCP have been carefully structured to ensure direct engagement with communities and other stakeholders or through their legitimate representatives. Here is a demonstration of these processes, along with justifications for the adequacy of information sharing:

**1. Free, Prior, and Informed Consent (FPIC) Workshops**

Conducted FPIC workshops across multiple villages, including Kg. Tulang-Tulang, Kg. Desa Permai, Kg. Kuamut, Kg. Tangkuyan, Kg. Kenang-Kenangan (formerly Kg. Tamoi), Kg. Keramuak Luar, Kg. Keramuak Dalam, and Kg. Tenaga Baru from 28 September 2022 to 29 September 2022 and on 11 October 2022 and 13 October 2022.

Objectives included explaining the KRCP, obtaining community consent, forming village committees, and signing project MoUs.

Justification:

Direct engagement: Workshops were held in the villages, involving community members directly.

Legitimate representatives: Village leaders and representatives were actively involved in organizing and facilitating the workshops.

Information sharing: Detailed presentations on project goals, benefits, and implementation plans were provided, followed by open discussions.

**2. Field Staff Training**

Training sessions were conducted on May 2022 to August 2022, 21-24 June 2023 and 23-26 Oct 2023 on research ethics, data collection, baseline study development, and project implementation.

Emphasized community engagement and accurate documentation.

Justification:

Direct engagement: Field staff, who are part of the community or closely connected to it, were trained to engage directly with community members.

Information sharing: Training included comprehensive information on the project's objectives and methodologies, ensuring that field staff could accurately communicate this to the community.

**3. Community Development Plan (CDP) Workshops**

Meetings were held in Kuamut cluster on 22 November 2022 and in Karamuak clusters on 23 November 2022 to co-develop the community plans and a joint workshop for both clusters were held on 25 Jan 2023 to present back to the community on the community development plans for agreement and consensus building.

Included community feedback sessions to refine and prioritize activities.

Justification:

Direct engagement: Workshops involved direct participation of community members in developing their development plans.

Legitimate representatives: Traditional Community leaders and the AJK Community Committee were involved in the planning and facilitation of these workshops.

Information sharing: Detailed presentations and interactive sessions ensured comprehensive information dissemination and feedback collection.

**4. Progress Meetings and Briefings**

Regular meetings held in 2023 to brief communities on the planning and implementation of project activities.

Discussions on benefit-sharing mechanisms, socio-economic surveys, and baseline studies.

Justification:

Direct engagement: Meetings held within the communities ensured direct involvement.

Legitimate representatives: Village community committees and community leaders facilitated these meetings.

Information sharing: Regular updates and detailed discussions on project activities, challenges, and progress were provided.

**5. Surveys and Baseline Studies**

Conducted socio-economic surveys, feasibility studies, and baseline studies throughout 2022 and 2023.

Collected data on community needs, resources, and development priorities.

Justification:

Direct engagement: Surveys were conducted directly with community members.

Legitimate representatives: Community leaders assisted in coordinating the surveys.

Information sharing: Results and findings were shared with the community through meetings and reports.

Documentation and Evidence of Adequate Information Sharing

Workshop reports and minutes: Detailed reports and minutes from FPIC workshops, CDP workshops, and progress meetings document the discussions, decisions, and information shared with the community.

Signed MoUs: Memorandums of Understanding (MoUs) signed by community representatives during FPIC workshops demonstrate informed consent and agreement on project participation.

Survey and study Reports: Comprehensive reports from socio-economic surveys, feasibility studies, and baseline studies provide evidence of data collection and information sharing with the community.

Feedback and grievance mechanisms: Established mechanisms for community feedback and grievances as to ensure that community concerns are addressed and documented through meetings and formal submission of complaints. However, in this reporting period, no grievances were reported.

**Conclusion**

The KRCP has undertaken extensive consultations and participatory processes directly with communities and other stakeholders through legitimate representatives. The project has ensured adequate levels of information sharing through detailed presentations, interactive workshops, regular progress meetings, comprehensive surveys, and established feedback mechanisms. The documentation, including workshop reports, signed MoUs, and survey reports, provides strong evidence of these processes and the effective dissemination of information to the community.

### 2.3.12 Stakeholder Participation in Decision-Making and Implementation (VCS, 3.18, 3.19; CCB, G3.6)

The KRCP has implemented specific activities and processes to ensure the effective participation of all communities, with particular attention to culture- and gender-sensitivity. In the reporting period (2022-2023) a total of 22 engagement sessions were conducted including workshops, meetings and training sessions to inform the community of the project and the progress but also to collect their input and facilitate decision-making.

### Community Workshops and Training Sessions

A total of 706 community members (450 male, 256 female) participated in these sessions, which covered topics such as Free, Prior, and Informed Consent (FPIC), co-designing the Community Development Plan (CDP), the Benefit Sharing Mechanism (BSM), and the grievance process.

The engagement process began with a full FPIC process (September–October 2022) to secure the agreement of local communities. This was followed by:

- Community Development Plan (CDP) workshops in November 2022 to design community-driven initiatives.
- Benefit Sharing Mechanism (BSM) workshops in May 2023 to discuss how project benefits would be distributed, including the grievance mechanism agreement with communities.
- Infrastructure meetings (July–November 2023) related to the installation of a gravity feed water system in participating villages of Tangkuyan and Kuamut.
- A solidarity sports event in December 2023, which served as a community engagement and awareness-building activity.

These sessions were critical in ensuring that community members understood the project's objectives, expected impacts, and their roles and responsibilities in the implementation process.

### Gender-Inclusive Approach

To ensure women's participation, specific focus group discussions were held to address cultural barriers. Out of the total 706 participants, 256 (36%) were women. Separate breakout sessions for women and youth were conducted in certain workshops to encourage open discussions.

### Formation of KRCP Community Committees (AJK)

During the FPIC process, KRCP Community Committees (AJK) were established in each participating village to ensure ongoing communication, decision-making, and coordination of project activities.

Summary List of Community Workshops, Meetings and discussion sessions

| No | Activities | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | FPIC Workshop on KRCP at Kg Kuamut and Kg Tangkuyan | 28 Sept 2022 | 36 | 34 | 70 |
| 2 | FPIC Workshop on KRCP for Kg Desa Permai and Kg Tulang Tulang | 28 Sept 2022 | 9 | 5 | 14 |
| 3 | FPIC Workshop on KRCP for Kg Tamoi (It is now known as Kg Kenang Kenangan) | 29 Sept 2022 | 22 | 8 | 30 |
| 4 | FPIC Workshop on KRCP for Kg Keramuak Luar | 11 Oct 2022 | 30 | 18 | 48 |
| 5 | FPIC Workshop on KRCP for Kg Kermuak Dalam | 12 Oct 2022 | 17 | 13 | 30 |
| 6 | FPIC Workshop on KRCP for Kg Tenaga Baru | 13 Oct 2022 | 33 | 7 | 40 |
| 7 | CDP Workshop for KRCP for Kuamut Cluster | 22 Nov 2022 | 17 | 20 | 37 |
| 8 | CDP Workshop for KCRP for Karamuak cluster | 23 Nov 2022 | 9 | 10 | 19 |
| 9 | CDP Presentation Workshop for KRCP Overall with Kuamut and Karamuak cluster | 25 Jan 2023 | 26 | 20 | 46 |
| 10 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Karamuak cluster | 23 May 2023 | 20 | 12 | 32 |
| 11 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Kuamut Cluster | 24 May 2023 | 33 | 12 | 45 |
| 12 | Meeting with Local Community from Kg Kuamut and Kg Tangkuyan on gravity feed water system installation | 19 July 2023 | 15 | 5 | 20 |
| 13 | Meeting with KRCP Community for Gravity Feed Water System at Kg Kuamut and Kg Tangkuyan | 23 Aug 2023 | 17 | 7 | 24 |

| | | | | | |
|---|---|---|---|---|---|
| 14 | Meeting and MOA signing for installation of gravity feed water system for Kg Kuamut and Kg Tangkuyan with KRCP AJK Community Committee | 13 Sept 2023 | 21 | 1 | 22 |
| 15 | Progress Meeting with local communities of Kuamut Cluster on Gravity Feed Water System | 29 Nov 2023 | 24 | 8 | 32 |
| 16 | Kuamut Rainforest Conservation Solidarity Sports event | 15 – 17 Dec 2023 | 121 | 76 | 197 |
| | TOTAL | | 450 | 256 | 706 |

### 2.3.13 Anti-Discrimination Assurance (VCS, 3.19; CCB, G3.7)

Permian Malaysia Sdn. Bhd., through Permian Global, has taken comprehensive steps to ensure that all entities involved in the project design and implementation are not involved in or complicit in any form of discrimination or sexual harassment. These measures are implemented through a detailed and robust framework outlined in the company's Staff Handbook, specifically in Section XII, which focuses on harassment and non-discrimination policies.

**Key Activities and Processes Implemented:**

- Comprehensive Employment Terms: Permian Global has collated and defined all employment terms into a Staff Handbook, which serves as a central reference for all staff. This handbook includes clear definitions and prohibitions of various forms of harassment and discrimination based on race, color, religion, sex, age, sexual orientation, national origin or ancestry, disability, medical condition, marital status, veteran status, or any other protected status defined by law.
- Mandatory Acknowledgment: All staff members are required to acknowledge and adhere to the guidelines set forth in Section XII of the Staff Handbook. This section provides an extensive overview of what constitutes harassment and discrimination, emphasizing the company's zero-tolerance policy towards such behaviors.
- Inclusion of All Project Stakeholders: The regulations outlined in Section XII extend beyond interactions among staff members. They explicitly apply to all beneficiaries and counterparts involved in the project, ensuring a harassment-free environment for everyone engaged in project activities.
- Prohibition of Sexual Harassment: The Staff Handbook includes explicit definitions and prohibitions against all forms of sexual harassment. This ensures that all staff members understand what constitutes sexual harassment and the serious consequences of such actions.

- Availability of Company Regulations: A full copy of the company regulations is available upon request, ensuring transparency and accessibility of the policies to all staff members and stakeholders.
- Grievance Reporting Mechanisms: Although not explicitly stated in the provided information, it can be inferred that there are mechanisms in place for reporting grievances related to harassment and discrimination. The absence of reported grievances to date indicates either effective prevention or a potential area for further development in terms of encouraging reporting and ensuring accessibility of these mechanisms.

**Demonstration of Non-occurrence of Sexual Harassment:**

To date, there have been no sanctions imposed on staff for infringements of the harassment and discrimination regulations. Additionally, no grievances related to harassment or discrimination have been reported. This record demonstrates the effectiveness of the company's policies and the commitment of Permian Global to maintain a safe and respectful working environment.

### 2.3.14 Grievances (VCS, 3.18.4; CCB, G3.8)

During the current monitoring period there were no grievances reported.

| Grievances received | Resolution and outcome |
|---|---|
| *N/A* | *N/A* |

A revised system to collect community members views and concerns regarding the project was agreed with communities during the current reported period, where grievances can be in the form of written or verbal by the communities and agreed timeline to resolve it within a week (3 days at community level, 3 days at KRCP Community Committee (AJK) level and 1 day at PACOS level). Improvements to enable ease of submission of grievances was identified i.e. in having 1) a box for collecting any type of written communication was installed at each community; 2) a dedicated instant messaging group (whatsapp); 3) frequent workshops and discussions with community organizers and 4) a third party involved the local court system (Mahkamah Anak Negeri) and the Human Rights Commission of Malaysia (SUHAKAM).

SUHAKAM was established by Parliament under the Human Rights Commission of Malaysia Act 1999 [Act 597] which was gazetted on 9 September 1999. Its main purpose was the protection and promotion of human rights in Malaysia. Among its functions, SUHAKAM promotes awareness of and provides education in relation to human rights and inquires into complaints regarding infringements of human rights in the country. SUHAKAM acts independently without any influence by the project. Through their local office in Sabah, they collect any concerns from communities that may find themselves under any form of human rights abuse, including the communities participating in the project. SUHAKAM is fully aware of the implementation of the Kuamut Rainforest Conservation Project.

Furthermore, in order to comply with the requirements of VCS Standard 3.18.4, the following stages were followed, as also described in the validated PD:

1) Amicably resolve all grievances and provide a written response in a manner that is culturally appropriate: This is not applicable because there were no grievances raised during the monitoring period.

2) Any grievances that are not resolved by amicable negotiations shall be referred to mediation by a neutral third party: This is not applicable because there were no grievances raised during the monitoring period

3) Any grievances that are not resolved through mediation shall be referred either to a) arbitration, to the extent allowed by the laws of the relevant jurisdiction or b) competent courts in the relevant jurisdiction, without prejudice to a party's ability to submit the grievance to a competent supranational adjudicatory body, if any.: This is not applicable because there were no grievances raised during the monitoring period

### 2.3.15 Worker Training (VCS, 3.19; CCB, G3.9)

To provide orientation and training for the project's workers and a wide range of people from the communities, several activities and processes were implemented. These are aimed at ensuring that the local capacity is not lost and continues to be strengthened. A total of 6 training sessions were conducted by the project to build capacity and capability of team members to carry out their duties. A summary table of the training that was conducted is as below.

| No | Activities | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | Training – Community Organizing and Leadership training | 9 May – 11 August 2022 | 2 | 2 | 4 |
| 2 | Training – 1st Aid | 13-15 Oct 2022 | 29 | 3 | 32 |
| 3 | Workshop - Biodiversity Data and Analysis | 14 – 19 Jan 2023 | 15 | 5 | 20 |
| 4 | Training – Socio Economic Data collection | 21 – 24 June 2023 | 28 | 19 | 47 |

| | | | | | |
|---|---|---|---|---|---|
| 5 | Training – Community Field Staff | 23 – 26 Oct 2023 | 4 | 5 | 9 |
| 6 | Training – 1st Aid | 26 – 28 Oct 2023 | 22 | 3 | 25 |
| | TOTAL | | 100 | 37 | 137 |

**Orientation and Training Activities:**

Opening and Project Introduction:

Introduction to the KRCP, its goals, and the importance of the staff and community developers' roles. This initial briefing sets the context for the project and ensures everyone understands the overall objectives and their specific contributions.

Research Ethics and Fieldwork Guidelines:

Detailed training on ethical guidelines for conducting research and fieldwork, emphasizing respect for community culture and professional behavior. This ensures that staff engage with the community appropriately and sustainably.

Data Collection Training:

Hands-on training on using the Kobocollect application for data collection. This includes practical exercises on gathering demographic data, mapping community resources, and conducting interviews. The use of technology in data collection is introduced to streamline the process and ensure accuracy.

Role-Playing and Practical Exercises:

Role-playing sessions to simulate fieldwork scenarios. Staff practice engaging with community members, collecting data, and explaining project objectives. These exercises help build confidence and improve communication skills.

Review and Discussion of Baseline Reports:

Reviewing previous baseline reports and discussing key findings. This helps staff understand the current status of the community and identify areas that need attention. Discussions also include challenges and threats faced by the community, fostering a problem-solving approach.

Development of Survey Questions:

Collaborative sessions to develop survey questions related to demographics, education, skills, infrastructure, health, economy, and environmental resources. This ensures that data collection is comprehensive and relevant to the project's goals.

Financial Management Training:

Training on budget management, including how to request and settle cash advances, and the importance of maintaining accurate financial records. This ensures transparency and accountability in project finances.

**Maintaining Local Capacity:**

Involvement of Community Members:

Engaging local community members in data collection and project activities ensures that the knowledge and skills developed during the project are retained within the community.

Regular Training and Updates:

Continuous training sessions and updates keep the staff and community members informed about new developments and best practices. This ongoing education helps maintain and build upon the skills acquired.

Clear Role Definitions and Responsibilities:

Defining clear roles and responsibilities for both project staff and community members ensures everyone knows their tasks and contributes effectively to the project. This structure helps in maintaining order and accountability.

Documentation and Reporting:

Encouraging thorough documentation and regular reporting of activities helps create a repository of knowledge that can be referred to in the future. This practice ensures that knowledge is not lost and can be used for future projects.

Community Involvement in Decision Making:

Involving the community in decision-making processes helps build a sense of ownership and responsibility towards the project. This involvement ensures that the community continues to support and sustain the project activities even after the initial implementation phase.

By implementing these activities and processes, the project not only provides effective orientation and training for workers and community members but also ensures that the local capacity is built and maintained in the long term.

### 2.3.16 Community Employment Opportunities (VCS, 3.19.13; CCB, G3.10)

To ensure that all community members have equal opportunities for work positions:

Job Posting and Outreach:

- We advertise job openings widely within the community, using various channels to reach everyone.

- Special efforts are made to reach women and marginalized groups through targeted outreach programs.

Equal Opportunity Policies:

- Our hiring policies explicitly state that all candidates are considered based on their qualifications without discrimination.
- We ensure that job requirements are clear and attainable for all community members.

Training and Capacity Building:

- Training programs are offered to all community members to help them meet job requirements.
- Special training sessions are available for women and marginalized groups to ensure they have the skills needed for available positions.

Fair Hiring Practices:

- A diverse hiring committee oversees the recruitment process to ensure fairness and transparency.
- All candidates are interviewed and assessed using the same criteria.

Gender Equity and Equal Pay:

- We conduct regular reviews to ensure equal pay for equal work, regardless of gender.
- Policies are in place to support gender equity, including maternity leave and flexible working hours.

The Kuamut Project is committed to employing local communities as staff of the project. In this reporting period of 2022, the Kuamut Project hired a total of 32 individuals on a full-time basis and the number increased to 38 individuals at the end of 2023. This includes 6 persons from Karamuak and Kuamut villages on full time basis.

### 2.3.17 Occupational Safety Assessment (VCS, 3.19; CCB, G3.12)

The KRCP, while prioritizing worker safety, has identified several substantial risks that have arisen due to its implementation. These risks are inherent to the project's nature and the environments in which the workers operate. The primary risks include:

- Exposure to Wildlife and Insects: Workers are at risk of bites and stings from venomous insects and other wildlife, which can lead to serious health issues.
- Navigation and Communication Challenges: The dense forest and remote locations increase the risk of workers getting lost or facing communication breakdowns.

- Physical Injuries: Activities such as fire suppression and field surveys pose risks of physical injuries from slips, falls, and accidents with equipment.
- Environmental Hazards: Workers are exposed to harsh weather conditions, potential flooding, and other environmental hazards.
- Logistical Shortfalls: Lack of adequate supplies and equipment can leave workers vulnerable in emergencies.

**Activities and Processes Implemented to Inform Workers of Risks and Minimize Them**

To mitigate these risks, the Kuamut Project has implemented comprehensive safety measures. Key activities and processes include:

- Provision of First Aid Kits: Workers are equipped with first aid kits containing anti-venom cream and insect repellent to address immediate health risks from wildlife and insects.
- Navigation and Communication Equipment: GPS devices, compasses, and handheld transceivers are provided to ensure workers can navigate safely and maintain communication.
- Buddy System: A buddy system is enforced, requiring a minimum of two people per group for all field activities to ensure mutual assistance and safety.
- Standard Safety Equipment: Workers are provided with essential safety gear including microfiber masks, rubber boots, heavy-duty gloves, uniforms, hats, harnesses, survival kits, portable water bottles/bags, and life jackets.
- Additional Logistics: Adequate supplies of fuel, boat propellers, and water and meals for three extra days are ensured to prepare for any unforeseen delays or emergencies.
- Safety Training: Comprehensive training on safety procedures, evacuation protocols, communication, equipment usage, and shelter making is conducted before the start of any activity. This training is tailored to address the specific risks associated with each activity.

**Minimization of Risks**

Through these measures, the project has effectively minimized the risks to worker safety. Here's how these initiatives contribute to risk minimization:

- First Aid Kits: Immediate treatment for bites, stings, and minor injuries reduces the severity and prevents escalation of health issues.
- Navigation and Communication Equipment: Ensures workers can find their way and stay in touch, reducing the risk of getting lost or isolated.

- Buddy System: Enhances safety through mutual support, allowing for quick assistance in case of emergencies.
- Safety Equipment: Protective gear mitigates the risk of physical injuries and exposure to harsh environmental conditions.
- Logistics: Sufficient supplies ensure workers are not left vulnerable in case of delays, providing a safety buffer.
- Safety Training: Empowers workers with the knowledge and skills to handle emergencies effectively, reducing the likelihood of accidents and injuries.

Permian Malaysia Sdn. Bhd. continues to emphasize safety through ongoing training and adherence to safety protocols. The safety SOP is strictly followed, and employee safety is a core consideration in all project planning activities. This comprehensive approach ensures that risks are continually assessed and mitigated, promoting a safe working environment for all project personnel.

## 2.4 Management Capacity

### 2.4.1 Required Technical Skills (VCS, 3.19; CCB, G4.2)

The project activities are primarily implemented by the project proponent in collaboration with technical and implementing partners. The team is composed of highly qualified and experienced professionals from diverse backgrounds, including forest management, conservation biology, silviculture, community development, financial management, business management, legal and technical regulation, and policy. The team is based in Kota Kinabalu, Sabah, with regional facilities throughout the project zone.

**Key Project Activity Themes and Required Skills**

1) Forest Resources Conservation

Protection and Enforcement

**Skills Required:**

- HCV (High Conservation Value) mapping
- Forest conservation techniques
- Biodiversity conservation
- Biodiversity Monitoring, Reporting, and Verification (MRV)

**Maintenance:**

- Regular training and updates on HCV mapping technologies and methodologies.

- Continuous professional development in forest and biodiversity conservation techniques.
- Participation in workshops and seminars on biodiversity MRV methods.

2) Habitat Conservation and Management

**Skills Required:**

- Habitat restoration methods
- Ecosystem management

**Maintenance:**

- Ongoing training in habitat restoration and ecosystem management practices.
- Fieldwork to apply and refine habitat management skills.

3) Research and Development

Knowledge Management

**Skills Required:**

- Data collection and analysis
- Information dissemination

**Maintenance:**

- Regular training in data management systems.
- Participation in knowledge-sharing platforms and networks.

4) MRV Methods

**Skills Required:**

- Carbon MRV
- Biodiversity MRV

**Maintenance:**

- Continuous learning and certification in MRV standards and practices.
- Attending international conferences on MRV methodologies.

5) Researching Natural Regeneration and Restoration Methods

**Skills Required:**

- Silviculture

- Biodiversity conservation

**Maintenance:**

- Training in silviculture and restoration ecology.
- Research projects and field studies to test and improve regeneration methods.

In this reporting period, a total of 6 training sessions were conducted where a total of 137 participants with 37 women were involved. The topics of training included on Community Organising and Leadership skills for the local community members, First Aid Training, Biodiversity Analysis and documentation, socio-economic data collection, roles of field staff on community engagement. Out of these figures, 91 were local community members with 31 females.

| No | Activities | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | Training – Community Organizing and Leadership training | 9 May – 11 August 2022 | 2 | 2 | 4 |
| 2 | Training – 1st Aid | 13-15 Oct 2022 | 29 | 3 | 32 |
| 3 | Workshop - Biodiversity Data and Analysis | 14 – 19 Jan 2023 | 15 | 5 | 20 |
| 4 | Training – Socio Economic Data collection | 21 – 24 June 2023 | 28 | 19 | 47 |
| 5 | Training – Community Field Staff | 23 – 26 Oct 2023 | 4 | 5 | 9 |
| 6 | Training – 1st Aid | 26 – 28 Oct 2023 | 22 | 3 | 25 |
| | TOTAL | | 100 | 37 | 137 |

Maintaining the technical skills required for the successful implementation of the KRCP involves continuous professional development, participation in specialized training, workshops, and field exercises. This approach ensures that the team remains proficient and up to date with the latest methodologies and best practices in their respective fields, thereby enhancing the project's effectiveness and sustainability.

### 2.4.2 Management Team Experience (VCS, 3.19; CCB, G4.2)

The management team at Permian Global possesses many decades of combined experience, covering all necessary areas for implementing land management and carbon projects on the scale of the KRCP. The team's extensive background and specialized skills ensure effective execution and monitoring of such large-scale initiatives.

The team includes experts with over 20 years of relevant experience in climate change and forest management. Their careers span various high-impact roles globally, demonstrating their ability to address complex environmental challenges effectively.

The technical team responsible for estimating and monitoring carbon stocks comprises highly respected scientists. These professionals have authored numerous publications on forest carbon estimates and monitoring, particularly within tropical forest ecosystems. Their research and practical experience provide a robust foundation for accurate carbon accounting and reporting.

Expertise in biodiversity evaluation and monitoring is also a significant strength of the team. This includes assessing species presence and activity, evaluating net positive biodiversity impacts, and implementing mitigation actions to preserve and enhance biodiversity within the project area.

Engaging with local communities is a critical component of the project. The team has extensive experience in community engagement, ensuring that local stakeholders are actively involved. This involvement helps address community concerns and incorporates local knowledge into project planning and execution.

Members of the management team have held significant positions related to climate change and forest management worldwide, contributing to international policy development and implementation. The scientists on the team have contributed to the academic and practical understanding of tropical forest carbon dynamics, with their publications serving as valuable resources for best practices in carbon estimation and monitoring.

The team's successful community engagement initiatives have fostered collaboration and ensured that project benefits are equitably shared. This experience is crucial for maintaining positive relationships and achieving long-term project sustainability.

The collective expertise and prior experience of the management team at Permian Global underscore their capability to manage and implement the Kuamut Rainforest Conservation Project effectively. Their combined knowledge in climate change, carbon estimation, biodiversity, and community engagement ensure comprehensive and successful project outcomes.

### 2.4.3 Project Management Partnerships/Team Development (VCS, 3.19; CCB, G4.2)

The KRCP collaborates extensively with a wide array of institutions, both as implementing partners and as sources of technical advice. These collaborations involve nationally and internationally recognized scientific and technical experts who provide advice on climate science, community development, site management, and biodiversity conservation. These partnerships complement the project team's capabilities and significantly contribute to the project's success.

For instance, collaborations with institutions like the Meteorological Department and universities specializing in climate research provide cutting-edge insights and data essential for the project's climate-related aspects. Partnerships with local NGOs and international development organizations bring expertise in participatory approaches, ensuring that community engagement strategies are culturally sensitive and effective. Technical advice on practical site management is obtained from experienced conservation groups and environmental consultancies, helping optimize resource allocation and conservation efforts. Biodiversity conservation benefits from inputs by academic institutions and wildlife organizations that offer advanced methodologies and monitoring techniques to maintain and enhance biodiversity.

These collaborations aim to enhance the project's wider benefits by making the site and its data open to new partners. To date, no gaps in capacity required to implement the project's core activities have been identified. However, if gaps were to emerge, the project management team is committed to addressing them promptly through targeted recruitment or further partnerships. This proactive approach ensures the continuous enhancement of the project's impact and sustainability.

### 2.4.4 Financial Health of Implementing Organization(s) (CCB, G4.3)

Permian Malaysia Sdn. Bhd. and the Kuamut Rainforest Conservation Project are financed with secure investment financing and will derive revenue through the sale of verified carbon units (VCUs). Financial forecasts and supporting documentation are available to the verifiers on request. As it can be observed in the Verra registry. Most of the VCUs from the first verification have been issued and most recently, an auction was conducted by Bursa Malaysia which demonstrated high demand from KRC project. Furthermore, Permian Malaysia and KRCP are financially backed by Permian Global, which has more than 17 years successfully operating in the carbon markets.

### 2.4.5 Avoidance of Corruption and Other Unethical Behavior (VCS, 3.19; CCB, G4.3)

To demonstrate that Permian Malaysia Sdn. Bhd., Permian Global, and other entities involved in the project implementation are not involved in or complicit in any form of corruption such as bribery, embezzlement, fraud, favoritism, cronyism, nepotism, extortion, and collusion, the following activities and processes have been implemented:

**Financial Control and Management Practices:**

Written Financial Management Practices: These are enshrined in the deeds of enactment of the company and in supporting documentation agreed upon by the Board of Directors on behalf of the shareholders. This ensures a clear framework for financial operations and accountability.

Segregation of Responsibilities: Full segregation of financial management responsibilities is strictly maintained. This includes separate roles for activity/purchase authorization, expense authorization, payment, and bookkeeping. Such segregation helps to prevent conflicts of interest and reduce the risk of fraudulent activities.

**Auditing and Transparency:**

Routine Internal Audits: Regular internal audits are conducted to continuously monitor and review financial practices and compliance with established policies.

Annual Independent External Audits: The company undergoes annual audits by independent external auditors. These audits provide an unbiased review of financial records and practices, ensuring transparency and accountability.

Availability of Audit Reports: Full external audit reports are available to verifiers upon request, demonstrating a commitment to transparency and openness in financial matters.

**Non-Corruption Policy:**

Policy Documentation: A strict non-corruption policy is documented in both the company's deeds of enactment and the Staff Manual. This policy explicitly prohibits practices such as bribery, embezzlement, fraud, favoritism, cronyism, nepotism, extortion, and collusion.

Contractual Arrangements with Project Partners: All project partners are bound by strict contractual arrangements that mandate compliance with the non-corruption policy. This ensures that all parties involved in the project adhere to the same ethical standards.

**Field Inspections and Documentation:**

Routine Field Inspections: Regular inspections of project sites and implementing partners are conducted to ensure compliance with project guidelines and financial practices.

Documentation of Expenses: All expenses are meticulously documented, including documented authorization for each transaction. This practice ensures a clear audit trial and accountability for all financial activities.

Centralized Procurement and Procedures: Procurement processes are centralized and strictly documented. This includes detailed procurement procedures that must be followed for all purchases, ensuring consistency and fairness in the procurement process.

**Staff Training and Awareness:**

Training Programs: Staff members receive training on acceptable behavior and the non-corruption policy. This training ensures that all employees are aware of the company's ethical standards and understand their responsibility in maintaining these standards.

By implementing these comprehensive measures, Permian Malaysia Sdn. Bhd. and its partners can assure stakeholders that they are committed to preventing and addressing any form of corruption in the project implementation process.

### 2.4.6 Commercially Sensitive Information (VCS, 3.5.2-3.5.4; CCB Program Rules, 3.5.13 – 3.5.14)

See Appendix 3 - In compliance with the provided instructions, all information related to the determination of the baseline scenario, demonstration of additionality, and estimation and monitoring of GHG emission reductions and removals (including operational and capital expenditures) is included in the public versions of the project documents and is not considered commercially sensitive.

## 2.5 Legal Status and Property Rights

### 2.5.1 National and Local Laws (VCS, 3.1, 3.6. 3.7, 3.14, 3.18, 3.19; CCB, G5.6)

The Kuamut Rainforest Conservation Project and Permian Malaysia Sdn. Bhd. operates in full compliance with Sabah state and Malaysia's laws and legislations. The Northern Kuamut Forest Reserve was constituted under the Forests (Constitution of Forest Reserves and Amendment) Enactment 1984 [No. 4 of 1984] that states its establishment as a model management area for protection that combines conservation, forestry and nature of tourism activities on a sustainable long-term basis. Under Section 42 (Rules) of the Forest Enactment 1968, which is a law relating to the preservation of forest through the regulation and control of dealings in the forest produce and matters connected, the Forest (Northern Kuamut Conservation Area) Rules 2016 was established.

The Forest (Northern Kuamut Conservation Area) Rules 2016 came into effect on 30 June 2016 and stated the establishment of a management committee for the purpose of overseeing the management of the forest reserve as a protected area in perpetuity for the biological diversity, promoting research on the composition and functioning role of the ecosystem within the forest reserve, promote education and training in conservation, natural history, ecology, forestry and related sciences, promote recreation and nature tourism, that does not significantly compromise the management objectives of the forest reserve and to integrate the management objectives of the forest reserve with other planned development in the surrounding areas as to create a model management area in the Northern Kuamut Forest Reserve that combines conservation, forestry and nature of tourism activities on a sustainable long-term basis.

The Kuamut Management Committee met twice for the duration of this 2nd monitoring report, with its 1st meeting held on the 29 September 2022 and the 2nd meeting on the 25 August 2023 deliberating on matters of activities that has been implemented by the project partners including patrolling, biodiversity monitoring and preparation for the verification of the Kuamut Project, under the VERRA's standards of Voluntary Carbon and Climate, Community and Biodiversity Assurance. The meetings provided a platform for Permian Malaysia Sdn. Bhd., as the project proponent to brief the committee about the Kuamut Rainforest Conservation Project and its long-term goal and outcomes as well as the implementation of initiatives and activities henceforth, as set forth as a forest carbon project.

Permian Malaysia Sdn. Bhd. is not aware of any national and local laws and regulations in Malaysia that have gone into effect, changed, or been eliminated since the project's 1st verification that are relevant to the project activities.

However, for the state of Sabah, in its aspiration to achieve sustainable development through adoption of emission reduction strategies, it has incorporated Green Sustainability and Infrastructure Network as a key element of the Sabah Maju Jaya (SMJ) Development Plan (2021-2025). Within this, Sabah in 17 March 2022, established the Sabah Climate Action Council (SCAC) to serve as the state's coordinating body for managing climate change initiatives at the state level. Subsequently, a study was commissioned on 19 Dec 2023 to develop Sabah Climate Change Policy regarding the development of Sabah Greenhouse Has (GHG) Inventory and a study on the impacts, vulnerability and adaptation of climate change in Sabah.

### 2.5.2 Relevant Laws and Regulations Related to Worker's Rights (VCS, 3.18, 3.19; CCB, G3.11)

The KRCP and Permian Malaysia Sdn. Bhd. operate in full compliance with Malaysia and Sabah's labor laws, striving to set an example of best practices regarding employment terms, conditions, and practices.

In Malaysia, labor engagement, also known as industrial relations, is principally governed by the Ministry of Human Resources at the national level and by the Sabah Labour Department at the state level. The practices, policies, attitudes, and values within an organization's environment shape its industrial relations. A common variable across all organizations is change, as the environment is dynamic and continuously evolving.

The Employment Act and the Sabah Labour Ordinance provide provisions to protect workers from exploitation and offer minimum benefits for all workers covered by these respective Acts. As of 2023, the Employment Act's coverage has been extended to all employees, with certain benefits excluded for those earning above a specified level. Benefits provided in the Employment Act include termination and maternity benefits, the right to a weekly rest day, annual leave, and sick leave.

The laws and legislation adhered to by the Kuamut Project and Permian Malaysia include the following:

Employment Terms and Conditions

- Employment Act 1955, amended 2022
- Sabah Labour Ordinance, amended 2005 (https://sagc.sabah.gov.my/?q=en/content/labour-ordinance-cap-67)
- National Wages Consultative Council Act 2011 (https://jtksm.mohr.gov.my/sites/default/files/2023-03/3.%20National%20Wages%20Consultative%20Council%20Act%202011.pdf)
- Children and Young Persons (Employment) Act 1966 (https://jtksm.mohr.gov.my/sites/default/files/2023-03/5.%20Children%20and%20Young%20Persons%20%28Employment%29%20Act%201966_0.pdf)
- Employees, Minimum Standards of Housing, Accommodations and Amenities Act 1990, amended 2019 (https://jtksm.mohr.gov.my/sites/default/files/2023-03/2.%20Employees%20Minimum%20Standards%20of%20Housing%2C%20Accomodations%20and%20emenities%20Act%201990.pdf)

Weekly Holidays Act 1950

- Pensions Act 1980 (https://tcclaw.com.my/wp-content/uploads/2020/12/Pensions-Adjustment-Act-1980.pdf)
- Minimum Retirement Age Act 2012 (https://jtksm.mohr.gov.my/sites/default/files/2023-03/6.%20Minimum%20Retirement%20Age%20Act%202012.pdf)

Social Security Laws

- Employees Provident Fund Act 1991 (https://www.miea.com.my/sites/default/files/webmaster/Employees%20Provident%20Fun%20Act%201991%20Act%20452_1May2020.pdf)
- Employees Social Security Act 1969 (https://faolex.fao.org/docs/pdf/mal211971.pdf)
- Employment Insurance System Act 2017 (https://tcclaw.com.my/wp-content/uploads/2020/12/Employment-Insurance-System-Act-2017.pdf)

Safety Laws

- Occupational Safety and Health Act 1994 (https://legal.usm.my/phocadownload/laws/Occupational%20Safety%20and%20Health%20Act%20-%20Act%20514.pdf)

Laws Relating to Training of Employees

- Pembangunan Sumber Malaysia Berhad Act 2001 (https://tcclaw.com.my/wp-content/uploads/2020/12/Pembangunan-Sumber-Manusia-Berhad-Act-2001.pdf)

These regulations represent the highest and most comprehensive set of rules governing employment, including employment agreements, working hours, wages, paid leave, termination of employment, discrimination, and grievance procedures.

The KRCP and Permian Malaysia Sdn. Bhd. have compiled and defined all employment terms into the respective organizations' operational rules or Staff Handbook. These rules are relevant to the individual circumstances of each organization and are consistently and fairly upheld.

Among other things, the Staff Handbook details the grievance process that employees can follow if they are unhappy with any aspect of their employment. If an issue cannot be resolved internally, employees can report their complaint directly to the Sabah Labour Department. The department can address the complaint to the company, seek to assist in a bipartite resolution, or enlist the help of an independent mediator for a tripartite resolution.

To date, no staff members have initiated such grievance procedures, but the opportunity remains open.

### 2.5.3 Human Rights (VCS, 3.19)

There has been no change to any Human Rights development in the country or in the project area. The Kuamut Rainforest Conservation Project in Sabah, Malaysia, is a comprehensive initiative that actively recognizes, respects, and promotes the rights of Indigenous Peoples (IPs), local communities (LCs), and customary rights holders. The project aligns with international human rights law, including the United Nations Declaration on the Rights of Indigenous Peoples and ILO Convention 169 on Indigenous and Tribal Peoples, through various measures:

Free, Prior, and Informed Consent (FPIC): The project engaged the local communities through extensive FPIC workshops conducted by PACOS Trust, a Sabah-based indigenous peoples NGO. These workshops provided detailed information and addressed community concerns about the project, ensuring that the communities could make informed decisions about their involvement.

Community Participation and Benefit Sharing: The project involves communities in designing and implementing social development programs. This participatory approach ensures that the benefits of the project, such as sustainable local businesses, improved health and education services, and job creation, are equitably shared with the local communities.

Legal and Policy Frameworks: The project complies with the Verra Climate, Community, and Biodiversity (CCB) standards and the Verra Verified Carbon Standard (VCS). These standards require adherence to robust environmental and social safeguards, ensuring the rights and well-being of IPs and LCs are protected.

Monitoring and Reporting: Regular monitoring and reporting mechanisms are in place to ensure transparency and accountability. The project's first tranche of verified carbon units was recently generated, demonstrating compliance with internationally recognized standards for climate, community, and biodiversity progress.

Protection and Restoration of Customary Lands: The project protects and restores significant areas of tropical rainforest, which are crucial for the cultural and subsistence needs of the local communities. This includes preventing commercial logging and other activities that could harm the forest and its resources.

### 2.5.4 Indigenous Peoples and Cultural Heritage (VCS, 3.18, 3.19)

The KRCP places a strong emphasis on preserving and protecting cultural heritage as part of its activities. This commitment is demonstrated through several key initiatives:

Engagement with Local Communities: The project has engaged extensively with the Kuamut and Karamuak communities through the Free, Prior, and Informed Consent (FPIC) process. This engagement ensures that the project respects the cultural practices, traditions, and knowledge of these communities, allowing them to actively participate in the project's design and implementation.

Community-Led Development Programs: The social development programs designed and implemented as part of the project are community-led, ensuring that cultural heritage is preserved and integrated into sustainable development activities. These programs focus on improving health, education, and economic opportunities while respecting and incorporating traditional knowledge and practices.

Protection of Customary Lands: The project protects significant areas of tropical rainforest that are integral to the cultural heritage of the local communities. By preventing commercial logging and other harmful activities, the project safeguards the land that holds cultural, spiritual, and subsistence value for the Indigenous Peoples and local communities.

### 2.5.5 Recognition of Property Rights (VCS, 3.7, 3.18, 3.19; CCB, G5.1)

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| **Disputes over rights to territories and resources** | N/A, The project area is a Class I forest reserve designated by the state government, and as such no local population lives inside.<br><br>The Forest Reserves in Sabah are gazetted under 7 functional classes. Class 1 refers to as Forest that are conserved for the protection of forests, watershed areas, soil & other essential climatic and environmental factors. Timber harvesting is not permitted in this forest reserve.<br><br>Class 2 refers to forest reserve functioning as a commercial forest reserve which means the forest within are allocated for harvesting to supply timber and other forest produce, to contribute to the state of Sabah's economy. Harvesting is carried out according to sustainable forest management principles.<br><br>All entry into any gazetted forest reserve in Sabah requires a permit from the Sabah Forestry Department. For Class 1 forest reserve, no entry is allowed. Entry into a Class 2 Forest Reserve in Sabah is generally allowed, but only with a permit from the Sabah Forestry Department; this is because Class 2 forests are considered commercial forests, meaning logging is permitted, so controlled access is necessary. |
| **Respect for property rights** | Within state of Sabah, beyond the Project Areas, Ongoing measures to protect and preserve the property rights of stakeholders, Indigenous Peoples (IPs), Local Communities (LCs), and customary rights holders involve a multi-faceted approach that incorporates legal, social, and administrative strategies. Here are some key measures typically implemented:<br><br>Legal Framework and Recognition:<br><br>Formal Recognition: Ensuring that the rights of IPs, LCs, and customary rights holders are formally recognized in national and international legal frameworks. This includes the demarcation and legal registration of lands.<br><br>Legislation: Enacting and enforcing laws that protect land rights and prevent illegal land grabs and encroachments. This often involves the alignment of national laws with international conventions such as the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).<br><br>Community Engagement and Participation: |

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| | Free, Prior, and Informed Consent (FPIC): Implementing FPIC processes to ensure that communities are fully informed and have the opportunity to participate in decision-making regarding their lands and resources.<br><br>Consultations : Regular consultations with stakeholders to understand their needs and perspectives,<br><br>Conflict Resolution Mechanisms:<br><br>Grievance Mechanisms: Establishing accessible and effective grievance mechanisms to resolve disputes over land and resource use, as well as other issues related to the project implementation.<br><br>Environmental and Social Safeguards:<br><br>Environmental Protection: Implementing measures to protect the environment, which in turn supports the livelihoods and cultural practices of IPs and LCs.<br><br>Social Safeguards: Ensuring that development activities incorporate social safeguards to prevent displacement and protect the social fabric of communities.<br><br>Advocacy and Awareness:<br><br>Raising Awareness: Conducting awareness campaigns to inform communities about their rights and the mechanisms available to protect those rights. |

### 2.5.6 Benefit Sharing Mechanism (VCS, 3.18, 3.19)

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| **Summary of the benefit sharing plan** | The Benefit Sharing Mechanism provides a comprehensive framework for distributing the gains from emission reduction initiatives among the local community. Following extensive consultations with local communities, the project introduced various benefits and has updated the framework from 2023 onwards based on the community development plan.<br><br>Key components include the expansion of benefits to five additional villages over the next three years and improved healthcare access through a dedicated medical transportation boat for Kuamut village.<br><br>The Village Development Fund will invest annually to support health, education, and infrastructure projects aligned with the SDGs and community consensus, implemented by community members. Additionally, a social support program consisting of a monthly cash contribution will be provided to 450 households, who meet the agreed criteria established by the project and local community.<br><br>Post the sale of carbon credits, proceeds will finance further benefits such as a microfinance program to support local enterprises and eco-tourism, agricultural advancements through garden and nursery projects, and food security initiatives via regenerative and agro-ecological practices. These programs are selected in conjunction |

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| | with community input to ensure they align with both the project's objectives and SDGs. The Village Development Fund, Social Support Program of RM100 cash contribution and Microfinance program will be carried out in phases or staggered with full understanding and participation of the local communities.<br><br>Elements of the plan that stakeholders wish to keep private are documented as commercially sensitive information, with the project proponent ensuring the community's desire for privacy is respected. Any renegotiations or opt-outs during the monitoring period have been recorded in the commercially sensitive document, demonstrating the community's preference for confidentiality. |
| Benefit sharing during the monitoring period | The Benefit Sharing Mechanism in the Kuamut Rainforest Conservation Project ensures equitable distribution of gains from emission reduction initiatives to local communities.<br><br>Components Implemented:<br><br>**Healthcare Access:**<br><br>A dedicated medical transportation boat for Kuamut village was mooted and the process to source for it began in mid 2023. This was to provide timely medical assistance during emergencies (SEARRP KRC Progress Report Aug – Dec 2023)<br><br>**Clean Water Access:**<br><br>Feasibility studies were completed for clean water access for the whole seven villages in the Project Area (Feasibility Report by PACOS). The construction of water gravity systems in Kuamut and Tangkuyan started in this reporting period, with expected completion by December 2024. Despite challenges like material supply delays and difficult terrain, progress has been steady (KRC SEARRP Progress Report Jan – July 2023 and SEARRP KRC Progress Report Aug – Dec 2023)<br><br>**Electricity Expansion:**<br><br>Feasibility studies for extending electricity to Desa Permai and Tulang Tulang was completed in this reporting period but analytical work on the needs and maintenance care for such a system carried on to 2024. |

### 2.5.7 Free, Prior, and Informed Consent (VCS, 3.18, 3.19; CCB, G5.2)

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| Consent | The Free, Prior, and Informed Consent (FPIC) process for the KRCP is designed to ensure the active participation and agreement of Indigenous Peoples (IPs), local communities (LCs), and customary rights holders at the start of the project and continuing throughout the lifetime of the project. In the development of designing the Project Document, it was identified that only 8 villages are within the 20km |

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| | radius of the project boundaries and as such, these villages were approached in greater detail, post Covid-19 i.e. in 2022 for the FPIC process.<br><br>The FPIC process adhered strictly to its core principles—ensuring consent was given freely, prior to any project commencement, and with all relevant information provided in a comprehensible format. Initial engagements aimed to enhance community understanding of the project, discuss potential impacts and benefits, and gather demographic and spatial data. A Memorandum of Agreement was signed between the Project and 7 villages excluding Kg Tenaga Baru, to participate in the project. Kg Tenaga Baru's community were not ready to be part of the project.<br><br>The MOU and consent forms were signed by community representatives, project representatives, and the Village Headman as representing a third-party.<br><br>A critical component of the FPIC process was the establishment of KRCP Community Committee where local community members representing the women folk, youth and men sections of the village came together and will represent the wider villagers in their participation in the project. |
| Outcome of FPIC | The main outcomes of the FPIC process according to the attached reports are as follows:<br><br>Obtaining Community Consent: The community consent was crucial for the KRCP. The FPIC workshops facilitated informed decision-making, ensuring that the community fully understood the project and its implications before granting their approval.<br><br>Formation of KRCP Community Committees: The FPIC process led to the establishment of Village Community ~~Implementation~~ Committees in each participating village. These committees play a vital role in coordinating project activities, organizing training/workshops, and acting as a bridge between the community and external organizations like PACOS and Permian<br><br>Signing of MoUs: The FPIC workshops concluded with the signing of MoUs between PACOS and the community. These MoUs outlined the responsibilities and commitments of both parties, ensuring transparency and mutual understanding.<br><br>Post the FPIC process, the project reached a mutual understanding to work with the community members to co-design the KRCP Community Development Plan for the involvement of local community members.<br><br>Addressing Basic Needs and Socio-Economic Development: The FPIC process identified and planned for the basic needs of the community, such as access to clean water, energy, and medical facilities.<br><br>Documentation and Mapping: The FPIC workshops also highlighted the need for proper documentation and mapping of community resources and customary land. This was essential for securing land rights and ensuring sustainable management of natural resources . |

### 2.5.8 Property Right Protection (VCS, 3.18, 3.19; CCB, G5.3)

The KRCP guarantees no involuntary relocations. The project area contains no permanent human settlements, ensuring that no property rights holders have been removed or relocated against their will.

Permian Malaysia Sdn. Bhd., as the sole license holder of the Project Area, holds comprehensive rights and responsibilities, including generating and selling carbon offset credits and preventing other organizations from applying for concessions within the project area. This has been agreed to between the three partners of the project i.e. Sabah Forestry Department, RBJ Sdn Bhd and Permian Malaysia, as captured in the signed Management Agreement for the KRCP project.

Under Sabah's Forest classification system, the Kuamut Forest Reserve was initially designated as a Class II Forest Reserve (FR), allowing commercial timber harvesting under strict Sustainable Forest Management License Agreement (SFMLA) conditions. These conditions prohibited any commercial or other exploitation, including hunting, gathering non-timber forest products, agricultural, or shifting cultivation activities, except by the license holder.

The project's reclassification of 83,381 ha of Kuamut from Class II to Class I FR transitioned it to a fully protected status. This reclassification prohibits timber harvesting or other commercial exploitation, limiting activities to non-extractive ones like ecotourism, research, and trading in ecosystem services such as carbon. Community use of Class I FRs remains heavily restricted, with no rights to harvest timber, non-timber forest products, or engage in hunting or agriculture. These access rights restrictions are consistent with those under the Class II FR designation.

The reclassification did not diminish community rights, as these rights were already restricted under the Class II designation. The transition to Class I FR status maintained the same level of restrictions, ensuring no involuntary removal or relocation of rights holders or their activities important to their culture or livelihood.

### 2.5.9 Identification of Illegal Activity (VCS, 3.19, CCB, G5.4)

As the period of 2022-2023 was the years coming out of the COVID19 phase, the KRCP started its engagement with the local communities of the 8 villages about the project, ensuring that FPIC is obtained prior to commencing its activities. A socio economic and demographic survey was initiated during this phase. Through this process, no illegal activities were detected.

The identification of illegal activities in the context of the Project activities are defined as illegal logging and hunting of animals and harvesting of plant species. Throughout the monitoring period, none were detected.

The Project through its partner, RBJ Sdn Bhd conducted patrolling activities on the ground, along the boundaries of the project area on a regular basis as a preventive measure towards any illegal activities from happening. The patrolling activities serve as monitoring action and enforcement by trained forest rangers from RBJ Sdn Bhd. The Project also utilizes technologies including satellite imagery and deploying drone to beef up efforts to detect illegal activities on the ground.

The Project in coordination with RBJ Sdn Bhd is collaborating with the local authorities such as Sabah Wildlife Department and Sabah Forestry Department to take legal action against any perpetrators of illegal activities in the Project Area,

In terms of advocating for continuous protection of the flora and fauna in the project area, an environmental education program to educate local communities about the importance of conservation and the legal consequences of illegal activities is needed. The Project is building towards ensuring sustainable livelihood program including eco-tourism, agriculture, and employment opportunities such as rangers, guides are created involving local community members. The Project is adhering to no human trafficking, forced labor and child labor takes place within the Project Area.

**Demonstration of Compliance**

The Kuamut Rainforest Conservation Project adheres to all relevant national and international laws regarding labor and environmental practices. The project employs stringent measures to ensure that all activities are conducted legally and ethically, without any involvement in human trafficking, forced labor, or child labor. This is evidenced by regular audits, community engagement, and collaboration with enforcement agencies to uphold these standards.

### 2.5.10 Ongoing Disputes (VCS, 3.18, 3.19; CCB, G5.5)

All project activities within the project area adhere to local, national, and international laws and regulations, ensuring that no actions are taken that could influence or prejudice the outcome of any unresolved disputes.

There were no unresolved disputes within the project zone that are relevant to the project. This was properly documented through the extensive FPIC and consultation processes conducted since the project start date (see section 2.5.7).

Additionally, the project focuses on strengthening tenure rights and providing sustainable livelihood options and employment opportunities to local communities.

# 3 CLIMATE

## 3.1 Monitoring GHG Emission Reductions and Removals

### 3.1.1 Data and Parameters Available at Validation (VCS, 3.16)

| | |
|---|---|
| **Data / Parameter** | $CF_j$ |
| **Data unit** | tC·td.m.$^{-1}$ |
| **Description** | Carbon fraction of dry matter for species j |
| **Source of data** | IPCC default for aboveground tree biomass (table 4.3 in volume 4 of the 2006 IPCC guidelines) |
| **Value applied** | 0.47 |
| **Justification of choice of data or description of measurement methods and procedures applied** | Conservative value for tropical species |
| **Purpose of data** | Conversion of carbon to carbon dioxide |
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $D_j$ |
| **Data unit** | t.d.m. m$^{-3}$ |
| **Description** | Basic wood density of species j |
| **Source of data** | Global Wood Density Database (Chave et al. 2009) |
| **Value applied** | Average wood density values were estimated for each genus using the Global Wood Density Database (Chave et al. 2009). |
| **Justification of choice of data or description of measurement methods and procedures applied** | Using botanical information this is the best data available. |

| | |
|---|---|
| Purpose of data | Used in calculations |
| Comments | |

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|---|---|
| Data / Parameter | Relationship between Aboveground Carbon Density and LiDAR based Top of Canopy Height |
| Data unit | |
| Description | Model to determine relationship between Aboveground Carbon Density and LiDAR based Top of Canopy Height |
| Source of data | Project specific non-linear model |
| Value applied | |
| Justification of choice of data or description of measurement methods and procedures applied | Establishes relationship between LiDAR and canopy height, needed for subsequent modelling. |
| Purpose of data | Used in the calculations of ongoing forest growth in the project scenario |
| Comments | This model has been re-assessed and updated to work with other remote sensing data, see section 3.1.3 for details |

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|---|---|
| Data / Parameter | $BCEF_R$ |
| Data unit | t.d.m $m^{-3}$ |
| Description | Biomass conversion and expansion factor applicable to wood removals in the project area |
| Source of data | *IPCC* |
| Value applied | 1.89 |
| Justification of choice of data or description of measurement methods and procedures applied | As per methodology recommendation |
| Purpose of data | Estimation of emission factor |

| | |
|---|---|
| Comments | |

| | |
|---|---|
| Data / Parameter | $F_{RSD\|BSL}$ |
| Data unit | Dimensionless |
| Description | Residual Stand Damage Factor |
| Source of data | Based on Pinard and Putz (1996)[13] |
| Value applied | 1.8 |
| Justification of choice of data or description of measurement methods and procedures applied | For $F_{RSD\|BSL}$ the methodology suggests a value of 2.3 based on Pinard and Putz (1996) who found unharvested trees were severely damaged (uprooted and crushed) in conventional logging within the Ulu Segama area. We have used a more conservative value of 1.8. The $F_{RSD}$ value of 1.8 for both NFM and Mosaic stratum. |
| Purpose of data | Determination of baseline scenario |
| Comments | |

| | |
|---|---|
| Data / Parameter | $V_{l,j,i,sp}$ |
| Data unit | $m^3$ |
| Description | Merchantable volume for tree l of species j in sample plots p in stratum i |
| Source of data | Field measurements in 46 circular 30-meter radius (each 0.28 ha) permanent sample plots (PSPs) plots of trees above the defined cutting limit (40 cm DBH for the NFM areas, and 31 cm DBH for the Mosaic Planting Approach areas) |
| Value applied | See plot level data |

[13] Pinard, M., & Putz, F. (1996). Retaining Forest Biomass by Reducing Logging Damage. Biotropica, 28(3), 278-295. doi:10.2307/2389193

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | A total of 46 circular 30-meter radius (each 0.28 ha) permanent sample plots (PSPs) plots were set up within the Kuamut area. We recorded taxonomic information, taking leaf samples wherever possible. More than 75% of the individuals were identified to Genus, and more than 50% of the individuals have been identified to Species level. Average wood density values were estimated for each genus using the Global Wood Density Database (Chave et al. 2009). Using these values, we then calculated a plot-level basal area weighted average and assigned it to any individuals lacking botanical information.<br><br>Biomass was calculated according to equation 4 from Chave et al. (2014) utilising the measured diameter and heights, and the estimated wood density. This means that the taxonomic information is incorporated via the wood density, so while one equation is used – the estimated biomass will be quite different for different species of the same dimensions. The equations of Chave et al. (2014) are widely regarded as more accurate than species specific allometric (which also do not exist for the majority of species diverse tropical regions). We estimated timber volume from the calculated biomass using a BCEF-R of 1.89. The plot level timber volume was derived by summing the timber volume of all 70% of trees above the defined cutting limit (40 cm DBH for the NFM areas, and 31 cm DBH for the Mosaic Planting Approach areas). By using only 70% of the trees, we conservatively account for any species that would not be harvested without being reliant on perfect botanical information in every plot. |
| Purpose of data | Determination of baseline |
| Comments | |

| | |
|---|---|
| Data / Parameter | $f_j(X,Y...)$ |
| Data unit | t d.m. tree$^{-1}$ |
| Description | Allometric equation(s) for species j linking measured tree variable(s) to aboveground biomass of living trees |
| Source of data | equation 4 from Chave et al. (2014) |
| Value applied | $AGB_{est} = 0.0673 \times (\rho D^2 H)^{0.976}$ |

| | |
|---|---|
| **Justification of choice of data or description of measurement methods and procedures applied** | The equations of Chave et al. (2014) are widely regarded as more accurate than species specific allometric (which also do not exist for the majority of species diverse tropical regions) |
| **Purpose of data** | linking measured tree variable(s) to aboveground biomass of living trees |
| **Comments** | This is species specific because the wood density parameter is species specific. This is used ex-post, i.e for all tree measurements at every monitoring period. |

| | |
|---|---|
| **Data / Parameter** | *OF* |
| **Data unit** | Kg $kg^{-1}$ |
| **Description** | Fraction of wood products that will be emitted to the atmosphere between 3 and 100years after production; |
| **Source of data** | default values for the tropical forest region provided in the methodology |
| **Value applied** | |

| **Wood Product Class** | *OF* | | |
|---|---|---|---|
| | **Boreal** | **Temperate** | **Tropical** |
| Sawnwood | 0.39 | 0.62 | 0.86 |
| Woodbase panels | 0.62 | 0.86 | 0.98 |
| Other industrial roundwood | 0.86 | 0.98 | 0.99 |
| Paper and paperboard | 0.39 | 0.62 | 0.99 |

| | |
|---|---|
| **Justification of choice of data or description of measurement methods and procedures applied** | Default values for the tropical forest region provided in the methodology |
| **Purpose of data** | Determination of baseline |
| **Comments** | |

| | |
|---|---|
| Data / Parameter | *SLF* |
| Data unit | Kg $kg^{-1}$ |
| Description | Fraction of wood products that will be emitted to the atmosphere within 3 years of production |
| Source of data | default values given in the methodology were used which in turn are taken from Winjum et al (1998). |
| Value applied | Sawn wood: 0.12<br>Woodbase panels: 0.06<br>Other industrial roundwood: 0.18<br>paper and paperboard: 0 |
| Justification of choice of data or description of measurement methods and procedures applied | Default values provided in the methodology |
| Purpose of data | Determination of baseline |
| Comments | |

| | |
|---|---|
| Data / Parameter | *WW* |
| Data unit | Kg $kg^{-1}$ |
| Description | Fraction of extracted biomass effectively emitted to the atmosphere during production |
| Source of data | default values given in the methodology were used which in turn are taken from Winjum et al (1998). |
| Value applied | 24% |
| Justification of choice of data or description of measurement methods and procedures applied | Default values provided in the methodology |
| Purpose of data | Determination of baseline |

| | |
|---|---|
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $PML_{FT}$ |
| **Data unit** | % |
| **Description** | Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type |
| **Source of data** | merchantable volume data for all active logging concessions within the State of Sabah and biomass data from Asner, et al. (2018) |
| **Value applied** | See table below |
| **Justification of choice of data or description of measurement methods and procedures applied** | Data was recorded as either 'NFM', 'Salvage logging' or 'Plantation Timber'. We calculated the Volume per hectare (Harvest Volume / Harvest Area), for every individual record within the database. We then calculated the mean volume extracted per hectare, for each Forest Reserve and Logging Type ('NFM' or 'Salvage logging'). Using the mean volume extracted per hectare we estimate the biomass within the timber volume using the BCEFR of 1.89. We consider these records of timber that was harvested from the base year, the best estimate of merchantable timber biomass available.<br><br>The carbon per hectare (ACD) was calculated based on the total carbon for the forest reserve and the total area based on the SFD Forest Reserve boundaries. One forest reserve (Bengkoka FR.), had no remaining biomass per hectare, we therefore applied the ACD value of the lowest FR. The biomass per hectare was calculated from the carbon per hectare using the BCEFR of 1.89 and a Carbon fraction of 0.47. Using the Merchantable Biomass and total biomass values, we calculated the mean merchantable and total biomass, and then the PML for each of the comparable forest types in the analysed forest estate |
| **Purpose of data** | Determination of leakage |

| Logging Type | $PML_{FT}$ |
|---|---|
| Salvage Logging | 0.96 |
| NFM | 0.4 |

| | |
|---|---|
| Comments | |

| | |
|---|---|
| Data / Parameter | $RGR_i$ |
| Data unit | $tC.ha^{-1}.yr^{-1}$ |
| Description | Forest regrowth rate post timber harvest for stratum i |
| Source of data | Published data (see details below under justification of choice of data) |
| Value applied | 1.6 t C $ha^{-1}yr^{-1}$ for stratum 2 and 3<br>3.0 t C $ha^{-1}yr^{-1}$ for stratum 4<br>0 t C $ha^{-1}yr^{-1}$ for stratum 1 as a no-go area |
| Justification of choice of data or description of measurement methods and procedures applied | For stratum 2 and 3, $RGR_i$ is assumed to be 1.6 t C $ha^{-1}yr^{-1}$ based on table 1 of Suarez (2019)[14] (which would be an average growth rate of 3.4 Mg d.m. $ha^{-1}$ $year^{-1}$ for tropical rainforest in Asia and a carbon fraction of 0.47). For stratum 4, $RGR_i$ is estimated as 3.0 t C $ha^{-1}yr^{-1}$. For this estimation, data from Yahya and Ikau (2016)[15] on DBH, height, age, and planting density were used. In addition, we used 0.2955 Mg $M^{-3}$ as the mean wood density for Paraserianthes from the global wood density database (Chave 2009, Zanne 2009[16]). To our knowledge Neolamarckia was not in the database and we used a value of 0.362 from Mahmud et al. (2017)[17]. Using these values, Tree-level Above-Ground Biomass (in Mg) was calculated using Eq. 4 in Chave et al. (2014), and assuming an average age of planted individuals of 6.25 years. |

[14] Suarez *et all*, 2019. Estimating aboveground net biomass change for tropical and subtropical forests: Refinement of IPCC default rates using forest plot data

[15] Ahmad Zuhaidi Yahya & Albert Ikau A.G. (2016) Reforestation with naturally regenerated trees and selected forest plantation species based on mosaic planting approach. International Journal of Agriculture, Forestry and Plantation, Vol. 1 (Dec 2015)

[16] Zanne, A., Lopez-Gonzalez, G., Coomes, D., Ilic, J., Jansen, S., Lewis, S., Miller, R., Swenson, N., Wiemann, M. & Chave, J. 2009. Global Wood Density Database. Dryad Digital Repository

[17] Mahmud, Siti Zalifah & Hashim, Rokiah & Saleh, Abdul & Sulaiman, Othman & Saharudin, Nur & Lokmal, N. & Masseat, Khairul & Husain, Hamdan. (2017). Physical and mechanical properties of juvenile wood from Neolamarckia cadamba planted in West Malaysia. Maderas. Ciencia y tecnología. 19. 10.4067/S0718-221X2017005000020.

| | |
|---|---|
| | The average regrowth rate was estimated from the tree-level above-ground biomass based on a feasible planting rate and harvesting 15 years after planting. For the planting rate it was assumed that the entire area would take 30 years to plant, or 1261 hectares per year. Based on the planting density in Yahya and Ikau (2016), this planting rate would require nursery facilities for almost a million seedlings per year. This is an ambitious planting rate and results in a conservative overall RGR for the planted areas. We will further analyse the reference areas in the coming years to see if this planting rate has been achieved.<br><br>In estimating the forest regrowth in stratum 4, it was further assumed that there would be no growth between the salvage logging and the planting within the mosaic areas due to the damaging nature of salvage logging. If there was any regrowth during this interlude, not only would it be negligible, but there would also be additional site preparation clearing immediately before planting. When we average the growth rate based on this planting rate, we estimate the overall average growth rate mentioned above for the area to be 3.0 t C $ha^{-1}yr^{-1}$. |
| **Purpose of data** | Determination of baseline |
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $V_{EX,j,i\,\vert\,BSL}$ |
| **Data unit** | $m^3 \cdot ha^{-1}$ |
| **Description** | Mean volume of extracted timber per unit area for species j in stratum i |
| **Source of data** | Modeled timber harvest plan |
| **Value applied** | See updated values in Appendix 1 to this MR (table 16 in updated section 3.2.1) |
| **Justification of choice of data or description of measurement methods and procedures applied** | See updated section 3.2.1 in Appendix 1 to this MR |

| | |
|---|---|
| **Purpose of data** | Determination of baseline |
| **Comments** | This comes from plot data and Lidar maps, combined with what is allowed based on policy.<br>Stratum 1 is no go and excluded from the project (essentially 0). |

| | |
|---|---|
| **Data / Parameter** | $TH_{i,p}$ |
| **Data unit** | Years |
| **Description** | Number of years since timber harvest in stratum i in land parcel p |
| **Source of data** | timber harvest schedule |
| **Value applied** | Refer to modeled timber harvest plan and section 3.1.4 of the PD, sub-section titled 'Division of the harvestable forest into annual operating areas in the different strata based on common practice' |
| **Justification of choice of data or description of measurement methods and procedures applied** | Modeled timber harvest plan in the validated PD |
| **Purpose of data** | Determination of baseline.<br>Stratum 1 is no go and excluded from the project (essentially 0). |
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $A_{i,p}$ |
| **Data unit** | ha |
| **Description** | The area of stratum i in land parcel p that was harvested 1 year ago |
| **Source of data** | Calculated based on harvest plan using the approach described in the PD, section 3.2.1 (Baseline Emissions), subsection 'Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)' |
| **Value applied** | |

| | |
|---|---|
| | <table><tr><th>Year of Logging</th><th>Area (ha)</th></tr><tr><td>2016</td><td>6177.69</td></tr><tr><td>2017</td><td>7902.44</td></tr><tr><td>2018</td><td>5587.26</td></tr><tr><td>2019</td><td>9036.81</td></tr><tr><td>2020</td><td>5915.17</td></tr><tr><td>2021</td><td>2213.69</td></tr><tr><td>2022</td><td>0</td></tr><tr><td>2023</td><td>0</td></tr></table> |
| **Justification of choice of data or description of measurement methods and procedures applied** | Calculated from the modeled timber harvest plan and section 8.1.6 of the methodology |
| **Purpose of data** | Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks |
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $A_{1,l,p}$ |
| **Data unit** | ha |
| **Description** | The area of stratum i in land parcel p that was harvested between 2 and 10 year ago |
| **Source of data** | Calculated based on harvest plan using the approach described in the PD, section 3.2.1 (Baseline Emissions), subsection 'Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)' |
| **Value applied** | See PD and model outputs |
| **Justification of choice of data or description of measurement methods and procedures applied** | Calculated from the modeled timber harvest plan and section 8.1.6 of the methodology |

| | |
|---|---|
| Purpose of data | Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks |
| Comments | Stratum 1 is no go and excluded from the project (essentially 0). |

| | |
|---|---|
| Data / Parameter | $A_{2\text{-}10,i,p}$ |
| Data unit | ha |
| Description | The area of stratum i in land parcel p that was harvested between 11 and 20 years ago |
| Source of data | Calculated based on harvest plan using the approach described in the PD, section 3.2.1 (Baseline Emissions), subsection 'Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)' |
| Value applied | See PD and model outputs |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated from the modeled timber harvest plan and section 8.1.6 of the methodology |
| Purpose of data | Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks |
| Comments | Stratum 1 is no go and excluded from the project (essentially 0). |

| | |
|---|---|
| Data / Parameter | $A_{11\text{-}20.i,p}$ |
| Data unit | ha |
| Description | Cumulative area harvested until time t* |
| Source of data | Calculated based on harvest plan using the approach described in the PD, section 3.2.1 (Baseline Emissions), subsection 'Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)' |
| Value applied | See PD and model outputs |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | Calculated from the modeled timber harvest plan and section 8.1.6 of the methodology |
| Purpose of data | Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks |
| Comments | |

| | |
|---|---|
| Data / Parameter | $A_{t+}$ |
| Data unit | ha |
| Description | Cumulative area harvested until time t* |
| Source of data | Calculated based on harvest plan using the approach described in the PD, section 3.2.1 (Baseline Emissions), subsection 'Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)' |
| Value applied | See PD and model outputs |
| Justification of choice of data or description of measurement methods and procedures applied | Calculated from the modeled timber harvest plan and section 8.1.6 of the methodology |
| Purpose of data | Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks |
| Comments | |

| | |
|---|---|
| Data / Parameter | $A_{sp}$ |
| Data unit | ha |
| Description | Area of sample plots p |
| Source of data | Records of sample plots |
| Value applied | 0.28 ha |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | circular 30-meter radius permanent sample plots |
| Purpose of data | Field measurements |
| Comments | |

### 3.1.2 Data and Parameters Monitored (VCS, 3.16)

| | |
|---|---|
| Data / Parameter | $A_{burn,i,t}$ |
| Data unit | ha |
| Description | Area burnt in (stratum i) at time t |
| Source of data | LiDAR, Landsat 8-9 (OLI) & Sentinel-2 remote sensing data in combination with ground truthing |
| Description of measurement methods and procedures to be applied | Data on the area burned will be derived from the field plots and remote sensing analysis that are part of the monitoring of ongoing forest growth in the project scenario. To ensure sufficient coverage, this will be complemented with an analysis of optical data products (Landsat 8-9 & Sentinel-2) that have a proven capability for deforestation detection and some capacity for degradation detection. |
| Frequency of monitoring/recording | If applicable, maps of the area impacted by fires will be produced for every year, within each monitoring report. |
| Value monitored | 0 |
| Monitoring equipment | LiDAR, Landsat 8-9 & Sentinel-2 remote sensing data, NASA FIRMS alerts. |
| QA/QC procedures to be applied | The analysis of burned forest areas is performed using a combined approach which investigates field data from monitoring equipment and satellite optical-based fire detection tools (NASA FIRMS alerts), followed by a secondary specific assessment for each fire event in the that the extent and severity are evaluated through processing high resolution images from SAR (Sentinel-1) and optical (Planet Lab). |

| | |
|---|---|
| | For each event registered and notified by the FIRMS alert, a first evaluation will be carried out by the monitoring team. Subsequently, a remote sensing analysis is performed for each event, thus extracting the total area affected and the severity through the investigation of environmental spectral indices such as the NDVI - Normalized Difference Vegetation Index or the DNBR - Difference Normalized Burn Index. Additionally, available SAR products (e.g. Sentinel-1) will be used as support in the event that cloud cover prevents the acquisition of images coincidental or near-coincidental to the fire event. |
| **Purpose of the data** | Estimation of forest disturbance for calculation of the project emissions |
| **Calculation method** | |
| **Comments** | |

| | |
|---|---|
| **Data / Parameter** | $A_{dist,i,t}$ |
| **Data unit** | ha |
| **Description** | Area disturbed in stratum i at time t (natural disturbance) |
| **Source of data** | Airborne LiDAR, Landsat 8-9 (OLI) & Sentinel-2 remote sensing data in combination with ground truthing. |
| **Description of measurement methods and procedures to be applied** | High resolution (30 m spatial resolution) biomass maps are produced each year from the field plots and remote sensing analysis that are part of the monitoring of ongoing forest growth in the project scenario. We do not specifically report area disturbed, as, in our analysis, each pixel has the opportunity to go up as well as down each year. Therefore any disturbed area is included via a reduced overall growth rate for the project area. Note this method therefore incorporates all natural disturbances, and therefore may be considered conservative. Furthermore, in the event of particular fine scale natural forest disturbance identified by field teams or ongoing assessments with satellite imagery, these will be further investigated and manually digitized high-resolution optical satellite imagery.<br><br>To ensure sufficient reporting of unplanned deforestation disturbances, the biomass mapping will be complemented with an analysis of optical data products (Landsat & Sentinel-2) that have a proven capability for deforestation detection (see next parameter on illegal logging). |

| | |
|---|---|
| Frequency of monitoring/recording | High resolution biomass maps are produced for every year, within each monitoring report. |
| Value monitored | 3.42 ha |
| Monitoring equipment | Airborne LiDAR, Landsat 8/9 & Sentinel-2 remote sensing data |
| QA/QC procedures to be applied | Standard procedures for analysis of remote sensing data (see 'Biomass Mapping' section. To optimize the use of these optical data products, we will use airborne LiDAR data (2.4 points $m^{-2}$) from surveys undertaken in 2016) and the optical products (Sentinel-2 (10m spatial resolution) & Landsat 8/9 (30m spatial resolution))together with freely available satellite radar products (Sentinel-1 C-band (10m spatial resolution) SAR, available globally from April 2014) to monitor structural changes associated with deforestation, degradation, and regrowth. Satellite radar has all-weather capability and relatively fine spatial grain but is not yet widely employed for assessing forest change. We will investigate correspondence between Lidar-derived canopy metrics and the backscatter of VV and VH polarizations and the intensity ratio (VV/VH). |
| Purpose of the data | Estimation of forest disturbance for calculation of the project emissions |
| Calculation method | |
| Comments | |

| | |
|---|---|
| Data / Parameter | $A_{DIST\_IL,i}$ |
| Data unit | ha |
| Description | Area impacted by illegal logging (in stratum i) |
| Source of data | Landsat & Sentinel-2 remote sensing data in combination with ground truthing |
| Description of measurement methods and procedures to be applied | Data on the occurrence of disturbances and illegal logging will be derived from the remote sensing analysis of optical data products (Landsat 8/9 & Sentinel-2) that have a proven capability for deforestation. |
| Frequency of monitoring/recording | Maps of the area impacted by illegal logging are produced for every year, within each monitoring report. |

| | |
|---|---|
| Value monitored | 0 ha |
| Monitoring equipment | Landsat & Sentinel-2 (Harmonised Sentinel Landsat product) remote sensing data, GFW GLAD and RADD deforestation alerts |
| QA/QC procedures to be applied | Standard procedures for analysis of remote sensing data. The multi-year analysis of deforestation was carried out using optical images from the NASA-Landsat 8/9 and ESA-Sentinel-2 satellite missions. Using annual composites generated from cloud-free images acquired in the Kuamut region, a multitemporal land cover classification analysis was performed, covering the current monitoring period (2022-2023). Since small-scale forest degradation is annually accounted for on AGB's high-resolution maps, the final deforestation product provides information on deforestation events with size ≥2.5 ha. To support the validation process and evaluate any potential inadequacies derived from cloud-driven spectral interferences, very high-resolution cloud-free optical images (3m spatial resolution) from Planet Lab were used to visually assess the final deforestation product. |
| Purpose of the data | Estimation of area of forest clearly deforested for calculation of the project emissions |
| Calculation method | |
| Comments | |

| | |
|---|---|
| Data / Parameter | $\Delta C_{AB,t\|PRJ}$ |
| Data unit | $tCO_2e$ |
| Description | Annual carbon stock change in aboveground biomass of trees, in each strata, in the project scenario |
| Source of data | Remote sensing with optical and Synthetic Aperture Radar (SAR) satellite data), in combination with some remeasuring of field plots. |
| Description of measurement methods and procedures to be applied | The field data and remote sensing data will be combined to produce yearly high-resolution biomass maps. These biomass maps are used to estimate the yearly growth rate for each strata in the project area ($\Delta C$).<br><br>To avoid any risk of accounting for on-going forest growth prior to the parcel harvest date in the baseline, we have modified the equation as presented in the methodology so that only areas of |

| | |
|---|---|
| | the project that would have been harvested, prior to the close of the monitoring period, are considered. The first main difference here is that the equation iterates at the parcel level rather than strata level. Notably, we have simplified the equation to remove management strata as all parcels, considered in this project, comprise a single strata and corresponding project growth rate. Therefore, for each parcel the annual growth rate is calculated as the product of the area of the parcel, the growth rate and the conversion factor from carbon to $CO_2$. However, this annual growth is only applied on or after the baseline harvest date of the parcel. When year t is less than the baseline harvest date, the on-going forest growth is zero. When year t is equal to the baseline harvest date, the on-going forest growth is equal to the years since the start of the project multiplied by the growth rate, to account for growth prior to harvest. When year is greater than the baseline harvest date, only the growth in that year is considered.<br><br>The project remeasured all field plots in the project area. Due to difficulties with physical access on the ground (eg. Roads and bridges) and travel restrictions during COVID, the remeasuring of plots started in 2021 and ended in early 2022. The field plots are used to calibrate the model and it is therefore expected that subsequent monitoring of ongoing growth may rely entirely on remote sensing data and perhaps measurements from a subset of the plots. It is anticipated that this could be supplemented with measurements from other related and adjacent areas and/or new plots that are in more accessible areas. To further validate ongoing forest growth, targeted LiDAR data may be collected in specific areas or using satellite LiDAR using a sampling approach, in the future, if it is required. This will be complemented by other remote sensing data where necessary.<br><br>The strata-level species conservation factors (as used in the baseline) were then discounted from the growth rates to account for protected species. |
| **Frequency of monitoring/recording** | We will estimate $\Delta C$ for each strata, within each monitoring report, based on the slopes from a linear mixed effects model with yearly biomass maps (produced from both remote sensing and forest plot data). In this case the slope parameters are the growth rate for each strata. We do not expect to measure field plots every monitoring period. |
| **Value monitored** | After removing protected species, project-scenario growth rates: 2.98 for mosaic-planted, 2.92 for mosaic-unplanted and 2.03 for NFM. We do not apply growth rates for no-go areas. |

| | |
|---|---|
| Monitoring equipment | Predominantly Satellite Imagery and also DBH tapes. |
| QA/QC procedures to be applied | Standard operating procedures for field measurements and analysis of remote sensing data |
| Purpose of the data | Estimation of forest regrowth for calculation of the project emissions |
| Calculation method | Linear mixed effects models using biomass maps |
| Comments | |

| | |
|---|---|
| Data / Parameter | $B_{i,t\|PRJ}$ |
| Data unit | t d. m. $ha^{-1}$ |
| Description | Aboveground biomass stock present in the project scenario (but absent in the baseline scenario) before burning |
| Source of data | Calculated value |
| Description of measurement methods and procedures to be applied | If it is determined that an area has been burned (so $A_{burn,i,t} > 0$) the aboveground biomass stock before burning will be determined using the high resolution carbon maps. |
| Frequency of monitoring/recording | This would be estimated using biomass maps, which are produced for every year, within each monitoring report. |
| Value monitored | 0, |
| Monitoring equipment | |
| QA/QC procedures to be applied | Standard operating procedures for field measurements and analysis of remote sensing data |
| Purpose of the data | Estimation of forest disturbance for calculation of the project emissions |
| Calculation method | |
| Comments | no fires occurred. |

| | |
|---|---|
| Data / Parameter | $C_{AB,i\|BSL}$ |
| Data unit | tC·ha$^{-1}$ |
| Description | Carbon stock in aboveground biomass in areas disturbed |
| Source of data | The Carbon stock is based on maps we produced |
| Description of measurement methods and procedures to be applied | The field data and remote sensing data, obtained from SAR (Sentinel-1) and Optical (Landsat 8) satellite missions, are combined to produce yearly high resolution (30m spatial resolution) biomass maps, which where validated with the 2016 airborne LiDAR. See section 'Biomass Mapping' for full details. |
| Frequency of monitoring/recording | Maps of the area deforested are produced for every year, within each monitoring report. |
| Value monitored | 1,952.8 tC·ha$^{-1}$ (2023). Pixel level values in the wall-to-wall biomass map |
| Monitoring equipment | |
| QA/QC procedures to be applied | Standard operating procedures for field measurements and analysis of remote sensing data |
| Purpose of the data | Estimation of forest disturbance for calculation of the project emissions |
| Calculation method | |
| Comments | |

| | |
|---|---|
| Data / Parameter | $C_{DIST\_IL,i,t\|PRJ}$ |
| Data unit | $tCO_2e$ |
| Description | Biomass carbon of trees cut and removed through illegal logging |
| Source of data | The field data and remote sensing data are combined to produce yearly high resolution biomass maps. These biomass maps are used to estimate the biomass of trees removed through illegal logging and combined with the estimated area of illegal logging. |

| | |
|---|---|
| Description of measurement methods and procedures to be applied | If it is determined that an area has been illegally logged (so $A_{DIST\_IL,i} > 0$) the aboveground biomass will be determined using the high resolution maps. |
| Frequency of monitoring/recording | Every year (based on yearly maps of biomass and the area deforested) within each monitoring report. |
| Value monitored | Pixel level values in the wall-to-wall biomass map |
| Monitoring equipment | |
| QA/QC procedures to be applied | Standard operating procedures for field measurements and analysis of remote sensing data |
| Purpose of the data | Estimation of forest disturbance for calculation of the project emissions |
| Calculation method | |
| Comments | |

| | |
|---|---|
| Data / Parameter | PMPi |
| Data unit | % |
| Description | Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries |
| Source of data | Merchantable biomass and aboveground tree biomass are estimated from the forest biomass maps |
| Description of measurement methods and procedures to be applied | Within each stratum divide the summed merchantable biomass by the summed total of aboveground tree biomass. |
| Frequency of monitoring/recording | *At each monitoring event we will reassess if $PMP_i$ should be updated.* |

| | |
|---|---|
| **Value monitored** | Stratum / PMP_I<br>Mosaic / 0.71<br>NFM / 0.45 |
| **Monitoring equipment** | |
| **QA/QC procedures to be applied** | |
| **Purpose of the data** | According to the methodology, each project must calculate within each stratum the ratio of merchantable biomass to total biomass (PMPi). This shall then be compared to the ratio of merchantable biomass to total biomass for each forest type (PMLFT). |
| **Calculation method** | |
| **Comments** | Ex-ante a time zero measurement must be made of this factor.<br>The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory (Vj,i\|BSL), based on legal limits. |

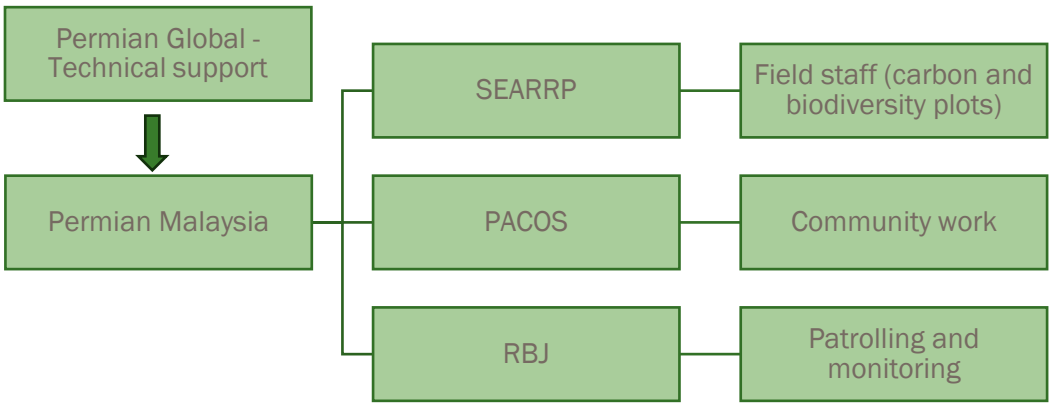
| | |
|---|---|
| **Data / Parameter** | $LF_{ME}$ |
| **Data unit** | dimensionless |
| **Description** | Leakage factor for market-effects calculations. Derived as from variables $PMP_i$ and $PMP_{FT}$ as described in the Leakage Factor calculation box on page 48 of the methodology. |
| **Source of data** | Derived from Project and state-level biomass and timber harvest data see parameters $PMP_i$ and $PMP_{FT}$. |
| **Description of measurement methods and procedures to be applied** | The deduction factor is specified in the methodology and is based on the % difference between $PMP_i$ and $PMP_{FT}$.<br>$PML_{FT}$ is equal (± 15%) to $PMP_i$ LFME = 0.4<br>$PML_{FT}$ is > 15% less than $PMP_i$ LFME = 0.7<br>$PML_{FT}$ is > 15% greater than $PMP_i$ LFME = 0.2 |

| | |
|---|---|
| **Frequency of monitoring/recording** | *At each monitoring event we will reassess if $PMP_i$ should be updated which can impact the value of $LF_{ME}$.* |
| **Value monitored** | Stratum: Mosaic — $LF_{ME}$: 0.2<br>Stratum: NFM — $LF_{ME}$: 0.4 |
| **Monitoring equipment** | |
| **QA/QC procedures to be applied** | |
| **Purpose of the data** | According to the methodology, each project must calculate within each stratum the ratio of merchantable biomass to total biomass (PMPi). This shall then be compared to the ratio of merchantable biomass to total biomass for each forest type (PMLFT). The difference in these values is used to define the leakage deduction factor. |
| **Calculation method** | |
| **Comments** | |

### 3.1.3 Monitoring Plan (VCS, 3.16, 3.20)

**Organizational structure, responsibilities and competencies of the personnel that will be carrying out monitoring activities.**

The Kuamut Rainforest Conservation Project (KRCP) operates under a structured governance model to ensure effective monitoring and conservation efforts. The key components of the organizational structure are as follows:




**Project Management:**

Managed by Permian Malaysia Sdn. Bhd., responsible for the overall administration, planning, and implementation of monitoring activities.
Ensures compliance with standard operating procedures (SOPs) and coordinates efforts among stakeholders.

**Technical Support and Oversight:**

Permian Global provides specialized technical expertise, covering key areas such as monitoring methodologies, field assessments, carbon accounting, biodiversity surveys, and community engagement. The same experienced personnel who developed the baseline for the project are involved in ongoing monitoring and assessments.

**Field Operations:**

- Local community employees and trained staff from SEARRP are actively involved in data collection and biomass monitoring.
- These field teams are equipped with necessary tools and undergo structured training programs, including classroom and hands-on instruction.
- RBJ, as a project partner, conducts the frequent patrolling and onsite monitoring in coordination with Permian Global

**Competencies of Personnel Conducting Monitoring Activities**

The monitoring team consists of professionals with extensive experience and expertise in various disciplines relevant to conservation and environmental monitoring. The core competencies include:

**Project Management, Forest Ecology, and Remote Sensing:**

- Expertise in managing large-scale conservation projects.
- Strong background in forest ecology, carbon modeling, and climate mitigation strategies.

- Skilled in using remote sensing technology for monitoring forest cover and biomass dynamics.
- Experience in overseeing field assessments and data validation.
- Proficiency in project coordination, stakeholder engagement, and compliance monitoring.

**Senior Scientist, Forest Ecology:**

- Extensive experience in tropical forest carbon dynamics and ecosystem management.
- Proficient in statistical modelling and data analytics related to forest growth and biomass assessments.
- Skilled in supervising PhD research and leading academic collaborations.
- Strong background in teaching and mentoring field researchers.

**Remote Sensing Analyst:**

- Advanced expertise in Geographic Information Systems (GIS) and remote sensing technologies.
- Experience with satellite data interpretation, including SAR-based environmental monitoring and hyperspectral imaging.
- Competence in designing and implementing remote sensing algorithms for deforestation detection and forest degradation monitoring.
- Skilled in developing informative maps, data visualization, and environmental reporting.
- Experience in training field personnel in environmental data collection and processing.

**The methods used for generating/measuring, recording, storing, aggregating, collating and reporting the data on monitored parameters.**

**Implementation of sampling approaches**

The monitoring of the annual carbon stock change in aboveground biomass of trees involves remote sensing in combination with targeted remeasuring of field plots.

For the field measurements, 46 circular 30-meter radius permanent sample plots (PSPs) plots were set up within the Kuamut area for the baseline. The project started remeasuring the plots during 2021, but due to heavy movement control orders, and access difficulties, we did not complete the plot remeasure until March 2022. All 46 of the field plots were re-measured. The field plot calibration/validation dataset therefore includes a total of 92 (two measurements of 46) field plots.

**Biomass Mapping**

Originally in the PD, the biomass for the baseline was estimated from the Top of Canopy Height using extensive LiDAR coverage for the first year of the project, 2016. As indicated in section 2.2.4 of this monitoring report, these values have been updated because of the availability of new more accurate and up-to-date datasets (also see Appendix 1 for the updated baseline numbers).

These new more accurate and up-to-date datasets have also been used to estimate the annual carbon stock change in aboveground biomass of trees in the project scenario ($\Delta C_{AB,t|PRJ}$). In order to quantify ongoing forest growth in the project scenario and to accurately estimate any emissions from small amounts of deforestation or degradation, the project has developed a multi-temporal modelling approach to estimate the spatial variability and distribution of aboveground biomass. The modelling approach adopted a machine learning workflow that uses the following data sources: aerial LiDAR scan (ALS) data from 2016 describing canopy height, optical (Landsat 8) and Synthetic Aperture Radar (SAR) (Sentinel 1) satellite imagery and forest plot data. LiDAR data was collected in 2016, forest plot data in 2016 and 2021/2022 and satellite remote sensing data for the years 2015-2023. The combination of remote-sensing data sources is used to produce an updated wall-to-wall Top of Canopy Height (TCH) map – broadly similar to the process described for the baseline where the TCH map was produced predominantly with LiDAR; this TCH model is then used to predict annual biomass maps in combination with plot and satellite data. It is important to note that while the forest growth monitoring process utilises both remote sensing and field measurements, it is very much supported with the field plot measurements, and it is possible to accurately model the regrowth without measuring the field plots every monitoring period.

As part of the workflow, annual composites of Landsat 8 (L8) imagery were created for the project area using Google earth engine. Landsat 8 annual median composites (used to generate covariates for biomass maps) were post-processed using temporal smoothing which fills any gaps which may occur due to clouds. Further it harmonises the images enabling the reliable prediction of the final biomass model across annual epochs. For the years 2016-2022 a loess smoother was used, to generate the temporal smoothing, capturing non-linear changes in spectral signatures. Loess regression is strongly influenced by trailing values however, for this time period the existence of field plot data for the years 2015 and 2022 facilitated confident constraint of the smoother. As no field plot data were collected in 2023, a linear temporal reduction was applied again from 2015-2023 which was used to generate the biomass map for 2023 only[8]. This approach was selected as it produced more conservative estimates for ongoing forest growth. The output of this processing step was a temporally consistent, gap-filled, wall-to-wall annual time series of L8 composite imagery (see Figure 3.1). A total of 20 vegetation spectral indices were calculated for this set of composites.

For the SAR data, imagery from Sentinel 1 (S1) was used; all S1 images, for a given year, that intersected the area of interest, were collected. Each image was pre-processed using the steps described in Mullissa et al (2021).[18] All S1 preprocessing was carried out using google earth engine and the {rgee} package. The Copernicus GLO 30 m global digital elevation model (DEM)[19] was used to derive terrain data for the area of interest including: slope, aspect, minimal curvature and mean curvature. All the bands from the imagery discussed above were combined into a data cube, comprising a total of 41 bands.

[18] https://doi.org/10.3390/rs13101954

[19] https://portal.opentopography.org/raster?opentopoID=OTSDEM.032021.4326.3

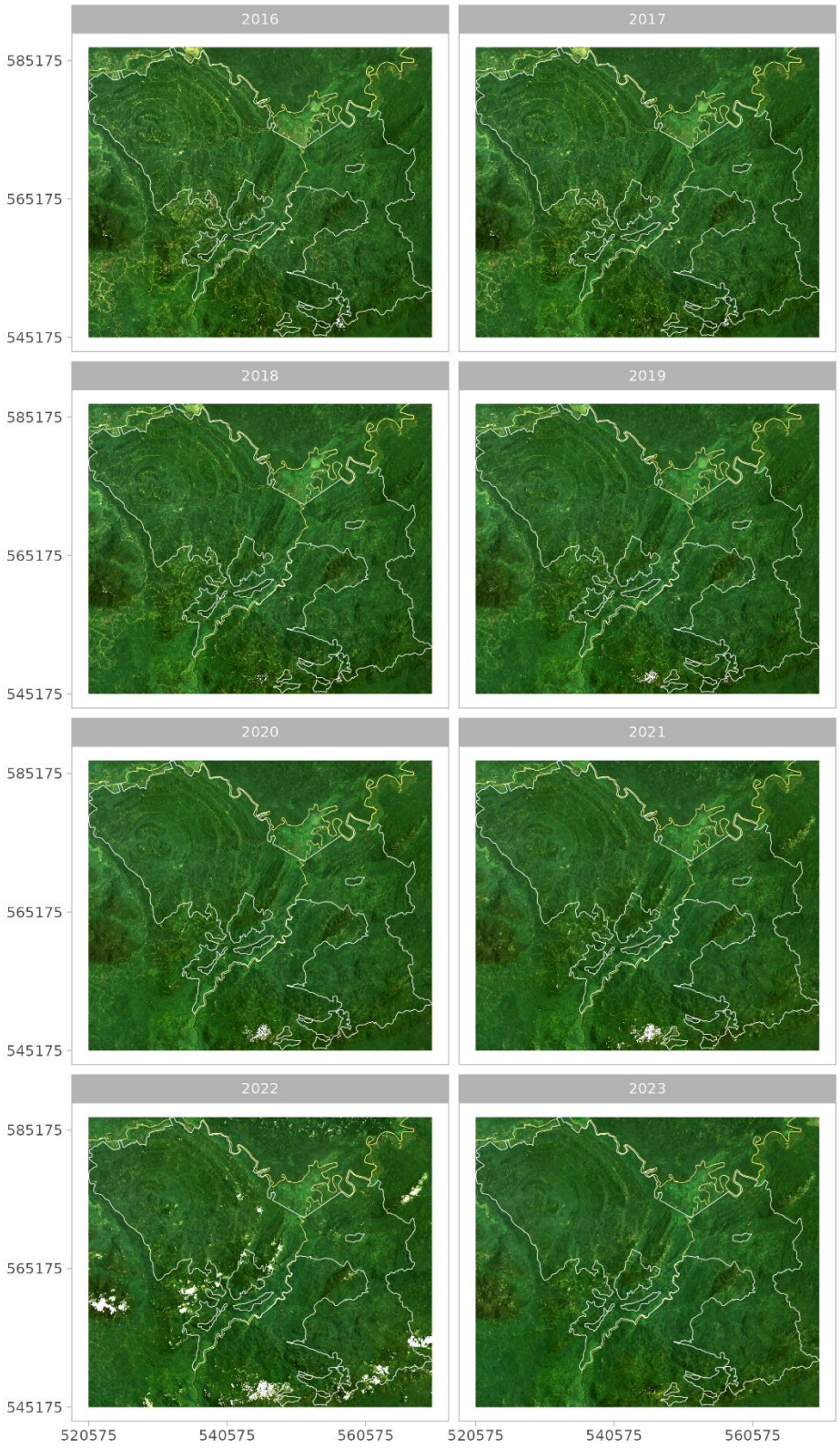



Figure 3.1. Temporally smoothed Landsat 8-RGB composites used for the biomass analysis, panels show each year's composite.

The data cube was aligned with the tree Canopy Height Model (CHM) that was generated for the baseline from our LiDAR dataset, (which is described in the PD), collected in 2016. The coverage of the CHM is not complete due to some areas where LiDAR point clouds where not directly available to the project as a result of clouds or areas not flown and are filled with predictions using the following methods. All regions that intersected the CHM were used to create a data frame comprising the measured canopy height values from the CHM and all of the environmental/ earth observation data contained within the data cube. Machine learning was applied, using the mlr3 R package ecosystem, to analyse the information in the data cube and develop a Canopy Height Model using the combination of environmental metrics that could produce a model with the lowest RMSE value. Spatial resampling was undertaken to evaluate the performance of the ensemble model as shown in Figure 3.2. The model was then used to predict canopy height for years 2015:2023. The resulting predictions were stored as spatial raster data.

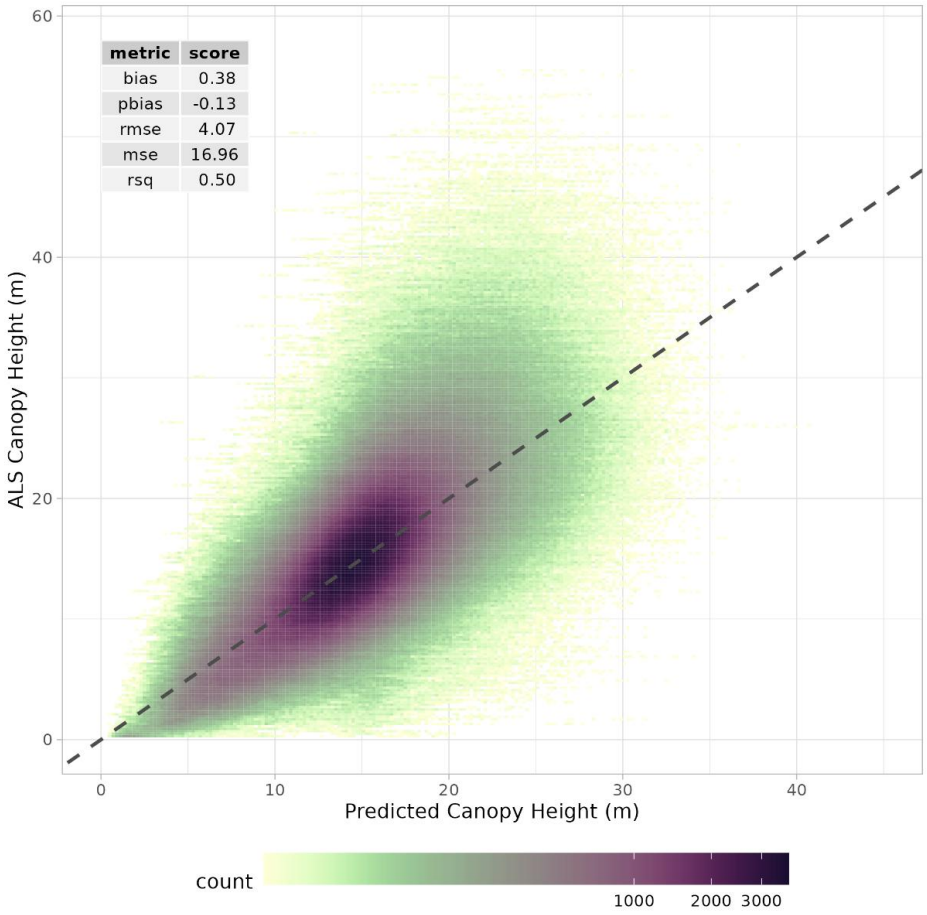



Figure 3.2. Evaluation of the performance of the developed Canopy Height Model against the Lidar generated canopy height data.

To determine the Above Ground Biomass, the canopy height model predictions for all years were appended to their respective year's data cube as an additional band to form the input data cube for biomass model development. This was combined with the data from the field measurements that were undertaken in 2016 and 2021/2022 in the Kuamut project area. Data cubes for the

corresponding years were used to extract the earth observation data that intersected each plot area for each year it was surveyed. The total Above Ground Carbon (AGC) in the plot was converted to Aboveground Carbon density (ACD) by dividing the AGC by the planimetric area of the plot. The derived dataframe was used to train a model to predict ACD. All variable combinations were tested that included between 6-10 control features, which were selected based on the models with the lowest AIC, two of which were required to be modelled: canopy height and mean curvature[20] (because of their importance). The best performing model was selected. The model was trained on the full forest plot inventory and validated using spatial resampling (see Figure 3.3).

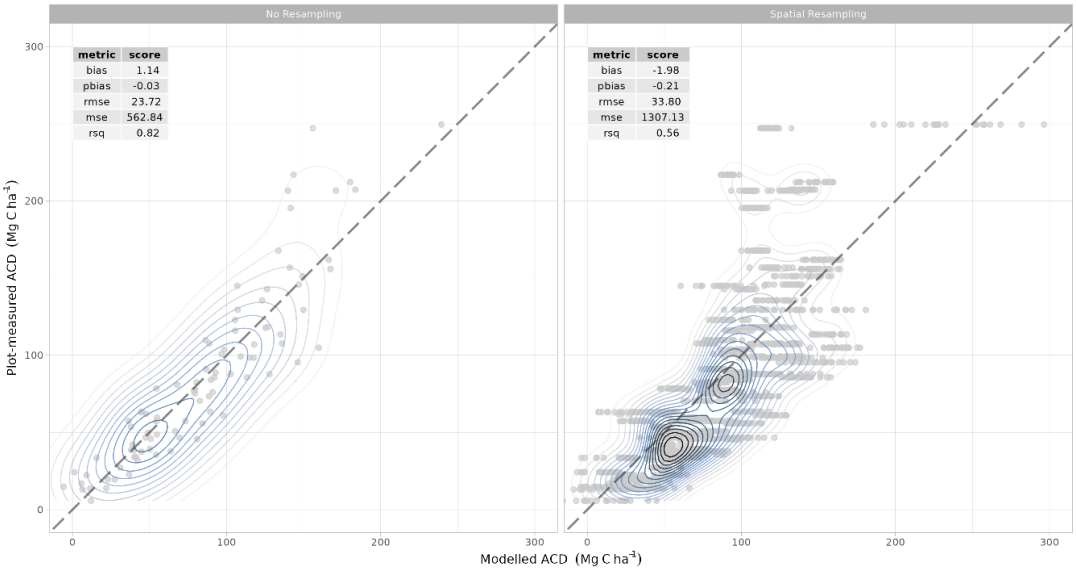



Figure 3.3. Model validation comparing plot-measured ACD against modelled ACD values, indicating low bias and good model performance.

The best model was used to predict ACD across the entire Kuamut project area. All steps related to the model were repeated for Merchantable Volume with cutting limits of 10 cm, 31 cm, and 40 cm. The combination of data sources was used to produce high resolution carbon maps for each year of the monitoring period as shown in figure 4 (and volume maps for 2016, as per the methodology and PD). The combination of data sources was used to produce high resolution carbon maps for each year of the monitoring as shown in figure 4 (and volume maps for 2016, as per the methodology and PD). We use these biomass maps to estimate the carbon stock per strata, and in turn determine the stock changes between sampling events. An interactive web-mapping App (Kuamut project AGB web-map) was developed with the aim of facilitating the exploration of the final yearly biomass maps which will be made available to the verifier, and demonstrated in the field via a geolocated tablet app.

[20] Mean curvature identifies upland areas and ridgelines, which in the Kuamut project area are typically less effected by historical logging activity, due to their inaccessibility.

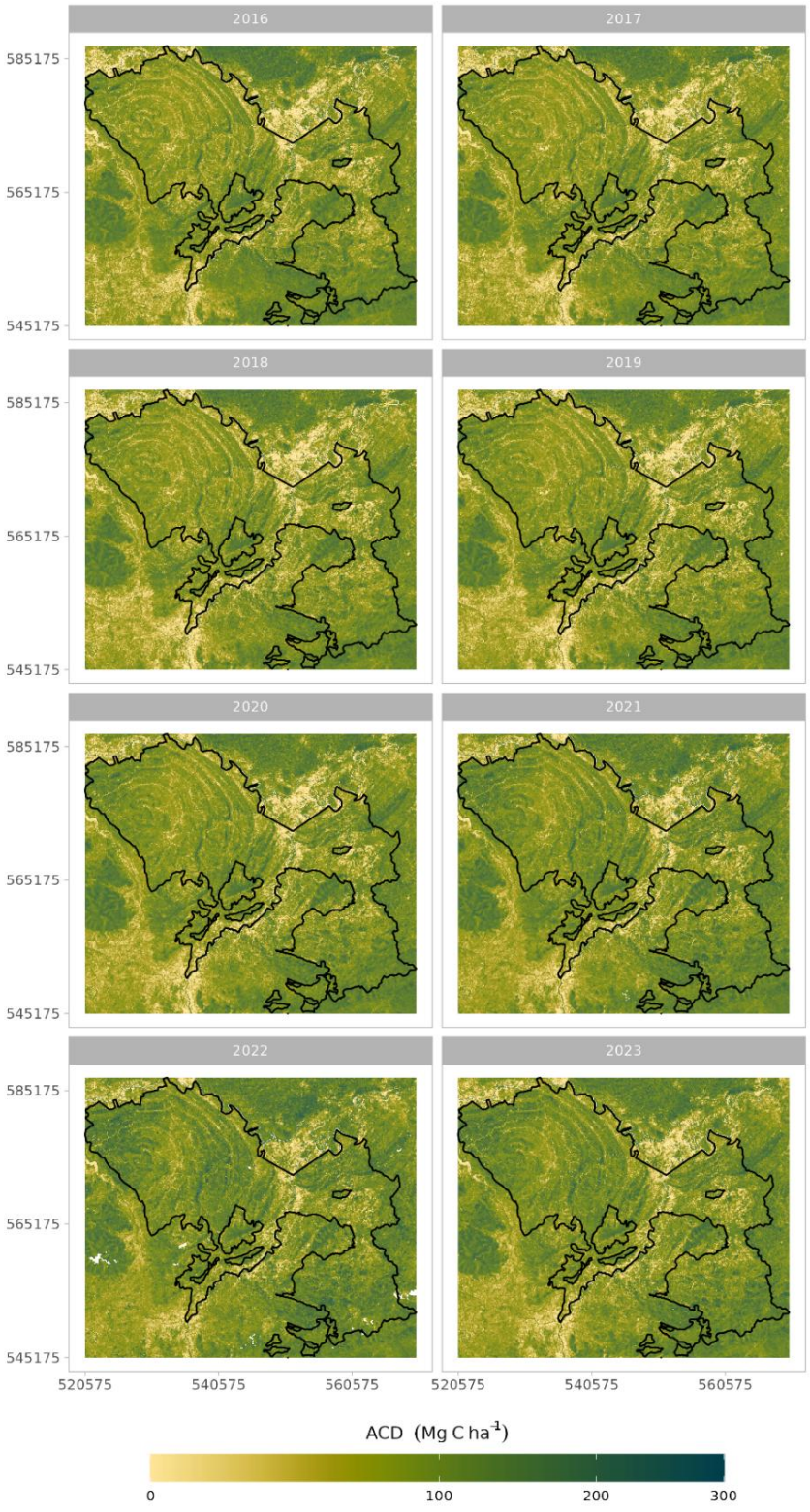



Figure 3.4. Yearly biomass maps generated for each year of the monitoring period. Colour scale shows ACD in Mg C $ha^{-1}$. X and Y axis are meters; the coordinate reference system is WGS 84 / UTM zone 50N.

**Growth Rate calculation:**

Growth rate was calculated across multiple years for the entire Kuamut project area in order to a derive the most robust estimate possible. Predicted ACD maps for years 2016-2023 were used to estimate growth rate to account for spatial variability in growth and degradation across the entire project area over the monitoring period. A linear mixed effects model was fit across the entire dataset, i.e. the biomass maps through time, providing a distribution of predicted growth rates. A fixed effect interaction was included for strata; the fixed effect slopes were therefore the growth rate for each strata. Biomass cell ID was included as a random effect with time included also as a random slope; this formulation allows for pixel level variability in growth rate to be considered within the model and provide uncertainty for growth rate estimates for each strata. Our modelling approach provides a single growth rate for the monitoring period, for each strata, and gives the most accurate estimate using a consistent linear model for all the years together. As suggested by the methodology, we therefore estimate a mean growth rate for each of the strata, within the project area, which are subsequently used in the annual calculations. These project-scenario growth rates were 3.17 t C $ha^{-1}$ $yr^{-1}$ for mosaic-planted, 3.11 t C $ha^{-1}$ $yr^{-1}$ for mosaic-unplanted and 2.67 t C $ha^{-1}$ $yr^{-1}$ for NFM. We do not apply growth rates for no-go areas. The model estimates a lower growth rate in the no-go areas, which makes biological sense as these areas have experienced less historic logging. The no-go areas are not part of the baseline scenario, and therefore are not accounted for. The strata-level species conservation factors (as used in the baseline) were then discounted from the growth rates to account for protected species. After removing protected species, project-scenario growth rates were: 2.98 for mosaic-planted, 2.92 for mosaic-unplanted and 2.03 for NFM. We do not apply growth rates for no-go areas (see Table 3.1).

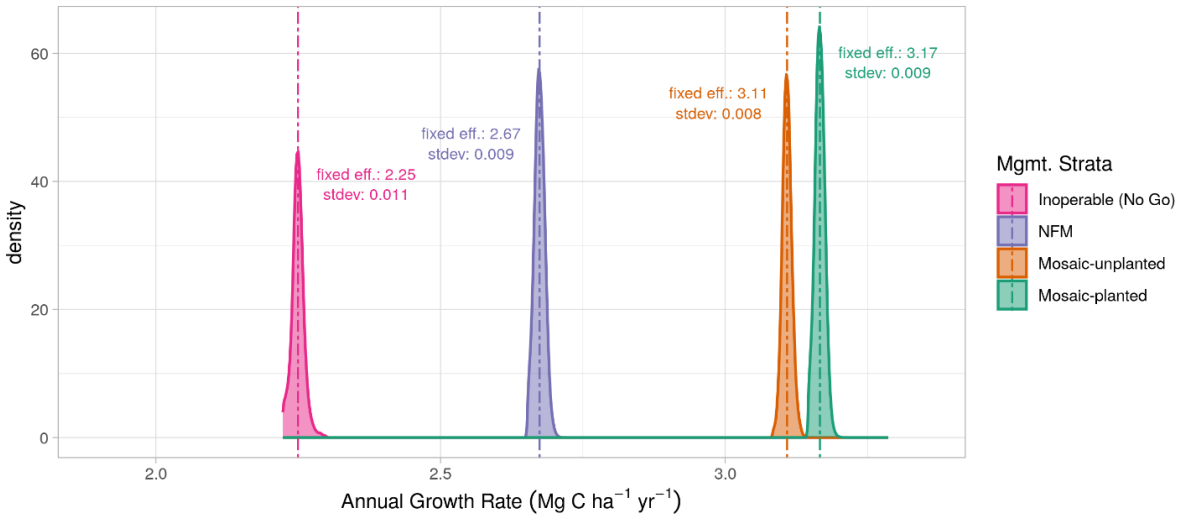



Figure 3.5. Project area annual growth rate density distribution for each of the strata, in Mg C ha-1 yr-1

Table 3.1. Growth rates before and after applying the strata-specific species conservation factor.

| Management Strata | Modelled Growth Rate (Mg C $ha^{-1}$) | Species Conservation Factor | Adjusted Growth Rate (Mg C $ha^{-1}$) |
|---|---|---|---|
| Inoperable (No Go) | 2.25 | - | - |
| NFM | 2.67 | 0.76 | 2.03 |
| Mosaic-planted | 3.17 | 0.94 | 2.98 |
| Mosaic-unplanted | 3.11 | 0.94 | 2.92 |

### Forest disturbance

To monitor forest disturbances (fire, non-fire forest disturbances plus illegal logging), the data on biomass and forest regrowth as described above are complemented with an analysis of optical data products (Landsat 8 (OLI), Sentinel-2 and Harmonised Landsat-Sentinel (HLS) that have a proven capability for deforestation detection and some capacity for degradation detection.

### Fire

The field team also monitors the presence of any fire within or just outside the project area and, if there were to be any fires, evaluates the best course of action to avoid spread. NASA FIRMS alerts[21] was used to monitor any possible fires, but it should be noted there were no fires in the project during the monitoring period. We would like to highlight that the monitoring strategy proposed in this section will be used in the event that any fire occurs within the project area.

Any hotspot inside or surrounding the project area, prioritising a 5000m buffer around the project boundaries, was checked. The NASA-FIRMS email alerts, which include the geographic coordinates of the detected hotspot, are sent to designated field team members for verification. The team would also receive monthly summaries with information on the fire events (and for the deforestation analysis – see below) that have occurred in the project area and its surrounding regions.

Were fires to occur, coincidental or near-coincidental High resolution optical (Planet, Sentinel-2, Landsat 8-9) and SAR (Sentinel-1) satellite imagery would be used to perform multi-temporal investigation of fire's impact on the forest, assessing the environmental conditions before and after the event. Various spectral indices would be used to characterise the affected areas, paying special attention to those developed specifically for the study of fires such as the dNBR –

[21] https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

Difference Normalized Burn Ratio[22] (Optical) or BAI - Burn Area Index[23] (Optical). Supporting SAR images would also be considered in in those scenarios in which cloud cover does prevent the acquisition of optical cloud-free imagery. In this case, specific radar indices such as the RBR - Radar Burn Ratio[24], which study the variation in the electromagnetic signal derived from structural changes in environmental conditions, would also be used.

**Other disturbances including illegal logging**

Apart from a single flood inundation event, identified during the continuous patrolling work carried out during the monitoring period, no significant natural disturbances (e.g. landslides, windthrow or hurricane) have occurred in the project area. Therefore, all non-fire disturbances have been considered as part of the deforestation analysis for illegal logging.

To address illegal logging, a field team from Rakyat Berjaya Sdn. Bhd monitored the project area on a regular basis. Specifically, this monitoring included either helicopter surveillance, ground & river patrolling or surveillance for around 10 days once every month by monitoring teams (see patrolling reports). In addition, the project also uses the Global Forest Watch optical- based GLAD and SAR-based RADD integrated deforestation alerts.[25] These alerts provide near-real time information that was used as a guide for the SEARRP field team to check specific locations where illegal logging may have occurred. To improve early detection of forest disturbances, the monitoring area was extended to include a minimum buffer area of 2000 m around the boundary of the project area, as well as some additional areas in the southern region of the project area, to include some legally granted logging concessions (see Figure 3.6). The monitoring team received instant email notifications of new alerts as soon as any of the three detection tools (GLAD-L, GLAD-S2 and RADD) detected a new deforestation event in the project area. The team received all notifications (regardless of confidence in detection), and in addition, special attention was paid to those which had higher detection confidence, thus evaluating in greater depth the alerts labelled with 'highest' confidence ("highest confidence: detected by multiple alert systems") (see Figure 3.6). These notifications provide detailed information, in Bahasa language, about the location, date-time and detection confidence on any new deforestation event occurring in the project area/buffer. Additionally, the team also received continuous monthly summaries with information on all deforestation events. The specific dataset containing all GFW's Integrated deforestation alerts for the monitoring period will be provided during the verification.

[22] (https://www.nature.com/articles/s41598-019-56967-x ,https://www.usgs.gov/landsat-missions/landsat-normalized-burn-ratio. https://un-spider.org/advisory-support/recommended-practices/recommended-practice-burn-severity/in-detail/normalized-burn-ratio

[23] https://www.mdpi.com/2504-3900/2/7/364

[24] https://www.sciencedirect.com/science/article/abs/pii/S0034425715301103?via%3Dihub

[25] https://www.globalforestwatch.org/blog/data-and-research/glad-deforestation-alerts/

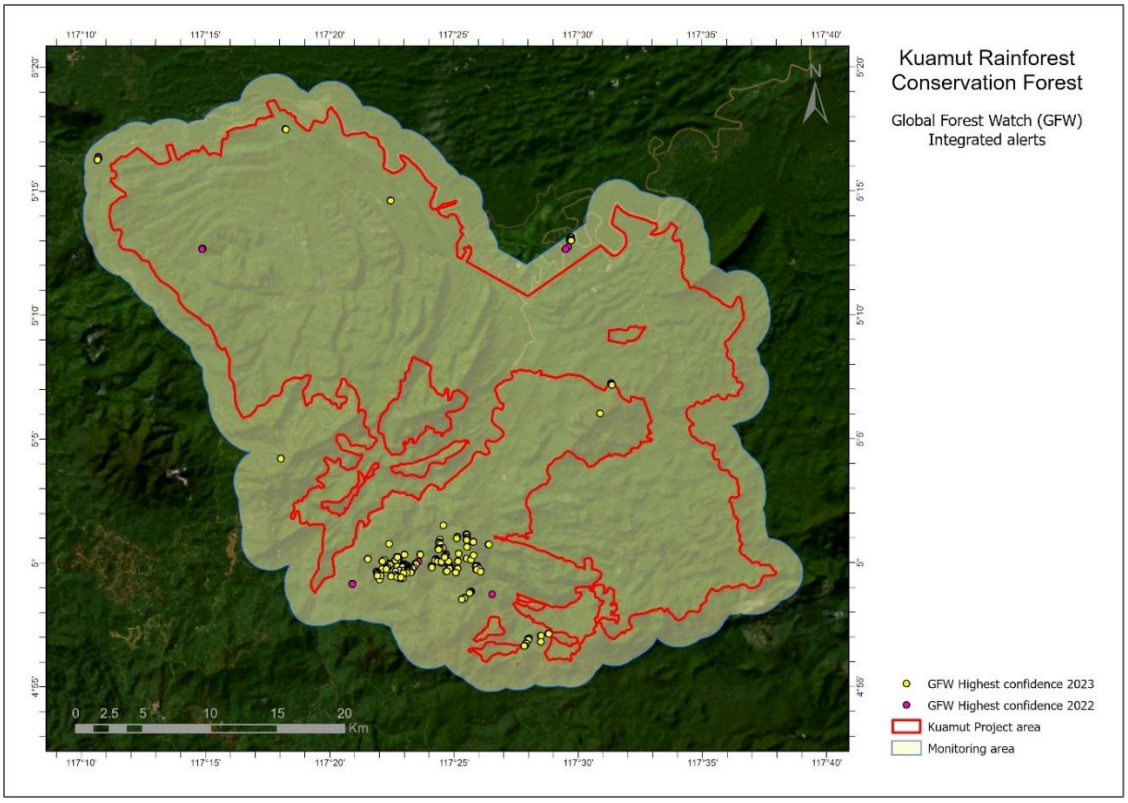



Figure 3.6. Highest confidence Global Forest Watch Integrated deforestation alerts identified in the Kuamut Rainforest Conservation Project area and its surroundings during the monitoring period (2022 and 2023).

The Global Forest Watch's integrated deforestation alert product presents some limitations associated with the fusion of different detectors; the authors specify, it is recommended not to use these alerts for global or regional trend assessment, nor for area estimates[26] [27] [28]. Therefore, to accurately identify and assess the impact of the events, a Remote Sensing based multi-temporal deforestation analysis was carried out with the objective of mapping the illegal logging, or deforestation events that have occurred within the project area during the monitoring period.

[26] Integrated Deforestation Alerts". UMD/GLAD and WUR, accessed through Global Forest Watch https://data.globalforestwatch.org/datasets/gfw::integrated-deforestation-alerts/about

[27] M. C. Hansen, S. V. Stehman, P. V. Potapov, Quantification of global gross forest cover loss, Proceedings of the National Academy of Sciences 107 (19) (2010) 8650–8655, publisher: Proceedings of the National Academy of Sciences. doi: 10.1073/pnas.0912668107.
https://www.pnas.org/doi/full/10.1073/pnas.0912668107

[28] N.Galiatsatos,D.N.M.Donoghue,P.Watt,P.Bholanath,J.Pickering,M.C.Hansen,A.R.J.Mahmood,AnAssessment of Global Forest Change Datasets for National Forest Monitoring and Reporting, Remote Sensing 12 (11) (2020) 1790, number: 11 Publisher: Multidisciplinary Digital Publishing Institute. doi:10.3390/rs12111790.
https://www.mdpi.com/2072-4292/12/11/1790

The core land cover classification and deforestation analyses were developed on the Google Earth Engine Platform (Gorelick, et. al.[29]). The method of this analysis consists of three main parts. The first stage focuses on filtering the optical satellite image collections and obtaining cloud-free images for the subsequent generation of the annual composite image. Second, a supervised land cover classification is performed using machine learning classification algorithms. Finally, the analysis focused on the cleaning and post-processing of the final results using advanced GIS tools and software.

For the first stage, a comprehensive cloud-free image analysis was performed for each year of the monitoring period. Historical image archives from the new NASA- Harmonised Landsat and Sentinel-2 (HSL) catalogue were investigated. The Harmonised Landsat and Sentinel-2 (HLS) dataset takes input data from the joint NASA/USGS Landsat 8 and Landsat 9 and the ESA (European Space Agency) Sentinel-2A and Sentinel-2B satellites to generate a harmonised, analysis-ready surface reflectance data product (NASA, 2018; [30]NASA, 2022[31]). The harmonization of the multispectral signature of Landsat and Sentinel-2 constellations has been a key aspect for the adoption of this new product for project monitoring, since it significantly improved the temporal resolution (2-3 days revisit time), thus facilitating the generation of cloud-free temporal composites, especially in regions with recurrent cloudiness such as the Kuamut project area. Both the Sentinel-2 (HLSS30.v2.0) and Landsat (HLSL30.v2.0) versions of the HSL catalogue were investigated using the NASA - Common Metadata Repository (CMR) Earth Science data catalogue. As shown in Figure 3.7, both the Sentinel and Landsat final products have been previously co-registered, resampled, atmospherically corrected and calibrated to surface reflectance (SR).

[29] https://www.sciencedirect.com/science/article/pii/S0034425717302900

[30] https://hls.gsfc.nasa.gov/wp-content/uploads/2017/08/HLS.v1.3.UserGuide_v2.pdf

[31] https://www.earthdata.nasa.gov/esds/harmonized-landsat-sentinel-2

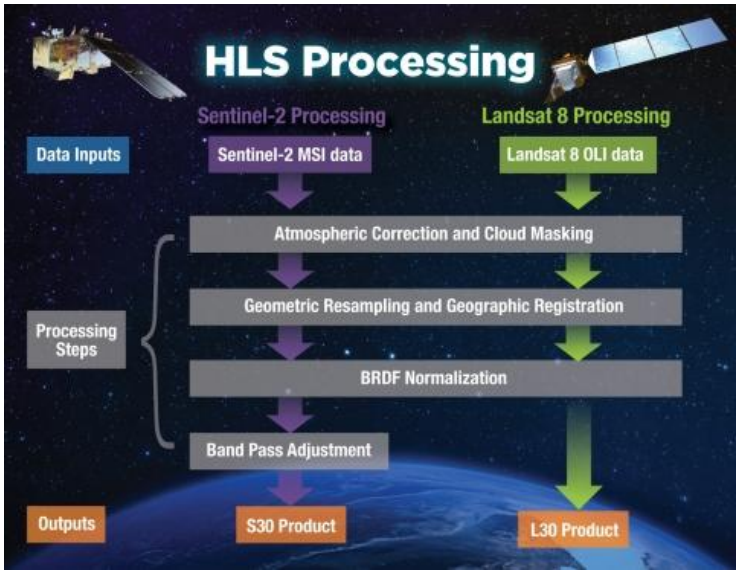



Figure 3.7. HLS science algorithm processing flow (NASA, 2022).

The first step was to perform a cloud mask on all images. As for previous years, we found a high and recurrent cloudiness in the project area, with only 1.04% [9 images] of all the images acquired [L8-9 & S2 (01/01/2023 - 05/06/2024) = 641 images] presenting a cloudiness percentage below 10%. Although this still included some cloud coverage, the improved temporal resolution achieved by the HSL dataset allowed the adoption of a more aggressive/conservative cloud filtering technique, ensuring the removal of any cloud-driven spectral distortion in the imagery used for the annual composite. A cloud mask function based on the Quality evaluation layer filtering (Fmask | QABits- quality control bits) was used, filtering out all pixels affected by cloud features such as cirrus (Bits 0), clouds (Bits 1) and cloud-shadows (Bits 3). Once all the images were masked, all the harmonised bands present in both constellations were merged, thus computing the annual median composites for each monitoring year (see Figure 3.8). Lastly, with the aim of enhancing the vegetation classification, both the Normalize Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) were calculated and added to each composite image using the spectral information from the Red and Near-Infrared (NIR) bands. This process was developed and compiled in a Jupyter notebook (python). The notebook can be freely accessed at Permian-Global-Research GitHub's central repository (HSL-STAC-Fusion)[32].

[32] https://github.com/Permian-Global-Research/HSL_STAC_Fusion

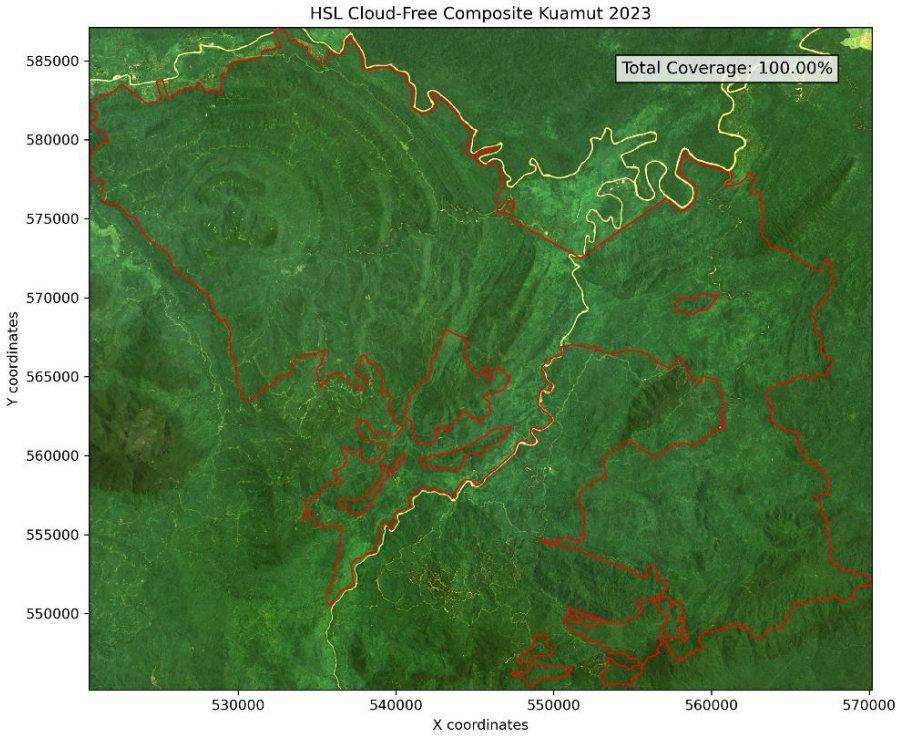



Figure 3.8. Harmonised Sentinel Landsat (HSL) | 2023 Cloud-Free annual median composite computed for the Kuamut rainforest conservation project area.

Table 3.2. Table showing the optical satellite missions used for the annual composites and the percentage of area coverage for each composite image. For more information on the imagery used please review the annual imagery spreadsheets that include the contribution of each scene to the annual composite.

| Year | Dataset | Monitoring dates | N images | Area coverage (ha) | Cloud-free cover (%) |
|---|---|---|---|---|---|
| 2022 | HSL.L.V2<br>HSL.S.V2 | 01/01/2023 – 31/12/2023 | 103 | 83,381.00 | 100 |
| 2023 | HSL.L.V2<br>HSL.S.V2 | 01/01/2024 – 03/07/2024 | 51 | 83,205.89 | 99.79 |

In the second stage, a supervised classification was carried out in the Google Earth Engine environment using a Random Forest classification algorithm[33]. The algorithm was trained with manually and equally distributed ground-truth data for each of the 3 classes present in the analysis: Forest, Non-Forest, Water. The classification analysis followed a 70-30 training/validation split, using 70% of the ground truth sample for algorithm training and 30% for validation and accuracy metrics extraction. All classifications had a satisfactory overall accuracy,

[33] https://developers.google.com/earth-engine/apidocs/ee-classifier-smilerandomforest

exceeding the minimum criteria of 90% defined in the methodology. Two (30 m spatial resolution) annual land cover classification maps were produced, which were used to investigate the forest changes that occurred in 2022 and 2023. Figure 3.9 shows one of these maps (for the year 2023) resulting from the supervised Random Forest classification.

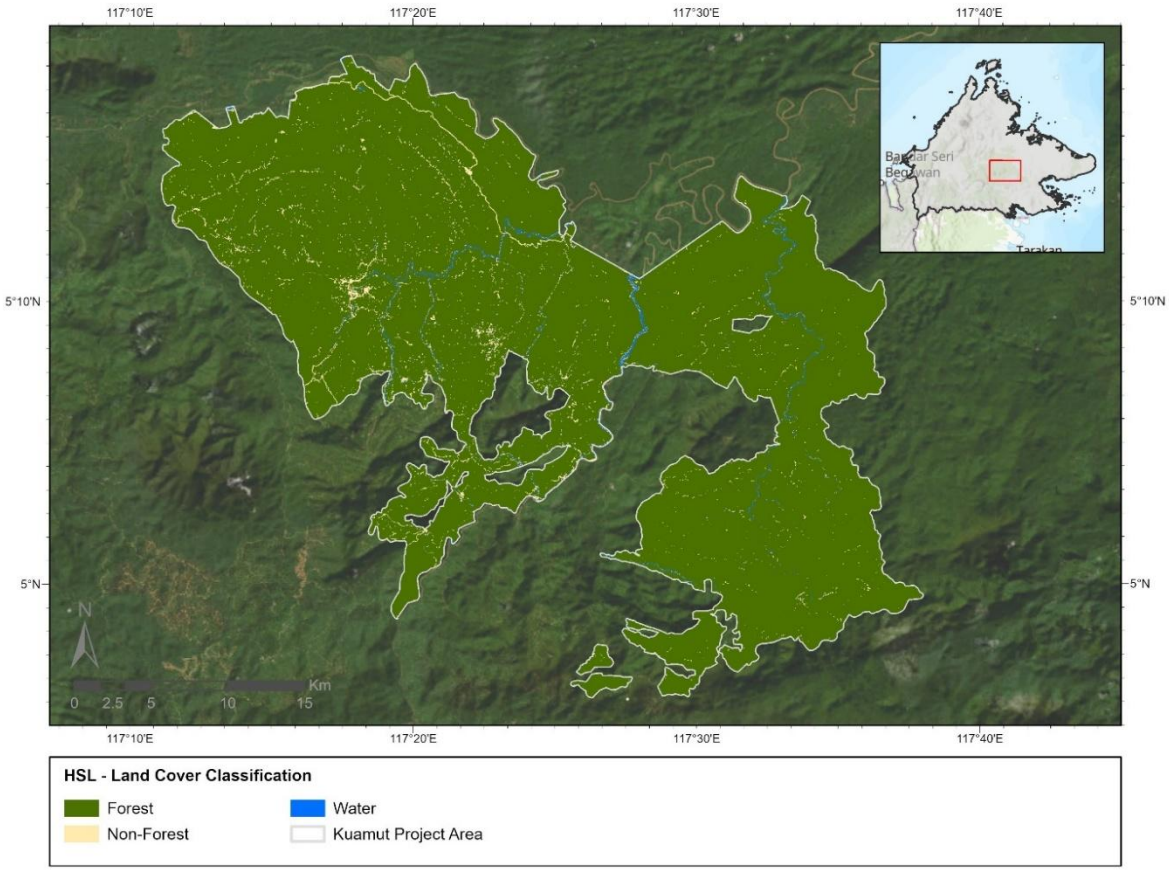



Figure 3.9. 2023 Annual Land Cover classification map for the Kuamut rainforest conservation project area.

To increase confidence in the detections and avoid errors in the final calculations due to false positives/negatives, a post-processing analysis of the final deforestation masks was performed. This post-processing consisted of two parts, the application of a morphological neighbourhood filter and a redundancy investigation. A morphological neighbourhood filter reduces the high false alarm rates that is a common problem when working with satellite imagery. A sieve filter[34] was used to remove all non-forest areas smaller than a given size. Considering that all structural disturbances and small-scale forest degradation were accounted for in the annual High-Resolution Above Ground Biomass (AGB) maps and, therefore, included in the final carbon stock calculations/ongoing forest growth rate, the detection filter was set to a minimum area of

[34] Ose, 2018: https://onlinelibrary.wiley.com/doi/10.1002/9781119457107.ch5 ; https://gdal.org/programs/gdal_sieve.html

deforestation in 2.5 ha. This filter increased the confidence levels of the detection by reducing the rate of false positives caused by spectral anomalies such as cloud edges. In addition, a forest change redundancy analysis was implemented to deal with specific areas that were identified as deforested on several occasion during the years. To avoid the repeated inclusion of all the 'already-identified' deforested areas in annual calculations, all 'Non-forest' areas from the years, prior to the year studied, were eliminated. For this, a cumulative strategy was used where all those areas that have been previously identified as 'deforested' in any of the previous years were subtracted from the non-forest annual mask investigated.

### Project and Baseline Uncertainty

There are three key sources of potential uncertainty in the prediction of baseline and project-scenario emissions. These include the total merchantable volume (TMV) stock for trees with a DBH > 31 cm and 40 cm and the observed growth rate of the project area. Uncertainty limits for TMV were derived as follows: Volume maps were masked to the project area, values from all three bands were (mean, lower Prediction Interval (PI), upper PI) converted to a dataframe. A simulation consisting of 10000 iterations was carried out; for each iteration, 100 random samples were drawn, for every cell, from a normal distribution centered around the cell mean and constrained by the upper and lower 95% PI values. All cell values for every simulation (n=1000000) were summed to give a simulated total. The 0.025$^{th}$ and 0.975 $^{th}$ percentiles of the distribution were calculated and used as the PIs. The results from these simulations are presented in Figure 3.10.

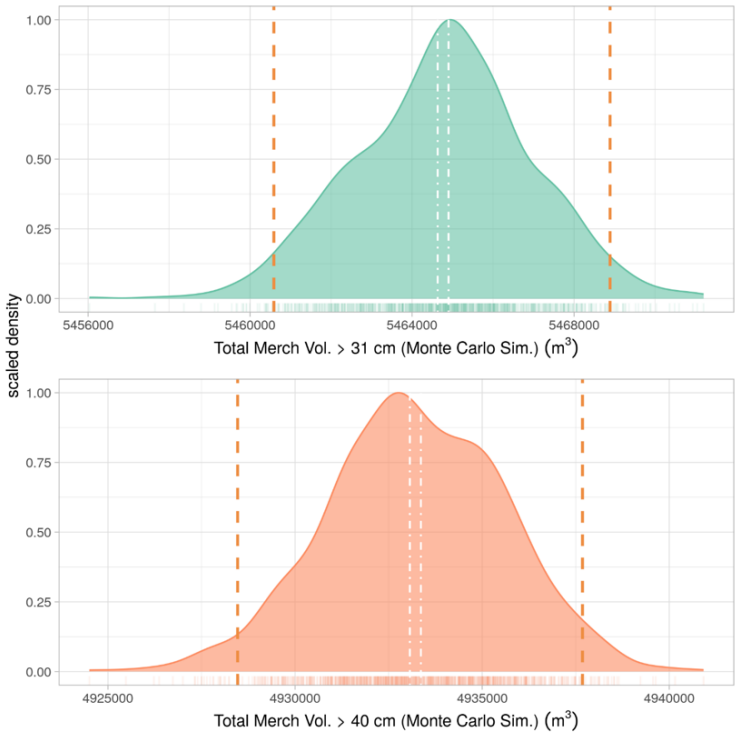



Figure 3.10. Uncertainty distributions for the total merchantable timber volumes for the two cutting limits relevant to mosaic plantings (31 cm) and natural forest management (40 cm) strata.

Uncertainty limits for the Project growth rate were derived from the fixed effects slopes of the linear mixed-effects (LME) model (Figure 3.11). Cell ID was used as a random effect in the LME model, and therefore, a slope value was generated for each cell. As with the Volume uncertainty, the 0.025th and 0.975th percentiles of the distribution were calculated and used as the PIs.

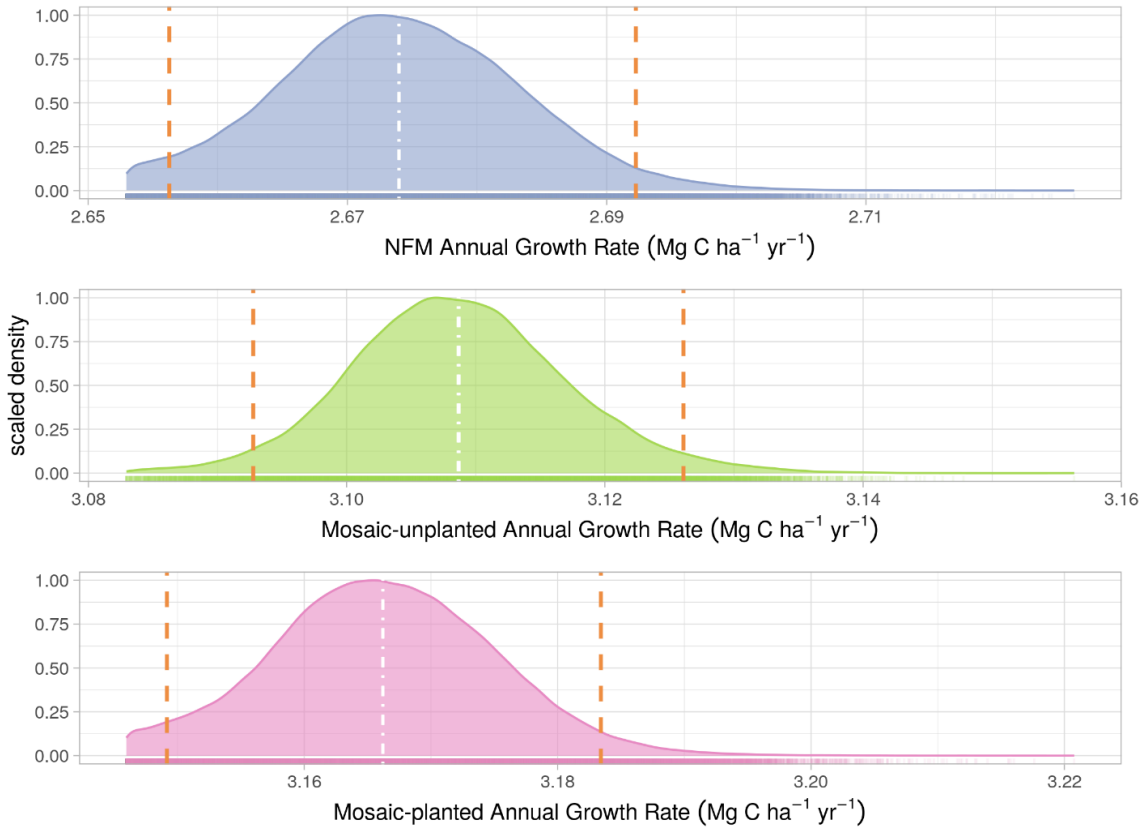



Figure 3.11 Error distributions of the fixed effects slopes of the biomass growth model. White vertical lines indicate the confidence intervals, and orange lines indicate the prediction intervals, which were used to define the uncertainty for each strata's growth estimate.

All sources of uncertainty were combined in a sum of squares as defined in equation 20.2 of the VM0010 methodology. This is outlined below in the equation below:

$$Utotal\ ltpf = \sqrt{Uvol31^2 + Uvol40^2 + Ugrnfm^2 + Ugrmpl^2 + Ugrmun^2}$$

Where:

*Utotal lpf* is the total project uncertainty,

*Uvol31* is the percent uncertainty for the total merchantable timber volume with a DBH > 31 cm,

*Uvol40* is the percent uncertainty for the total merchantable timber volume with a DBH > 40 cm,

*Ugrnfm* is the percent uncertainty for the growth rate of the natural forest management (NFM) strata,

*Ugrmpl* is the percent uncertainty for the growth rate of the mosiac-planted management strata

*Ugrmun* is the percent uncertainty for the growth rate of the mosaic-unplanted management strata.

**Recording, storing, aggregating, and collating the data on monitored parameters**

All climate, community and biodiversity data, generated by the project, was centrally managed on the Permian server– with scans of the datasheets. Hard copies of all data sheets are archived in field offices, with duplicate copies stored centrally on the Permian server. Field data is emailed from the field office. This 'database' is currently collated and managed manually, but it can be adapted to fulfil all monitoring and reporting needs using standard and custom-made report formats.

**The procedures used for handling any internal auditing performed and any non-conformities identified.**

All data collected, recorded, stored, and reported was subject to review and approval by team leaders and/or project managers (as specified above) in accordance with written SOPs covering each level of data management (Figure 3.12). As shown in Figure 3.12, the project uses a core protocol for data management and storage for all field activities (e.g., vegetation plot surveys, biodiversity surveys), following specific SOPs for each activity. A copy of the SOPs is available to validators upon request.

Security and traceability of data entry and QA/QC procedures are managed by both the Permian technical team and the SEARRP/Permian data manager in Tawau. This includes following the *Field Activity and Vegetation Plot Data Management SOP*, which outlines procedures for daily data backup, entry, verification, and final processing. The SOP ensures that all field data are securely handled, systematically reviewed, and processed using validated workflows prior to analysis.

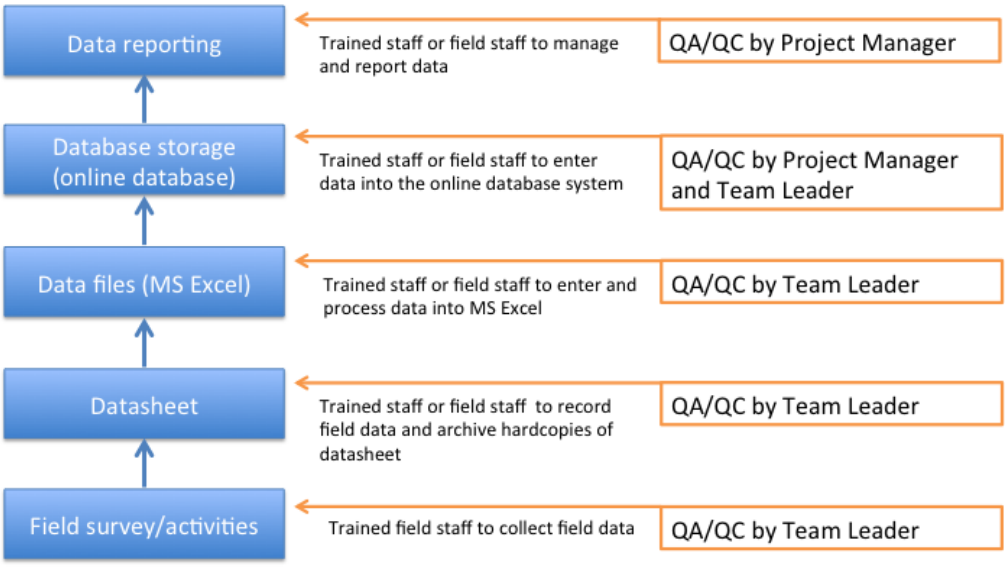



Figure 3.12. Data management QA/QC procedures.

### 3.1.4 Dissemination of Monitoring Plan and Results (VCS, 3.18; CCB, CL4.2)

The Kuamut Rainforest Conservation Project (KRCP) has implemented a comprehensive strategy to disseminate the results of its climate monitoring efforts, ensuring transparency and active engagement with both local communities and broader stakeholders.

**Public Dissemination via the Internet:**

Official Publications: KRCP has made its Monitoring Reports publicly accessible through the Permian Global website. These reports detail the project's achievements in forest conservation, biodiversity protection, and community development.
https://permianglobal.com/projects/kuamut-rainforest-conservation-project/

Social Media Platforms: KRCP maintains an active presence on platforms like LinkedIn and Instagram, where updates on project developments, achievements, and community engagements are regularly shared. This approach broadens the project's reach and keeps stakeholders informed.

**Communication with Local Communities and Stakeholders:**

Localized Materials: To ensure accessibility, KRCP produces project summaries, updates, FAQs, and monitoring reports in the local Malay language. These materials are tailored to resonate with the cultural and linguistic context of the communities.

Quarterly Newsletters: In collaboration with the PACOS Trust, KRCP distributes quarterly newsletters accompanied by voice notes via community WhatsApp groups. This method facilitates regular updates on project activities, upcoming visits, and provides a platform for community members to share their news and feedback.

## 3.2 Quantification of GHG Emission Reductions and Removals

### 3.2.1 Baseline Emissions (VCS, 3.15)

As indicated in section 2.2.4 of this monitoring report, the baseline numbers were updated because of the availability of more accurate and up-to-date datasets at the time of MR1 (see Appendix 1: Changes to the baseline due to the use of more accurate and up-to-date datasets' for the updated baseline numbers as they were presented at the time of MR1). Table 3.3 below contains the recalculated quantified net greenhouse gas emissions in the baseline scenario from Appendix 1.

Table *3.3*. Net greenhouse gas emissions in the baseline scenario.

| Year that logging would occur according to the timber harvesting plan | Net change in carbon stock across all parcels in the baseline scenario in year t* (tC) | Net greenhouse gas emissions in the baseline scenario in year t* ($tCO_2e$) | Cumulative net greenhouse gas emissions in the baseline scenario in year t* since the start of the project activity |
|---|---|---|---|
| 2022 | 168,602.8 | 618,210.3 | 3,526,533 |
| 2023 | 168,602.8 | 618,210.3 | 4,144,743 |

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### 3.2.2 Project Emissions (VCS, 3.15)

The net greenhouse gas emissions in the project are equal to carbon sequestration through ongoing forest growth minus any emissions resulting from forest disturbance (both illegal logging and natural disturbances).

<u>Ongoing forest growth in the project scenario (section 8.2.1 of the methodology)</u>

As detailed in section 3.1.3 above, the growth rate was calculated across multiple years for the entire Kuamut project area using the Aboveground Carbon Density (ACD) maps for the years 2016-2023. As explained in that same section, these maps are developed using a multi-temporal modelling approach to estimate the spatial variability and distribution of aboveground biomass. The modelling approach adopted a machine learning workflow that uses the following data sources: aerial LiDAR scanning (ALS) data from 2016 describing canopy height, optical (Landsat 8) and Synthetic Aperture Radar (SAR) satellite imagery and forest plot data.

The annual change in carbon stock in above ground biomass ($\Delta C_{AB,t|PRJ}$) is described in Eq. 32 of the VM0010 methods. For this MR we have adopted the equation form as presented in the corrections and clarifications document (v1.3 10-06-2024). Here, the formula stipulates that ongoing forest growth may only be accounted for in the cumulative area, harvested in the baseline, at time t. During the years 2022 and 2023, no baseline harvest was forecasted and therefore ongoing forest growth is only considered for the baseline harvest area for years 2016-2021.

Using the growth rates derived from the annual biomass maps, the annual carbon stock change in aboveground biomass of trees has therefore been calculated as:

$$\Delta C_{AB,t|PRJ} = \left( \sum_{i,p}^{M,P} \left( A_{t*,i,p} \times \frac{C_{AB,i,t2|PRJ} - C_{AB,i,t1|PRJ}}{T} \right) \right) \times \frac{44}{12}$$

Where:

| | |
|---|---|
| *ΔCAB,t\|PRJ* | Annual carbon stock change in aboveground biomass of trees in year t (t CO2e/yr) |
| *CAB,i,t\|PRJ* | Mean aboveground biomass carbon stock of trees in stratum i at time t (t C/ha) |
| *At*,I,p* | Cumulative area harvested of parcel p in stratum i at time t* (ha) |
| *sp* | 1, 2, 3, ..., SP sample plots |
| *T* | Number of years between monitoring time t1 and t2 (T = t2 − t1) (years) |
| *t1* | Beginning of the monitoring period or time of harvest event, whichever is later |
| *i* | 1, 2, 3, ..., M strata |
| *t* | 1, 2, 3, ... t* years elapsed since the start of the project activity |
| *p* | 1, 2, 3, ..., P land parcels harvested within the project crediting period |
| *44/12* | Ratio of molecular weights of carbon dioxide and carbon (t CO2e/t C) |

The growth rates, used for each strata in the project area as described above in the growth modelling section, and after deducting for protected species using the species conservation factor were 2.98 t C $ha^{-1}$ $yr^{-1}$ for mosaic-planted, 2.92 t C $ha^{-1}$ $yr^{-1}$ for mosaic-unplanted and 2.03 t C $ha^{-1}$ $yr^{-1}$ for NFM.

Applying these resulting "adjusted" growth rates to the parcels that would have been harvested, under the baseline within this monitoring period, gives the results provided in the table below.

Table 3.4. Annual carbon stock change in aboveground biomass of trees in the project area

| Year | Annual carbon stock change in aboveground biomass of trees in year t, tCO2e) |
|---|---|
| 2022 | 479,872.6 |
| 2023 | 479,872.6 |

Forest disturbance in the project scenario (section 8.2.2 of the methodology)

Forest disturbances in the project scenario result from fire and non-fire forest disturbances, plus any carbon stock changes that occur as a result of illegal logging or natural disturbances.

*Natural Disturbance - Fire*

The net greenhouse gas emissions resulting from fire disturbance are calculated as

$$\Delta C_{DIST-FR,t|PRJ} = \sum_{i-1}^{M} A_{Burn,i,t} * B_{i,t|PRJ} * COMF_i * G_{g,i} . 10^{-3} * GWP_{CH4} \quad \textit{Equation 1}$$

Where:

| | |
|---|---|
| $\Delta C_{DIST\_FR,t\|PRJ}$ | Net greenhouse gas emissions resulting from fire disturbance in year *t*, $tCO_2e$ |
| $A_{burn,i,t}$ | Area burnt for stratum *i* at time *t*, ha |
| $B_{i,t\|PRJ}$ | Average aboveground biomass stock present in the project scenario but absent in the baseline scenario before burning stratum *i*, time *t*; t d. m. $ha^{-1}$ |
| $COMF_i$ | Combustion factor for stratum *i*, dimensionless |
| $G_{g,i}$ | Emission factor for stratum *i* for methane, g $kg^{-1}$ dry matter burnt |
| $GWP_{CH4}$ | Global warming potential for $CH_4$ (IPCC default: 21), $tCO_2e$ $tCH_4^{-1}$; |
| *i* | 1,2,3 …*M* strata |
| *t* | 1,2,3 … *t** years elapsed since the start of the project activity. |

If any area is subject to a fire disturbance, the aboveground biomass stock present in the project scenario but absent in the baseline scenario before burning will be derived from the ACD maps (see Figure 3.13) by applying the following equation:

$$B_{i,t|PRJ} = \sum_{j=1}^{J} \{V_{EX,i,j|BSL} * BCEF_R\} \quad \textit{Equation 2}$$

Where:

| | |
|---|---|
| $_{i,t\|PRJ}$ | Average aboveground biomass stock present in the project scenario but absent in the baseline before burning for stratum *i*, time *t*, t d. m. $ha^{-1}$; |
| $V_{EX,j,i\|BSL}$ | Mean volume of extracted timber per unit area for species *j* in stratum *i,* $m^3.ha^{-1}$ |
| $BCEF_R$ | Biomass conversion and expansion factor applicable to wood removals in the project area, t.d.m $m^{-3}$; |
| i | 1,2,3 …M strata |
| j | 1, 2, 3 …J tree species |
| t | 1,2,3 … t* years elapsed since the start of the project activity. |

As detailed in section 3.1.3 above, the project monitors the presence of any fire within or just outside project area using. NASA FIRMS alerts.[35] Figure 3.13 presents all NASA FIRMS alerts for the monitoring period (2022 - 2023). As can be seen in Figure 3.13, no fires were registered

[35] https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

within the project area or the surroundings during this period. The specific dataset containing all fire alerts for the monitoring period will be provided during the verification.

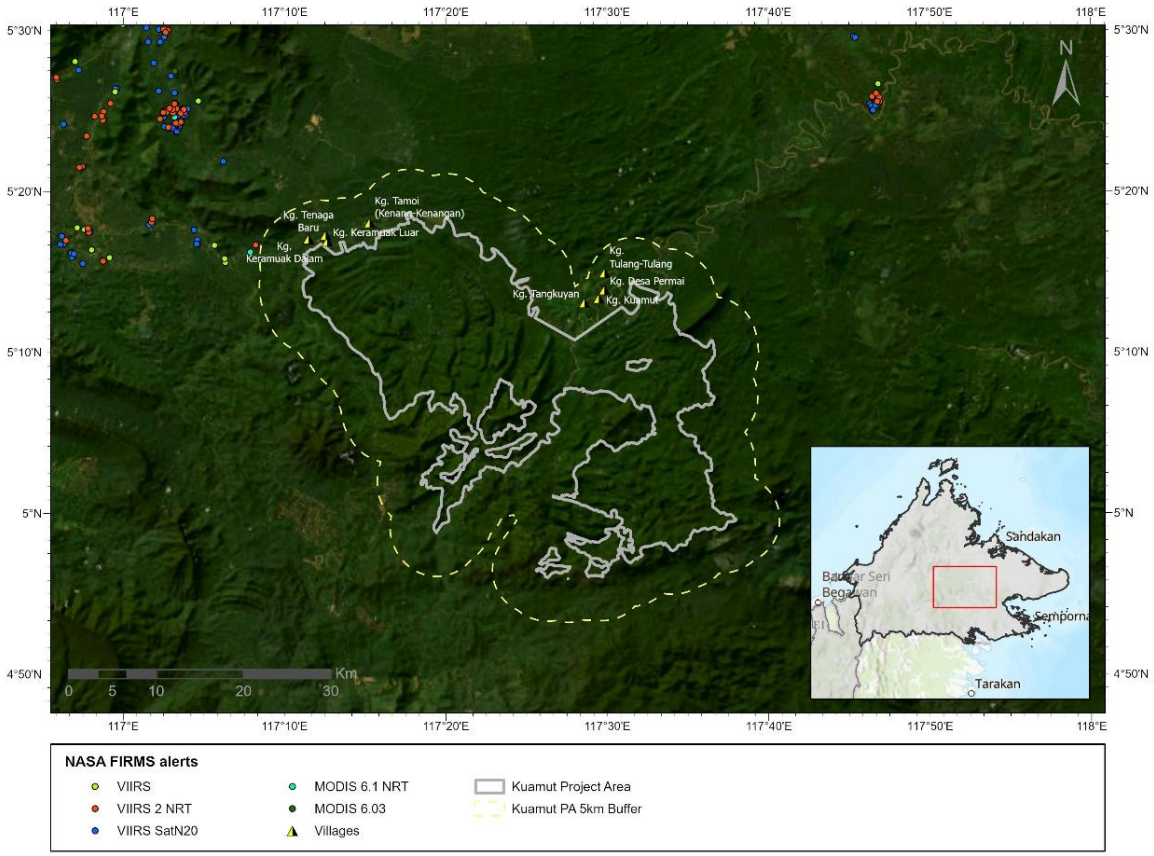



Figure 3.13 Map illustrating all NASA FIRMS (MODIS & VIIRS) fire alerts identified in the Kuamut project area and its surrounding region. Monitoring period investigated (01/01/2022 - 31/12/2023). Data downloaded from NASA-FIRMS.

*Disturbance - Non-Fire natural disturbance and illegal logging*

For non-fire natural disturbance (e.g. windthrow event, hurricane, landslide), it is assumed that a disturbance event in the project scenario would also have occurred in the baseline scenario. Project emissions are therefore equal to the non-fire natural disturbance to biomass absent in the baseline scenario (harvested and removed) but present in the project scenario. The resulting greenhouse gas emissions were calculated as:

$$\Delta C_{DIST,t|PRJ} = \sum_{i-1}^{M}(A_{dist,i,t} * \sum_{j=1}^{J}\{C_{AB,j,i|BSL}\}) * \frac{44}{12} \quad \text{Equation 3}$$

Where:

| | |
|---|---|
| $\Delta C_{DIST,t\|PRJ}$ | Net greenhouse gas emissions resulting from non-fire natural disturbance in year *t*, $tCO_2e$ |
| $A_{dist,i,t}$ | Area disturbed for stratum *i* at time *t*, ha |
| $C_{AB,i\|BSL}$ | Carbon stock in aboveground biomass per unit area in stratum *i*, $tC{\cdot}ha^{-1}$ |
| *44/12* | Ratio of molecular weights of carbon dioxide and carbon, $tCO_2e\ tC^{-1}$ |
| *i* | 1,2,3 …*M* strata |
| *j* | 1, 2, 3 …*J* tree species; and |
| *t* | 1,2,3 … *t** years elapsed since the start of the project activity. |

A single non-fire natural disturbance was identified in the project area during the monitoring period. This forest disturbance was identified during regular monitoring tasks performed with high-resolution optical satellite imagery, and subsequently verified by the field teams. Additional information and evidence on this event have been provided during the verification[36]. Both the patrol team's field visit report[35] and the investigation of the satellite imagery archives confirmed that this area has experienced flooding for several years. However, we observed that sustained rainfall during the 2023 wet season caused the flooded area to expand significantly, so we decided to conservatively include it as a natural disturbance as it exceeded the minimum area (2.5 ha) we established for this type of event. Since the automatic land cover classification analysis classified this event as 'water', it was decided to perform a manual digitization of the total area affected by the flood event (see Figure 3.14).

36

https://permianglobal.sharepoint.com/:f:/s/PermianGlobalActiveConservationProjects2/Elb18sdgOC9Bn2vsrMINa24Bl5sGIeFni8xAs1TFZb8LlA?e=g1IzPs




Figure 3.14 Reference map showing the extent of the natural flood event identified in July 2023. ESRI basemap generated by Maxar imagery acquired on 24/07/2023.

Apart from this event, no other forest disturbance, including both illegal logging or non-fire natural disturbance have occurred in the project area during the current monitoring period.

As detailed in section '3.1.3 Monitoring plan', a Remote Sensing based multi-temporal deforestation analysis was carried out with the objective of mapping the extent of the illegal logging or other deforestation events that have occurred within the project area during the monitoring period.

The annual areas of deforestation due to natural disturbances or illegal logging for the monitoring period are listed in Table 3.5 below.

Table 3.5. Annual deforestation figures resulting from natural disturbances or illegal logging activities within the Kuamut project area.

| Period | Area deforested (ha) | Project area deforested % |
|---|---|---|
| 2021 - 2022 | 0.00 | 0.000 |
| 2022 - 2023 | 3.42 | 0.004 |
| **Total** | **3.42** | **0.004** |

An interactive web-mapping App was developed with the aim of facilitating the exploration of the final results obtained from the multitemporal analysis of deforestation which will be made available

to the verifier. The results obtained from this monitoring period's deforestation assessment have been added to the web-map, thus showing the historical project forest disturbance areas (Kuamut – Forest disturbance Web-App).The monitored areas were combined with the ACD maps to calculate $\Delta C_{DIST,t|\ PRJ}$ as shown in Table 3.6.

Table 3.6. Net greenhouse gas emissions resulting from non-fire disturbance in year t

| Year | Area disturbed at time t (ha) | Net greenhouse gas emissions resulting from non-fire natural disturbance in year t (tCO2e) |
|---|---|---|
| 2022 | 0.0 | 0.0 |
| 2023 | 3.4 | 1,952.8 |

**Net greenhouse gas emissions in the project scenario (section 8.2.3 of the methodology)**

The net greenhouse gas emissions in the project scenario in year t are then calculated as:

$$\Delta C_{NET,t|PRJ} = \left(\Delta C_{DIST-FR,t|PRJ} + \Delta C_{DIST,t,PRJ} + \Delta C_{DIST-IL,t|PRJ}\right) - \Delta C_{AB,t|PRJ} \qquad \textit{Equation 4}$$

and

$$GHG_{Net|PRJ} = \sum_{t=1}^{t*} \Delta C_{Net,t|PRJ} \qquad \textit{Equation 5}$$

Where:

| | |
|---|---|
| $GHG_{NET\|PRJ}$ | Net greenhouse gas emissions in the project scenario since the start of the project activity, $tCO_2e$ |
| $\Delta C_{NET,t\|PRJ}$ | Net greenhouse gas emissions in the project scenario in year *t, not including areas that would not yet have been harvested under the baseline for this monitoring period*, $tCO_2e$; |
| $\Delta C_{DIST\_FR,t\|PRJ}$ | Net greenhouse gas emissions resulting from fire disturbance, assessed over the entire project area, in year *t*, $tCO_2e$ |
| $\Delta C_{DIST,t\|PRJ}$ | Net greenhouse gas emissions resulting from non-fire natural disturbance, included In growth, and therefore *not including areas that would not yet have been harvested under the baseline for this monitoring period*, in year *t*, $tCO_2e$ |
| $\Delta C_{DIST\_IL,t\|PRJ}$ | Net carbon stock changes as a result of illegal logging, assessed over the entire project area, at time *t*, $tCO_2e$ |
| $\Delta C_{AB,t\|PRJ}$ | Annual carbon stock change in aboveground biomass of trees in year *t*, *not including areas that would not yet have been harvested under the baseline for this monitoring period*, $tCO_2e\ yr^{-1}$ |
| *t* | 1,2,3 … *t** years elapsed since the start of the project activity. |

The area used to delineate disturbance due to fire and or illegal logging includes the entire area contained within the project perimeter. Conversely, the area used to account for on-going forest growth (with natural disturbance combined) corresponds to the cumulative area that would have been harvested at time t in the baseline scenario. The net carbon stock change has been converted to net greenhouse gas emissions resulting in Table 3.7.

Table 3.7. Actual greenhouse gas emissions in the project

| Year | Net greenhouse gas emissions resulting from fire disturbance in year t (tCO2e) | Net greenhouse gas emissions resulting from non-fire disturbance and illegal logging (tCO2e) | Annual carbon stock change in aboveground biomass of trees in year t (tCO2e) | Net greenhouse gas emissions in the project scenario in year t*(tCO2e) | Cumulative net greenhouse gas emissions in the project scenario in year t* since the start of the project activity |
|---|---|---|---|---|---|
| 2022 | 0 | 0.0 | -479,872.6 | -479,872.6 | -3,248,888 |
| 2023 | 0 | 1,952.8 | -479,872.6 | -477,919.8 | -3,726,808 |

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### 3.2.3 Leakage Emissions (VCS, 2.5, 3.2, 3.6, 3.15, 4.3)

In accordance with the methodology, leakage from activity shifting and market leakage are considered.

Analysis for leakage due to activity shifting (section 8.3.1 of the methodology)

As detailed in the PD, the project area is owned by Yayasan Sabah and under the baseline scenario would have been managed by its subsidiary, Rakyat Berjaya Sdn. Bhd. Licences to harvest, through annual coupe permits would have been issued by the Sabah Forestry Department and granted to Rakyat Berjaya Sdn Bhd.

The management plans for Yayasan Sabah and Rakyat Berjaya Sdn. Bhd. have not materially changed as a result of the project and neither have the permits issued by the Sabah Forestry Department materially changed. To show this, historical records of harvest volumes were obtained for the project time period. For the PD, historical timber harvest data was collated from the Sabah Forestry Department for each year from 2010 until 2019, for each active concession in Sabah during this time period. We have now updated this to include the data for 2020 and 2021 to directly reflect the monitoring period. The data collected included data on the volume extracted, the area that was harvested, and the logging type (NFM or Salvage logging). This results in multiple records for each forest reserve. Extracted timber volumes, derived from non-plantation concessions across Sabah, were compared over time to determine if there was a statistically significant trend in timber extraction since the commencement of the Kuamut project. In line with (section 8.3.1 of the VM0010 methods), two linear models were fitted to the data;

one for data from 2010 to 2016 (the project start date) and another for data from 2016 to 2021 (Figure 3.13). Neither model demonstrates a statistically significant trend with widely varying confidence intervals of the slope. The slope confidence range spans below and above zero demonstrating that there is no evidence for a trend in timber extraction either prior to or after the commencement of the Kuamut project. Any leakage as a result of the project is therefore not observable at the market-level. The results of this analysis are presented in figure 3.13. The full dataset, used to make this figure 3.13, including details of year and Forest reserve will be made available to the verifier.

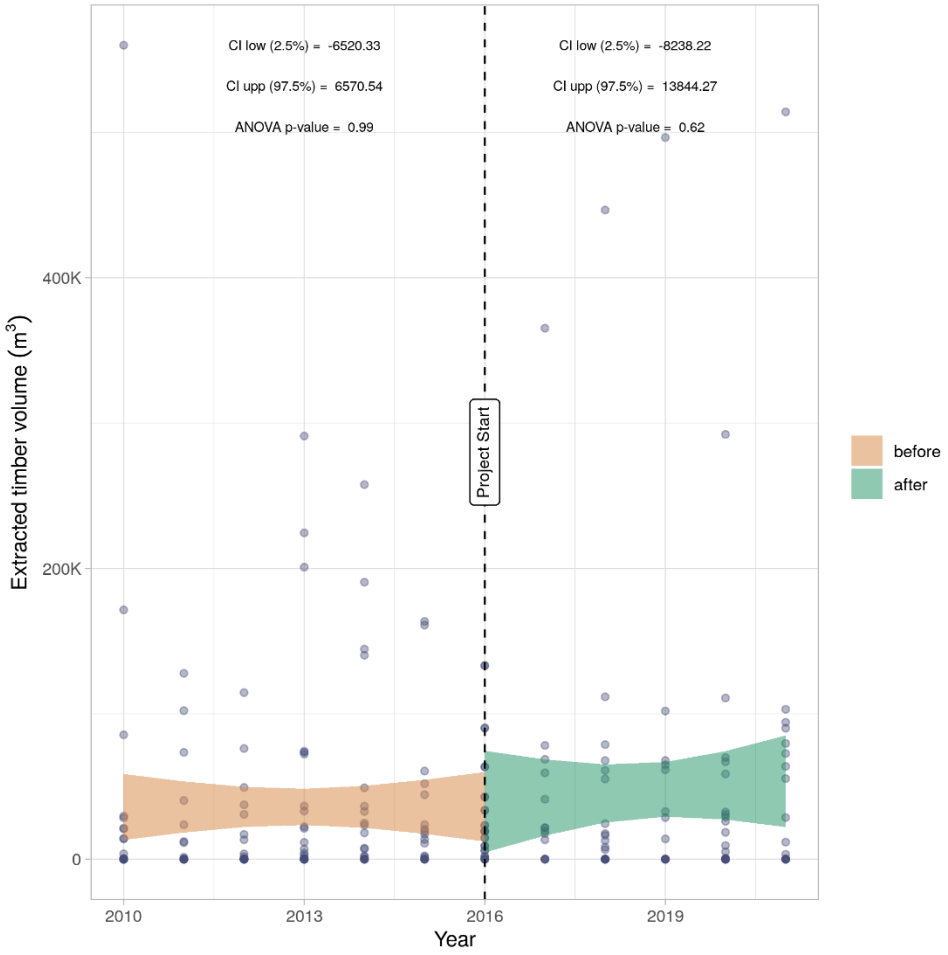



Figure 3.13. Reported extracted timber volume from non-plantation concessions across Sabah between 2010 and 2021. The orange ribbon indicates the 95% confidence interval (CI) for the linear model fit for the period before project start. The green ribbon indicates the 95% CI for the linear model fit for the period after project start.

Analysis for leakage due to market effects (section 8.3.2 of the methodology)

Market leakage theoretically could occur when the project significantly reduces the production of timber causing a change in the supply and market demand equilibrium that results in a shift of

production elsewhere to make up for the lost supply. According to the methodology, market leakage will be estimated as:

$$GHG_{LK|LtPF,t*} = LF_{ME} * GHG_{NET|BSL,t*} \quad \textit{Equation 6}$$

Where:

| | |
|---|---|
| $GHG_{LK\|LtPF,t}*$ | Total market leakage as a result of IFM LtPF activities, in the year t* since the start of the project activity, $tCO_2e$ |
| $LF_{ME}$ | Leakage factor for market-effects calculations; dimensionless |
| $GHG_{NET\|BS,t*L}$ | Net greenhouse gas emissions in the baseline scenario in the year *t** since the start of the project activity, $tCO_2e$ |

The leakage factor that is applied to the baseline emissions is determined by comparing the ratio of merchantable biomass to total biomass in the project area and the forests to which timber harvesting would have been displaced. In the PD, the factor was calculated as shown in Table 3.8 below:

Table 3.8. Calculated deduction factors ($LF_{ME}$).

| Stratum in the project area | Corresponding forest type in the analysed forest estate | % difference between $PMP_i$ and $PML_{FT}$ | $LF_{ME}$ |
|---|---|---|---|
| Stratum 2 | Natural Forest Management | -10.3% | 0.4 |
| Stratum 3 and Stratum 4 | Salvage logging | 35.5% | 0.2 |

Based on the area of the NFM Strata (35241.45 ha), and the Mosaic Strata (44808.52 ha), we estimated an area weighted leakage for the entire project as 0.288.

Market leakage concerns the timber that would have been harvested under the baseline scenario based on the merchantable biomass and total biomass present in the project area under that baseline scenario. As indicated in section 2.2.4 of this monitoring report, the baseline numbers have been updated because of the availability of new more accurate and up-to-date datasets (see Appendix 1 for the updated baseline numbers). However, despite the small change in the PMPi value, and resulting minor change in the estimated ratio of merchantable biomass to total biomass ($PMP_i$) in the project area and the resulting leakage factor ($LF_{ME}$) stayed the same as was calculated in the PD. See Appendix 1 for the full description of the updated input data values

Applying the estimated value of 0.288 to equation 7 and using activity leakage of zero, this leads to the following results for the leakage calculation as shown in Table 3.9.

Table 3.9. Estimated emission as a result of conservatively accounting for leakage.

| Year that logging would occur according to the timber harvesting plan | Leakage due to activity shifting ($tCO_2e$) | Market leakage as a result of IFM LtPF activities in year t* ($tCO_2e$) | Total cumulative leakage in year t* since the start of the project activity |
|---|---|---|---|
| 2022 | 0 | 178,044.6 | 1,015,641.4 |
| 2023 | 0 | 178,044.6 | 1,193,686.0 |

### 3.2.4 GHG Emission Reductions and Carbon Dioxide Removals (VCS, 3.15, 4.1)

| | |
|---|---|
| State the non-permanence risk rating (%) | *12%* |
| Has the non-permanence risk report been attached as either an appendix or a separate document? | ☒ Yes ☐ No |
| For ARR and IFM projects with harvesting, state, in tCO2e, the Long-term Average (LTA). | *N/A, no harvesting* |
| Has the LTA been updated based on monitored data, if applicable? | ☐ Yes ☐ No<br>*If no, provide justification.* |
| State, in tCO2e, the expected total GHG benefit to date. | *6,677,864.6* |
| If a loss occurred (including a loss event or reversal), state the amount of tCO2e lost: | *1,952.8* |

| Vintage period | Baseline emissions ($tCO_2e$) | Project emissions ($tCO_2e$) | Leakage emissions ($tCO_2e$) | Buffer pool allocation ($tCO_2e$) | Reductions VCUs ($tCO_2e$) | Removals VCUs ($tCO_2e$) |
|---|---|---|---|---|---|---|
| *01-Jan-2022 to 31-Dec-2022* | *618,210.3* | *-479,872.6* | *178,044.6* | *131,771* | *365,979* | *422,287* |

| | | | | | | |
|---|---|---|---|---|---|---|
| *01-Jan-2023 to 31-Dec-2023* | *618,210.3* | *-477,919.8* | *178,044.6* | *131,537* | *365,979* | *420,568* |
| *Total* | *1,236,420.6* | *-957,792.4* | *356,089.1* | *263,308* | *731,958* | *842,855* |

***Table Only for highlighting % difference from PD**, after leakage and buffer.*

| Vintage period | Ex-ante estimated reductions/ removals | Achieved reductions/ removals | Percent difference | Explanation for the difference |
|---|---|---|---|---|
| *01-Jan-2022 to 31-Dec-2022* | 638,050.82 * | 788, 266.0 ** | *21.06%* | *Monitored growth rate was higher than estimated for the Ex-ante emissions. This was also because of the use of more accurate data for protected species.* |
| *01-Jan-2023 to 31-Dec-2023* | 638,050.82 * | 786,547.00 ** | *20.85%* | *Monitored growth rate was higher than estimated for the Ex-ante emissions. This was also because of the use of more accurate data for protected species.* |
| *Total* | 1,276,101.64 | 1,574,813 | | |

Note | ***** *"Ex-ante estimated reductions/removals" come from the following pages of the PD: 461,766.88 (project scenario, page 148 of PD); 369,790.54 (baseline, page 140 of PD); 106,499.67 (leakage, page 155 of PD), and assuming a buffer of 12%, gives* ***638,050.82.***

***** *"The Achieved reductions/removals" is the sum of the "Reductions VCUs" and the "Removals VCUs" from the above table.*

## 3.3 Optional Criterion: Climate Change Adaptation Benefits

The Kuamut project was evaluated using the CostingNature Policy support system (Mulligan, 2024), which assessed three vegetation scenarios across three time periods. For this monitoring report's purpose, results were compared relative to the status of forest cover in 2021. Additionally, two other scenarios were analysed, reflecting changes in vegetation cover for the year 2022 and 2023. These scenarios were used to gauge the project's progress and effectiveness in meeting its environmental objectives.

It is important to note that while some variables may not show significant changes between 2022 and 2023, the analysis was conducted for both years to account for potential variations in hydrological functions that could occur due to land cover changes. Despite the possibility of delayed responses in certain variables, this comprehensive analysis allows for a thorough evaluation of the project's impact over time.

The analysis was conducted at two distinct spatial scales: First, a 1-kilometer scale to contextualize the project's hydrological benefits within the broader Sabah district of Malaysia, which continues to face deforestation threats; and second, a more detailed 1-hectare scale analysis at the project level to closely examine the specific changes and improvements that occurred relative to the status of the forest in the year 2021. This multi scale approach allowed for a comprehensive evaluation of the project's impact on the project zone and to target more specific climate adaptation actions within the project area.

The project's outcomes were evaluated in terms of ecosystem services that support climate adaptation. These services included changes in surface water balance, runoff, erosion, sediment transport and their effects on water quality and availability for both human consumption and agricultural development downstream. Additionally, this report considers the role of the project's conservation and recovery efforts in enhancing water availability and regulation for downstream communities and biodiversity through increased fog water interception.

Furthermore, we investigated the impact of forest cover conservation and recovery on water quality in the area and downstream regions. This analysis is essential for preserving aquatic ecosystems and reducing the human water footprint's impact on water quality. Additionally, it helps to identify areas where further climate adaptation actions may be needed, particularly near agricultural activities. By examining these climate adaptation benefits and required actions from multiple angles we gained a comprehensive understanding of the project's environmental contributions and its positive effects on local communities.

The Kuamut Project region is depicted in Figure 3.14 together with its hydrological influence along the Kinabatangan River, which runs through the project area. Figure 3.14 also shows the position of the Kuamut Project area in the Sabah district.

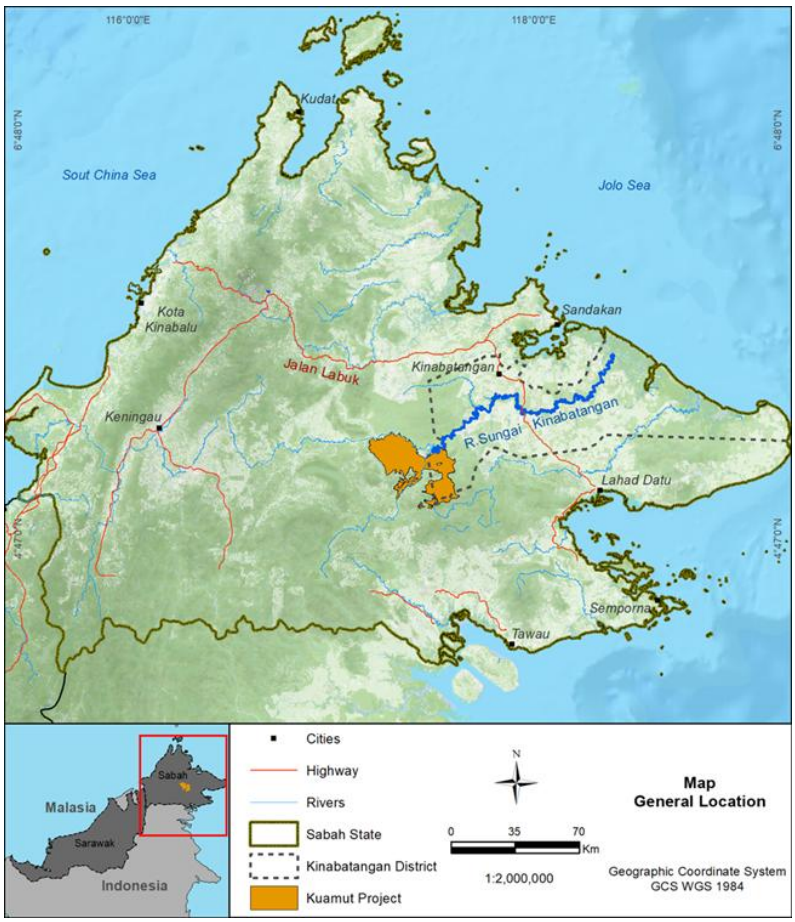



Figure 3.14. Kuamut Project area and location in the Sabah district.

*Hydrological Modelling*

Using the CostingNature Policy support system, the hydrological effects of forest conservation and regrowth at the Kuamut Project Scale were modelled. The spatial eco-hydrological model CostingNature was created to evaluate ecosystem services in scenarios of changing climate and land use. The model can simulate changes in water supply and stress, which could have an impact on potential climate adaptation strategies. Variables are modelled at a spatial resolution of 1 km, 90 m and 30 m. The model creates the area's baseline hydrology and enables the development of scenarios for changing land use and cover, as well as their interaction with ecological factors like biodiversity. It is especially appropriate to comprehend the function of ecosystems in providing climate adaptation benefits for people and biodiversity.

The model was used to depict the annual hydrology for the entire Sabah district at a spatial scale of 1-kilometer and to explore the potential climate adaptation benefits of the Kuamut project relative to the hydrological status of the whole district. Moreover, the model was also run at a 1-hectare scale in the project area to better understand the role of the conservation actions promoted by the project and to guide continued focalized adaptation actions.

The climate data for rainfall and temperature used for model parameterization was the same used as project baseline for the validation report, so no changes in temperature or rainfall are considered. Therefore, the adaptation benefits studied here are explored because of a better and more protected forest, under the assumption that such benefits will help the project area, and its areas of influence, adapt to the changing climate described in the validation report.

*Land Cover Change Scenarios*

Land cover scenarios for the project in the years 2021, 2022 and 2023 were generated by means of remote sensing analysis at a resolution of 30 meters, according to the methods described in section 3.1.3 (Monitoring Plan). Forest, Water, Non-Forest, and No Data were the classes that were considered in the maps and introduced into the CostingNature model. The remote sensing analysis ensured that a very low proportion of cloudy areas contaminated the scenes. In areas where clouds remained, scenes were filled with Global Forest Watch (GFW) data for forest and non-forest categories and for each of the years considered, ensuring compatibility with CostingNature. Section 3.1.3 (Monitoring Plan) shows the change in forest cover calculated for this monitoring report for the years 2022 and 2023.

Figure 3.15 shows the change in forest cover in the Sabah district between 2021 and 2023, highlighting the Kuamut project area. Despite continued forest loss across the Sabah district, the Kuamut project area has maintained and recovered forest cover. Therefore, the regional analysis at a 1-kilometer spatial scale will serve to demonstrate how hydrological functions within the project area are likely more stable than in surrounding regions, and may even improve, enhancing climate change resilience within the project area and downstream. Section 3.3.4.2 shows higher resolution analysis for the project area at 1-hectare spatial scale.
Over the 2-year period from 2021 to 2023, the Sabah district in Malaysia experienced an important decline in forest cover, amounting to approximately 145,000 hectares (GFW, 2024). These losses were observed across the entire district, with a varying degree of intensity in different regions (Figure 3.15d). The most significant declines in forest cover in the district were concentrated towards the northeast, but there have been forest losses throughout (Figure 3.15d). Most importantly, the project has continued to regenerate lowland mixed dipterocarp forest enhancing habitat connectivity. The project area is part of an important ecological corridor with the Danum Valley Conservation Area (Figure 3.16), including different habitats and forest types. Figure 3.16 shows the distribution of Tropical Mountain Cloud Forests of Sabah, according to Mulligan (2011), suggesting that there may be higher elevation forest types south of the project area. In the following sections, we will examine any climate adaptation implications in greater detail.

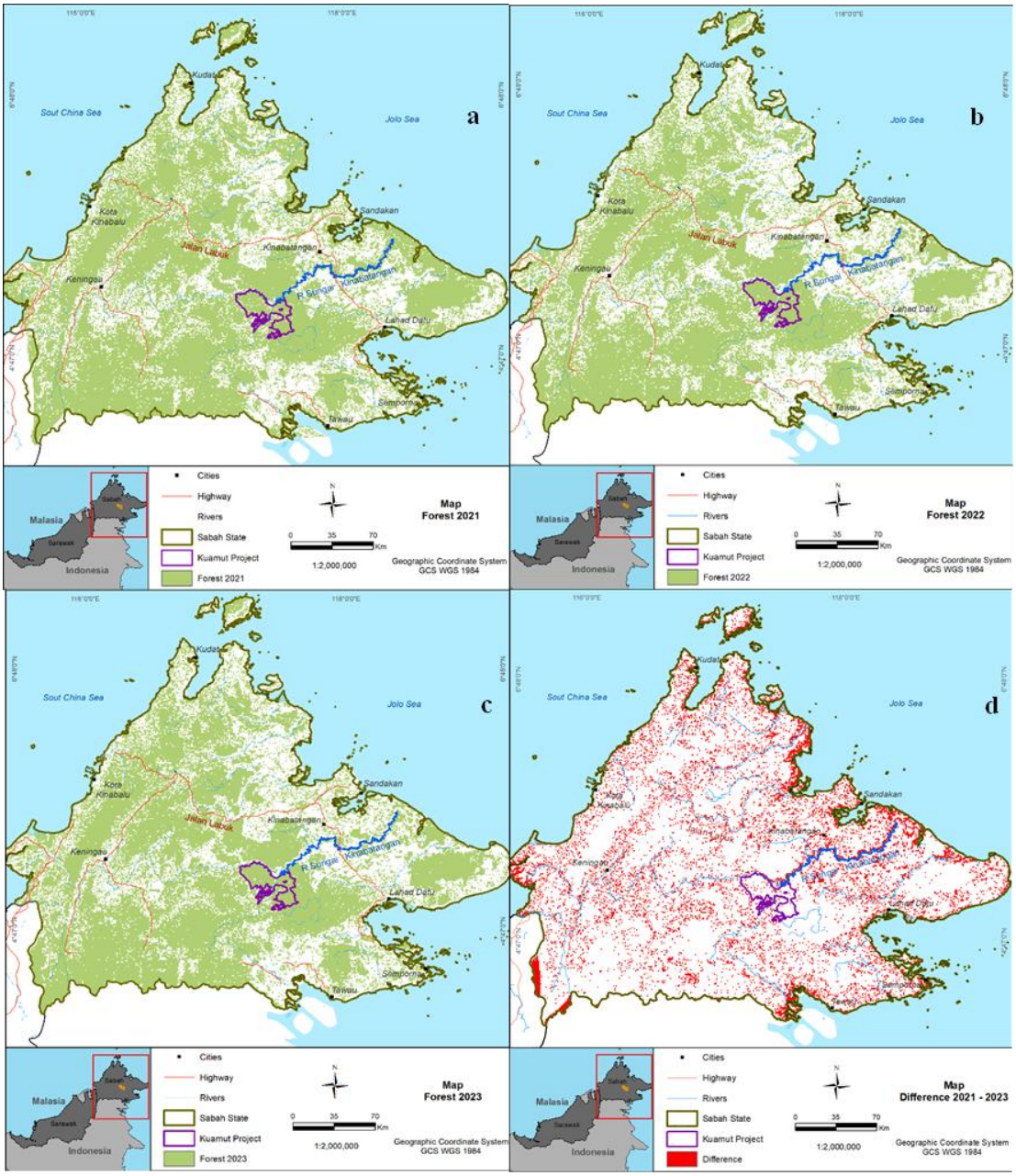



Figure 3.15. Forest cover in the Sabah district of Malaysia at a 1km scale with a detail of the Kuamut project area. a. Forest Map 2021. b. Forest Map 2022. c. Forest Map 2023. d. Difference in forest cover between 2021 and 2023. Forest maps were used in the CostingNature model.

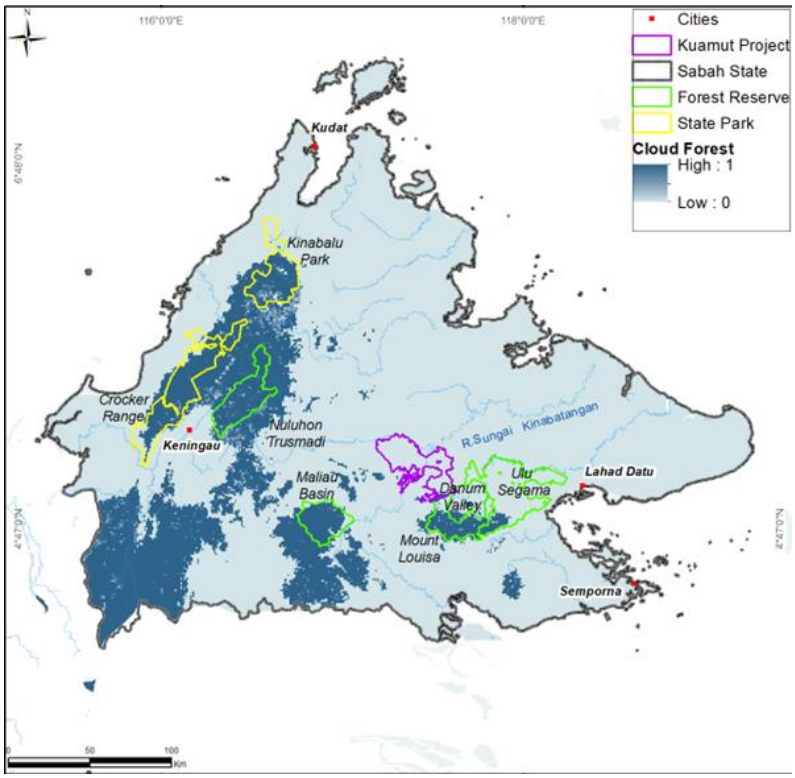



Figure 3.16. Tropical Mountain Cloud Forests of Sabah. Source: Mulligan (2011).

*Soil Erosion and Transport*

Soil erosion was modeled using the CostingNature Policy Support System, which emphasizes hillslope erosion processes such as sheet erosion (Saenz et al., 2014). The project's forest cover data, with a precision of 30-meter resolution, was used to evaluate the percentage of soil covered by vegetation according to the section (3.1.3 Monitoring Plan). The increase in vegetation-covered soil fraction simulates a reduction in soil erosion in the project area by providing better protection against sheet erosion caused by runoff. Additional factors controlling soil erosion such as terrain slope, exposure to winds, surface runoff, and soil types, were considered in the model using its comprehensive database (Mulligan, 2024).

*Human Footprint on Water Quality (HFQW)*

The Human Footprint on Water Quality (HFWQ) is the percent of runoff at any point that falls as rainfall on potentially contaminating land uses upstream. It is calculated as cumulated downstream runoff from polluting (i.e. agriculture) and non-polluting (i.e. natural land) land uses, with the polluted runoff then expressed as the proportion of total runoff (Mulligan, et al., 2020). For application in the Kuamut project, the HFWQ represents the decrease in the percentage of water contaminated by sediments as a result of decreased erosion due to forest recovery in the project area.

*Fog Water Interception*

The analysis assessed the impact of forest conservation and regeneration within the Kuamut project area on fog water interception by the vegetation between 2021 and 2023. Fog water

interception is an important hydrological component in tropical mountain ecosystems, as it involves capturing water from passing clouds that would otherwise bypass surface hydrology (Bruijnzeel, et al. 2011). The CostingNature incorporates fog water interception from the model FIESTAFD component. This model, when implemented at 90-meters spatial scale or higher, yields fog water inputs comparable to other techniques applied in cloud forest sites like fog gauges or eddy-covariance data (Bruijnzeel, et al., 2010). However, the model may overestimate fog water interception where there is limited or no cloud forest or may underestimate fog water interception due to topographical smoothing of rugged terrain in some highly wind exposed cloud forest sites (Bruijnzeel, et al., 2010). Thus, fog water interception could be somewhat underestimated in the analysis, particularly in exposed slopes and ridges of the project area.

*Climate Adaptation Outcomes*

*a. Regional Outcomes*

*- Water Balance (mm/year)*

As indicated in the validation report, and Figure 3.17a, the water balance across the Sabah district ranged from approximately 3,400mm per year in the western regions to considerably lower values in the coastal areas to the northeast. As the current regional analysis centers on surface hydrology, negative values in Figure 3.17a are likely compensated by subsurface flows (Mulligan, 2024). Upon examining the impact of land use change, it is evident that certain areas experienced increases in surface water yield, which can be attributed to a reduction in actual evapotranspiration (AET) due to the loss of forest cover, particularly to the northeast of the district. Nevertheless, it is essential to note that the analysis does not account for the potential changes in soil hydrology due to the loss of trees or the impacts of deforestation on cloud formation and rainfall, which can safely offset any short-term gains due to reduced AET. In subsequent sections, at the scale of the Kuamut project area, we will delve deeper into the complex interplay between deforestation, and hydrological processes, highlighting the importance of strengthening forest protection and recovery to ensure the long-term supply of climate adaptation services.

However, while localized increases in water yield might suggest an improvement in water availability it is essential to consider other factors that may offset these short-term gains. One such factor is the long-term impact of deforestation on soil hydrological functions. The removal of trees and their root systems can lead to diminished infiltration rates and reduced ground water recharge, potentially negating the initial increases in water balance and in fact reducing water yield and regulation services especially in the dry season (Peña-Arancibia, et al., 2019). What's more, the loss of trees in sections subject to cloud immersion (TMCFs) can also reduce water yield as fog water interception is largely diminished (Bruijnzeel, et al., 2010). Moreover, rainfall declines in Borneo since the 1960s have been attributed largely to deforestation due to alterations in moisture recycling and cloud formation (McAlpine, et al., 2018). In addition, deforestation and soil compaction have been linked to the increase in flooding hazards in tropical forest regions due to the intensification of rapid runoffs (Bradshaw, et al., 2007; Peña-Arancibia, et al., 2019). This highlights the importance of considering various factors when assessing hydrological impacts.

Conversely, when examining the differences in water yield between 2021 and 2023 as an average across the Sabah district, changes appear to be mostly neutral, which can be explained

by the interplay between forest losses and gains. The average water yield increase was only around 0.3%, with similar neutral changes within the Kuamut project area. This result can be attributed to forest recovery in the project area's highest parts, generating additional water inputs from fog water interception (see section b. Project Level Outcomes). This finding reveals that the project has contributed to stabilizing the hydrology in the Kuamut region (Figure 3.17b). Despite mostly neutral changes across the Sabah district, the project area maintained a more balanced hydrology due to fog water interception from forest conservation and regeneration. To further examine these impacts and better understand the hydrological impacts of forest protection efforts, a higher resolution (1-hectare scale) analysis was conducted and presented subsequently (see section b. Project Level Outcomes).

Figure 3.17 displays the water balance across the Sabah district in 2021 and the potential changes in percentage between 2021 and 2023. The Kuamut boundary is added to illustrate that the changes in the project area are mostly neutral and that the project is in parts of the district exhibiting more stable hydrology emphasizing its higher climate resilience compared to other areas.

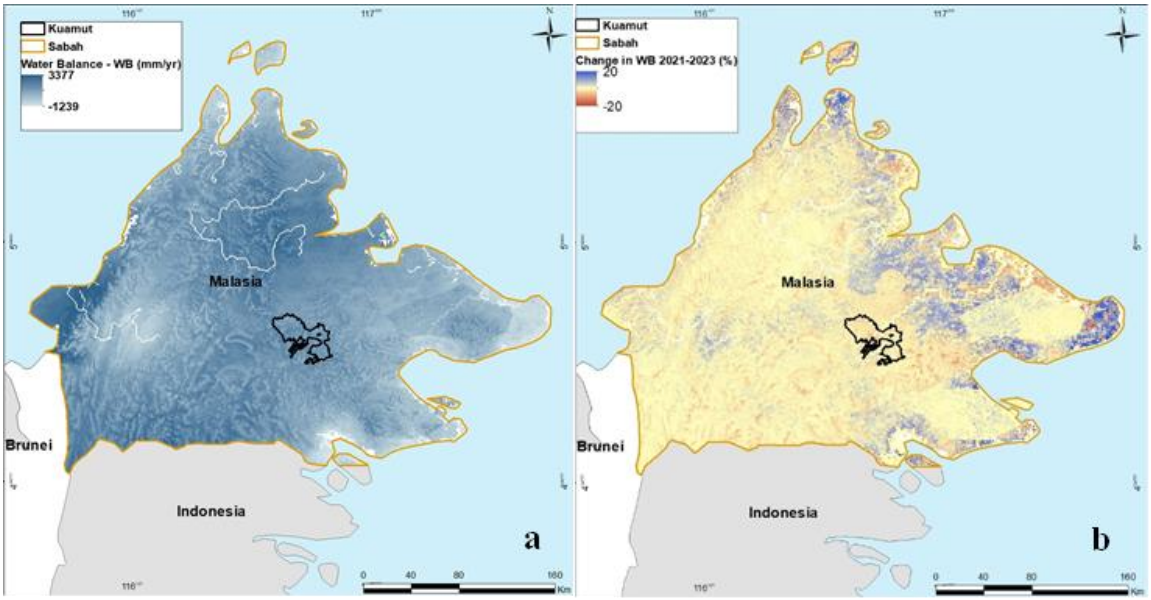



Figure 3.17. Water Balance across the Sabah district (a) and differences in percentage between 2021 and 2023 (b). Areas to the north-east exhibit increases in surface water resulting from deforestation in those areas, potentially increasing flooding risks. The Kuamut project appears located in an area where changes in surface water have been mostly neutral emphasizing its higher climate resilience compared to other parts of the district. As the water balance studied corresponds only to the surface component, the negative values in Figure 4a are likely compensated by subsurface flows (Mulligan, 2024).

- *Runoff (m3/year)*

Due to neutral surface water yield effect, annual surface runoff showed minimal changes downstream across the Sabah district, except for localized increases to the northeast (Figure 3.18b). These localized increases are attributed to reduced AET from deforestation, which may exacerbate flooding events downstream of the Kinabatangan River basin. However, the middle to long term impact could lead to reduced water availability due to decreased infiltration, limited

ground water recharge and disrupted regional cloud formation and rainfall patterns (GWP, 2013). The project area also exhibited neutral changes in this regard.

Figure 3.18a presents runoff across the Sabah district. Figure 3.18b reveals the differences in percentage between 2021 and 2023. Notably, changes in runoff during this period remain largely neutral within the Kuamut project area.

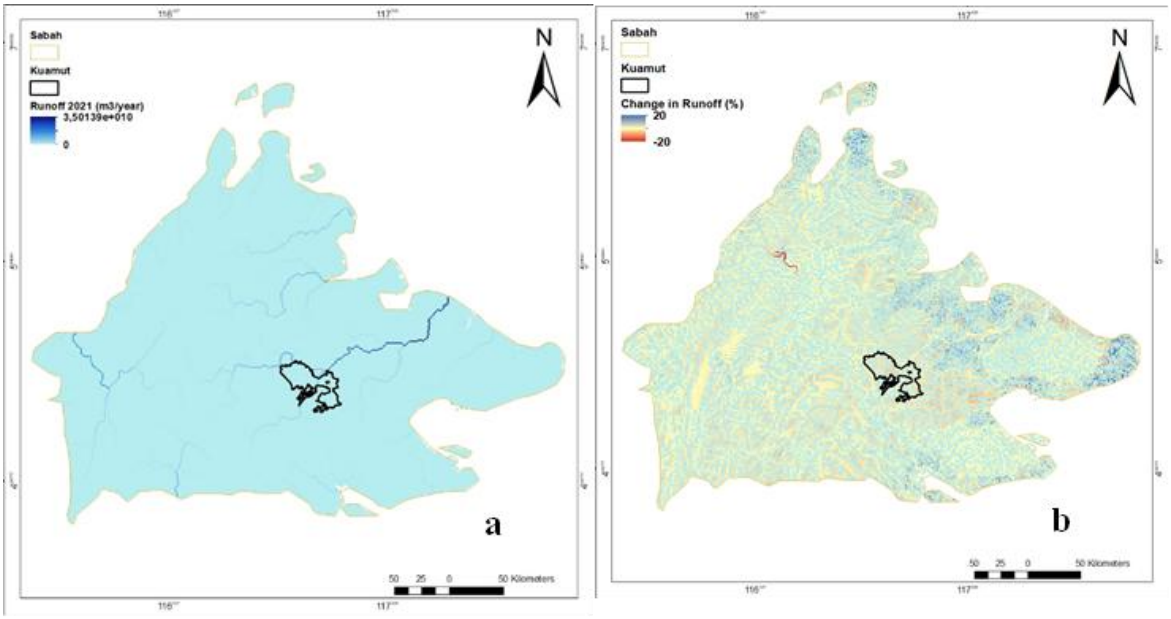



Figure 3.18. Runoff across the Sabah district (a), and differences in percentage between 2021 and 2023 (b). Notably changes in surface runoff during this period remain largely neutral within the Kuamut project area, positioning it among the regions where surface runoff stays relatively stable. These findings suggest positive climate adaptation outcomes for both downstream communities and biodiversity.

- *Water Stress (%)*

The annual water stress indicator reveals that the Sabah district does not suffer from water stress due to sufficient water yield (Figure 3.19). However, maintaining healthy forest cover is essential for mitigating potential water stress during the dry season of exceptionally dry years (Oettli, et al., 2018). Similarly, no water stress is observed within the project area, where forest conservation and recovery contribute to a more stable hydrological regime. Ensuring low water stress levels is crucial to better adapt to the predicted temperature increases resulting from climate change (see validation report).

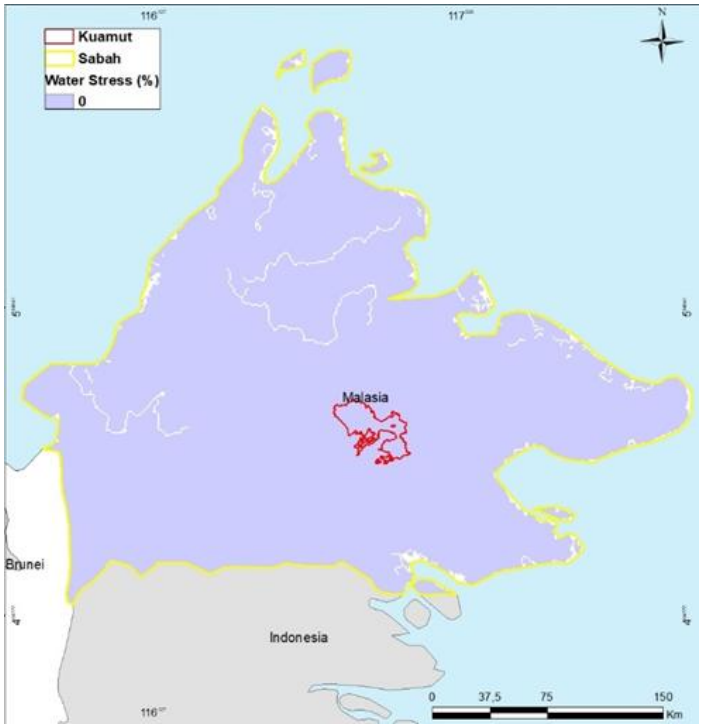



Figure 3.19. Water stress across Sabah. The indicator reveals that the Sabah district does not suffer from water stress, which can be explained by the fact that the surface water yield is plentiful.

*- Soil Erosion (mm/year)*

The analysis conducted at the Sabah District scale and compared to the Kuamut project area, aimed to understand regional erosion dynamics and potential project benefits. Regional trends reveal that the mean annual erosion across Sabah has largely remained constant, with a slight decline potentially attributed to forest recovery in mountainous areas such as in the Kuamut project. Despite localized increases in erosion due to deforestation in flatter terrain to the north and east (see section Land Cover Scenarios above), the average soil erosion rate across the district remained at approximately 2 mm per year or around 24 tons of average soil loss per hectare. Significant variations in erosion rates exist, with higher rates observed in heavily deforested and along rivers, while flatter terrains typically exhibit lower rates. Figure 3.20a shows the distribution of soil erosion across the district using a log10 representation to improve visibility.

Soil erosion within the Kuamut project area decreased by 2.6% between 2021 and 2023 (Figure 3.20b), due to successful forest conservation and recovery efforts particularly in steep terrain. This contrasts with ongoing erosion increases in deforested areas such as the northeast and coastal regions. These results emphasize the importance of forest preservation in wet tropical mountains as deforestation disproportionately escalates soil erosion compared to flatter terrain (Stenfert Kroese, et al., 2020). The Kuamut project is precisely doing that with positive impacts not just within the project area but further downstream along the Kinabatangan River basin. Further higher-resolution analysis at the project area scale will be subsequently presented to

refine the assessment of the avoided erosion benefits of the Kuamut project (see section 3.3.4.2).

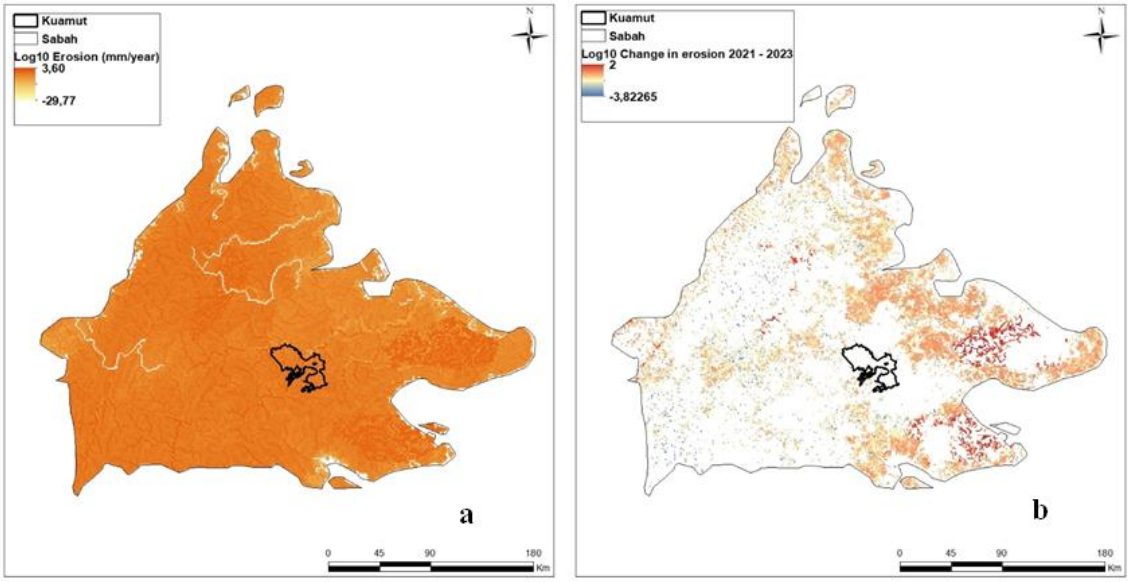



Figure 3.20. Distribution of soil erosion across the Sabah district. a. Log10 representation of the distribution of soil erosion in 2021. b. Change in soil erosion between 2021 and 2023, also using a log10 representation to improve visibility. Areas of higher soil loss coincide with recent deforestation towards the northeast and along the coast. The project area is in a region where soil erosion has remained neutral or declined (undefined numbers in white represent zero changes or declines using a Log10 representation).

*- Human Footprint on Water Quality (HFWQ) Index*

Water quality benefits from forest conservation and regeneration within the Kuamut project area were assessed at the regional scale using the Human Footprint on Water Quality (HFWQ) Index and compared to the overall state of water quality across the Sabah district. While no significant changes occurred within the Sabah district, ongoing deforestation and agricultural activities along the coast have led to increased water contamination in the northeast (Figure 3.21a). Conversely, the Kuamut project area maintained minimal water contamination (Figure 3.3.8a), with largely neutral changes observed between 2021 and 2023 (Figure 3.21b). These results underscore the efficacy of the project's interventions in preserving water quality, despite surrounding areas grappling with increased contamination due to deforestation.

Figure 3.21 shows the distribution of the HFWQ index across the Sabah district. Figure 3.21a presents the HFWQ index for the year 2021 indicating greater values along the coast. The index shows lower values in the most forested regions including the Kuamut project area. Figure 3.21b exhibits the change in HFWQ between 2021 and 2023, revealing increased water contamination to the east of the district, where ongoing deforestation and conventional farming are likely responsible.

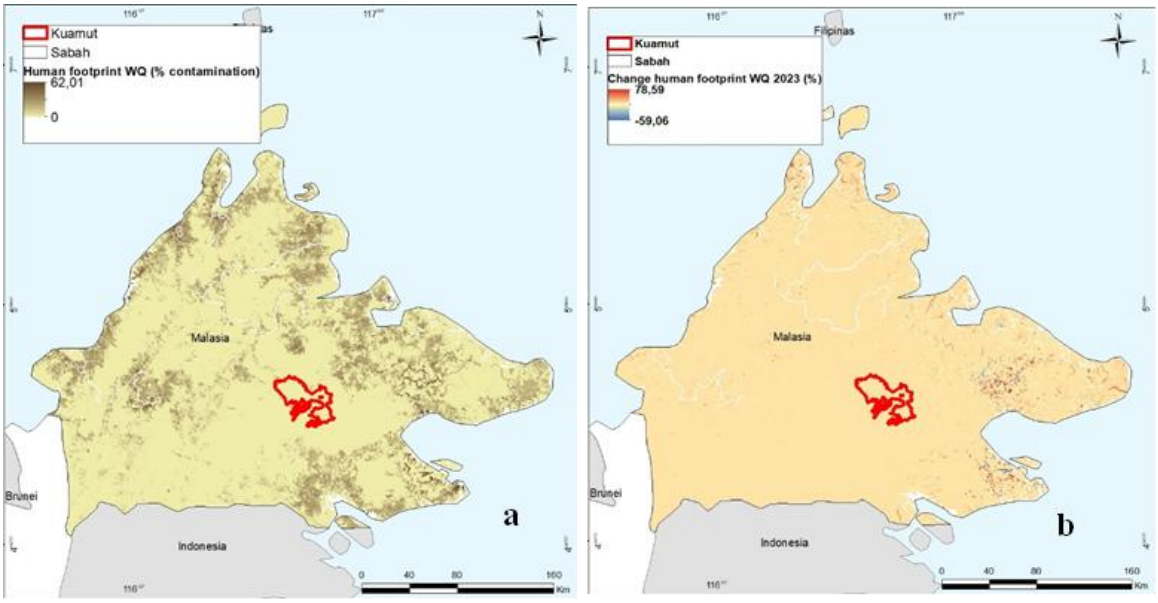



Figure 3.21. Distribution of the HFWQ index across the Sabah district. a. shows the HFWQ index for year 2021 indicating higher values along the coast, whereas it is lower in the most mountainous often forested regions, including the Kuamut project area. b. Change in HFWQ between 2021 and 2023. The map reveals water increased contamination to the east, likely due to ongoing deforestation and conventional farming activities.

*b. Project Level Outcomes*

*- Forest Cover Scenarios*

Scenario analysis examined the impacts of forest cover changes between 2021 and 2023 using data from the section (3.1.3 Monitoring Plan). Findings revealed that the Kuamut Project significantly contributed to forest recovery across 4,300ha, with an increase in both forest cover and biomass (Figure 9d). These improvements likely had positive effects on various ecosystem services and functions within the project area and its surroundings. The increased forest cover contributes to better regulation of water flows and an improvement in water quality through reduced soil erosion and sedimentation of river flows. Additionally, avoiding soil erosion helps maintain soil carbon stocks, preventing their rapid release into the atmosphere or loss through downstream transport (Feng et al., 2021). The following sections will explore these benefits and their implications for climate adaptation in the project area and further downstream. Figure 3.22 shows changes in forest cover between 2021 and 2023 highlighting areas where forest recovery occurred.

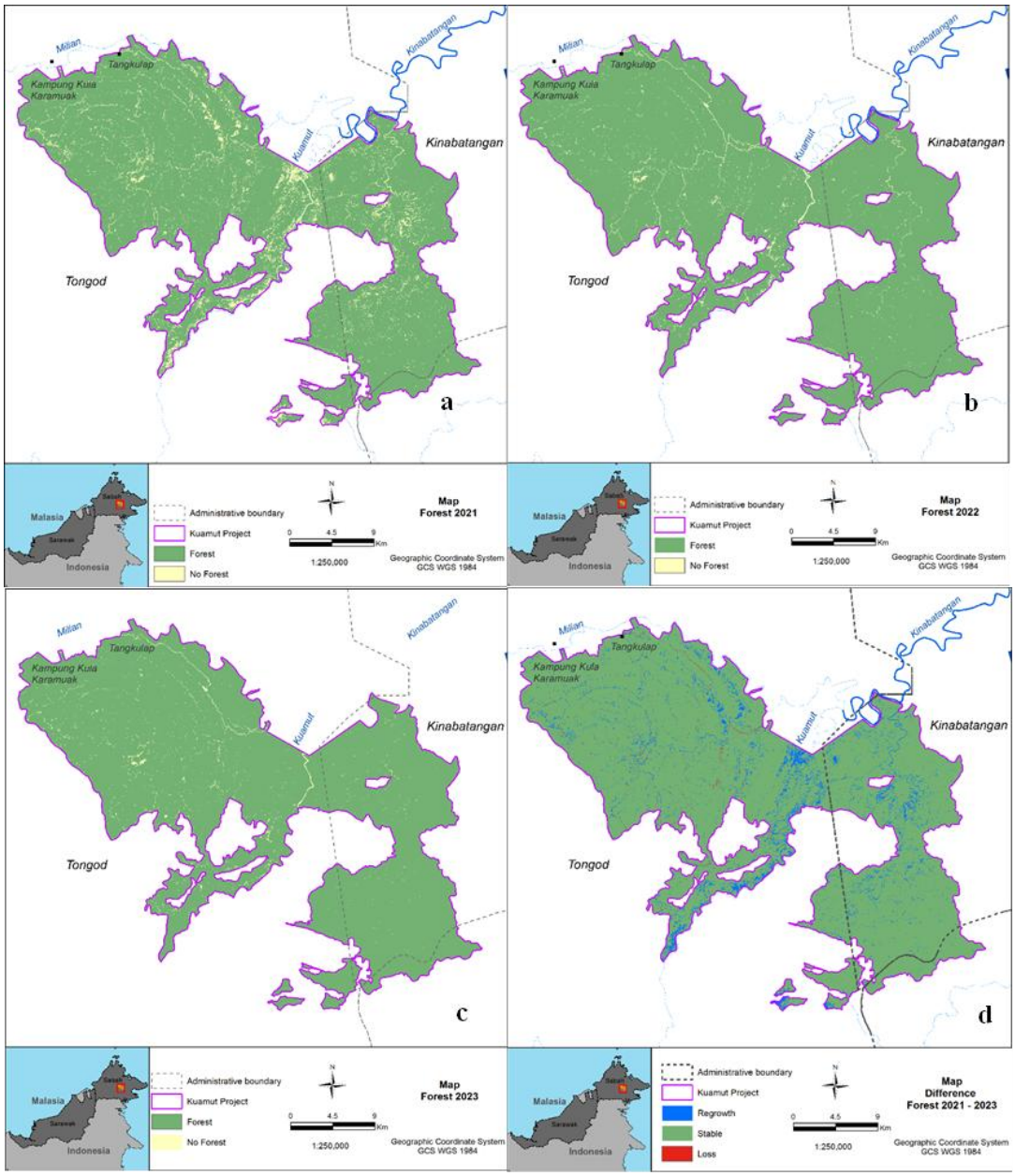



Figure 3.22. Forest cover in the Kuamut Project area at 1-hectare scale. a. Forest Map 2021. b. Forest Map 2022. c. Forest Map 2023. d. Difference in forest cover between 2021 and 2023. Forest maps were used in the CostingNature model to implement the scenario analysis.

- *Water Balance (mm/year)*

By the end of the current monitoring report period, the surface water balance across the project area was found to be plentiful ranging from 1,590 mm/year to 3,041 mm/year, with an average of approximately 2,256 mm/year (Figure 3.23a). Between 2021 and 2023 the 1-hectare analysis confirmed a neutral overall response with slight increases or decreases in water yield across the project area, depending on local factors such as changes in AET and/or fog water interception by the forest vegetation (Figure 3.23b).

In deforested areas the model indicates a general increase in water yield due to reduced AET resulting from the loss of tree cover. However, these changes are likely counterbalanced by declines in fog water interception in deforested areas. Though not modelled here, reductions in infiltration and soil water storage after deforestation are likely to offset any increase in water yield due to reduced AET. Conversely, areas with increased forest cover tend to exhibit higher AET but also higher fog water interception and water storage capacity provided by the vegetation. In fact, these areas reported net surface water gains as subsequently described in the fog interception section. The interplay between these factors contributes to the hydrological resilience of the project area to climatic changes.

While the current model utilizes global data for soils (Mulligan, 2024), incorporating more detailed local data would provide a more comprehensive understanding of the benefits of forest conservation and recovery within the project area, particularly regarding soil hydrology. On a regional scale, future evaluations should examine the impacts of deforestation and forest recovery on rainfall patterns. However, current models such as CostingNatature are not yet capable of addressing these scenarios. Due to lack of regional data, we were not able to account for losses of this component, which have been reported as substantial in Borneo (McAlpine, et al., 2018). As the Kuamut project progresses, continued monitoring and analysis of water availability will be essential to evaluate the effects of land cover changes on water resources. This information will be crucial in developing effective water management strategies to ensure the project's success and its contribution to climate adaptation efforts in Malaysia. Figure 3.23 shows the distribution of surface water across the project area.

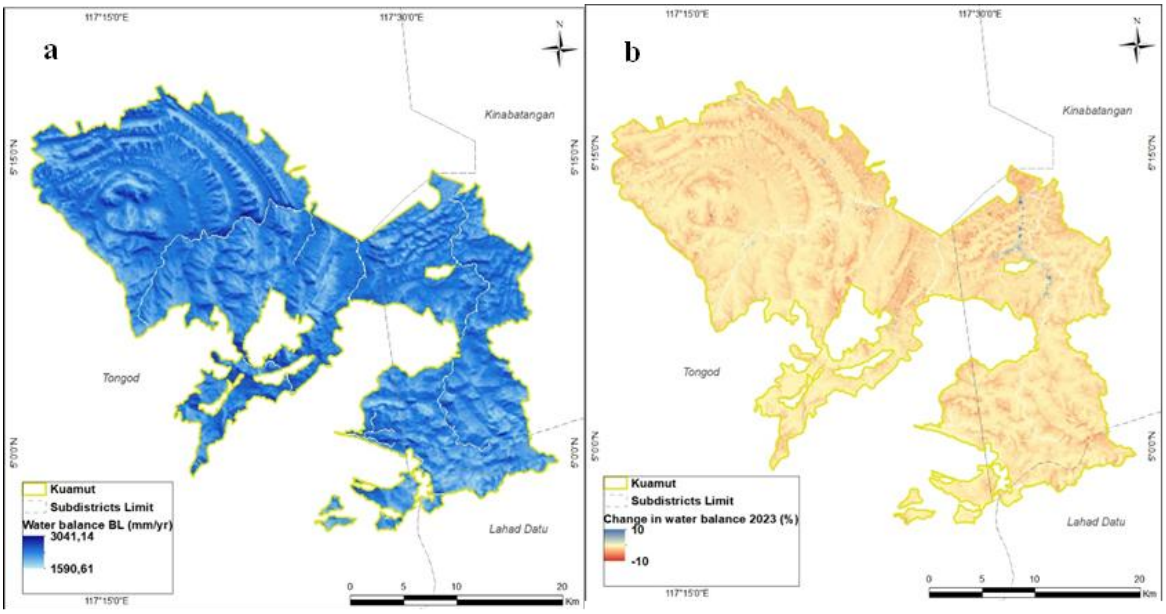



Figure 3.23. Distribution of surface water across the project area. Figure 3.23a shows the surface water yield in 2021; and Figure 3.23b shows the change in surface water yield between 2021 and 2023. The surface water yield is highest in steep areas. Changes are a function of variations in AET, and fog water interception in the most mountainous areas following forest recovery. The overall change is neutral indicating resilience to climatic changes, although the highest parts reported net gains due to increased fog water interception.

*- Fog Water Interception (mm/year)*

Under baseline conditions, it is estimated that vegetation in the project area intercepts water from traveling clouds, accounting for roughly 3% of the surface water availability. This equates to around 56.5 million m3 of additional surface water, equal to approximately 22,400 Olympic swimming pools. In steep areas, this contribution can reach up to 12% of the surface water yield (Figure 3.24a). Higher elevations to the south and southeast of the project area are more likely to experience this phenomenon, particularly around 600 masl or higher (Figure 3.24a). Some of these regions have significant forest cover (Figure 3.3.3 and Figure 3.24a).

According to the model, the project's recovery and conservation efforts have slightly enhanced fog water interception in key areas, particularly higher elevations (Figure 3.24b). Increased forest cover is creating a more effective barrier for capturing water from passing clouds. The model suggests that the targeted efforts have resulted in an additional 2 to 4 mm of water input from fog on average, representing an extra 1.7 to 3.2 million m3 per year across the project area. This equates to approximately 680 to 1260 Olympic swimming pools of additional water. As a result, the project area is seeing increased water inputs, positively impacting local ecosystems and communities. The sustained water availability and regulation within the project area showcase the positive impact of the Kuamut project on forest protection, climate adaptation and water security.

Figure 3.24 shows the distribution of water inputs from fog interception across the project area. Figure 3.24a shows the fog water interception in 2021; and Figure 3.24b shows the change in fog water interception between 2021 and 2023.

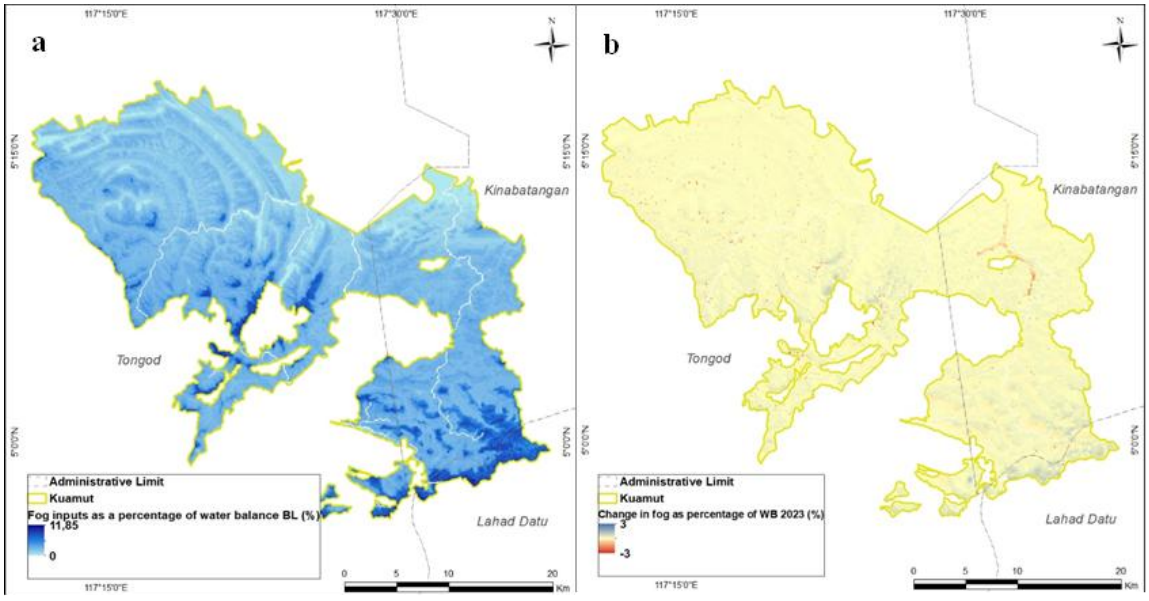



Figure 3.24. Distribution of fog water interception across the project area. Fog water inputs are a more significant proportion of the surface water yield in the highest parts. The overall change in fog water interception between 2021 and 2023 has been a net increase, revealing that this climate adaptation function has been boosted by forest conservation and recovery.

*- Runoff (m3/year)*

The 2021-2023 analysis shows that the Kuamut project's conservation and recovery efforts have helped maintain and likely improve runoff patterns. While surface runoff changes were largely neutral, some areas saw slight increases or decreases due to varying local evapotranspiration rates and enhanced fog water interception (Figure 3.25a, Figure 3.25b). Overall, the project promotes more stable and regular surface runoff patterns by balancing various factors affecting the water cycle. Though not modeled, the project has likely improved water infiltration rates and reduced flooding potential, contributing to a more resilient water supply and ecosystem health within the Kinabatangan River basin, which drains the project area.

The biodiversity-rich Kinabatangan River basin relies on a well-maintained ecological flow to preserve its diverse ecosystems. By promoting forest conservation and natural regeneration, the Kuamut project contributes to the basin's overall stability, which is essential for local flora, fauna, and indigenous communities like the Orang Sungai. The project's efforts in understanding surface runoff dynamics and implementing effective conservation measures are crucial for supporting biodiversity, local communities, and sustainable development in Malaysia. Continued monitoring and analysis of surface runoff patterns will help assess the long-term impacts of these interventions and inform future water management strategies in the region.

Figure 3.25 shows the distribution of surface runoff across the project area. Figure 3.25a shows the surface runoff in 2021; and Figure 3.25b shows the change in surface runoff between 2021 and 2023.

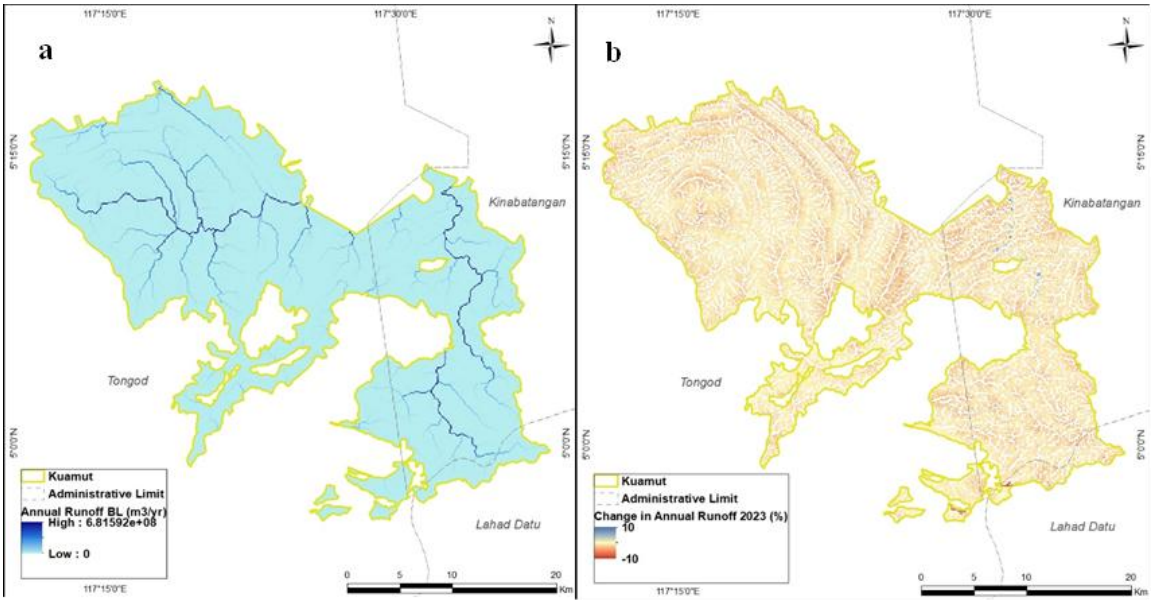



Figure 3.25. Distribution of surface runoff across the project area. Changes in surface runoff are a function of forest recovery or deforestation, with the overall change being neutral between 2021 and 2023, but with steep areas enjoying net increases due to intensification of fog water inputs.

*- Erosion (mm/year)*

The modelling effort indicates an average soil erosion of between 2.01 mm to 3.07 mm per year in the project area, which equates to 24 tons to 37 tons per hectare annually. This value is consistent with findings reported in the literature for logged forests with a combination of timber extraction and the presence of logging infrastructure such as skid trails, where soil erosion can significantly increase compared to natural values (Lefeuvre et al., 2022; Hartanto, et al., 2003; Vijith, et al., 2020). In addition, the analysis helped to identify key areas to focus additional forest regeneration efforts on steep slopes and river streams to mitigate the impact of erosion on local ecosystems and communities (Figure 3.26a).

Between 2021 and 2023 forest conservation and regrowth resulted in a 1.96% decline in soil erosion, reducing between 0.47 to 0.72 tons per hectare annually. Extrapolating this across the project area, the Kuamut project could prevent between 40000 and 60000 tons of soil loss annually, without considering other erosion components such as rain splash erosion and gully erosion that could be significant. This reduction in soil erosion equates to between 14 and 20 Olympic swimming pools per year and can improve water quality for water infrastructure downstream and decrease flooding risks and benefit navigation activities. This positive impact is likely to benefit the aquatic biodiversity of the Kinabatangan River basin and the local communities inhabiting its surrounding including the Orang Sungai, the indigenous people who have lived along the river for generations.

In addition, avoided erosion has led to further reductions in CO2 emissions from soils within the project area. Soil erosion is responsible for the loss of soil carbon, which can be quickly released to the atmosphere or at various time frames when deposited further downstream (Feng et al., 2021). Using an average of 6.30% +/- 1.7 of carbon in soils reported for Tropical Montane Forest of Sabah (Suhaili, et al., 2021), reduced erosion results in an additional avoidance of CO2 emissions between 9085 to 13860 tCO2e per year.

In conclusion, the soil erosion analysis provided valuable insights into the dynamics of erosion within the Kuamut project area, aligning with existing literature on the subject for northern Borneo. The findings demonstrate the positive impact of forest conservation and recovery efforts on mitigating soil erosion and highlight the importance of continued monitoring and evaluation to inform targeted interventions and management strategies that promote climate resilience in the project area and downstream.

Figure 3.26 shows the distribution of soil erosion across the project area. Figure 3.26a shows soil erosion patterns in 2021; and Figure 3.26b shows the change in soil erosion between 2021 and 2023.

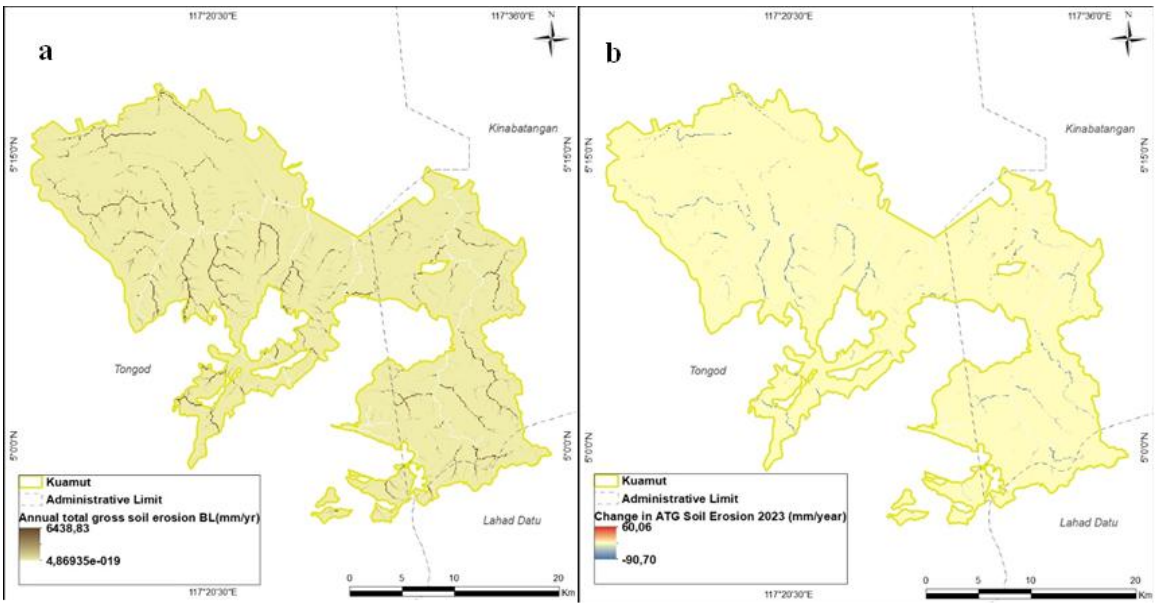



Figure 3.26. Distribution of soil erosion across the project area. Changes in soil erosion are a function of forest recovery or deforestation. The project area exhibits a reduction in soil erosion between 2021 and 2023, highlighting the effectiveness of forest conservation and recovery.

*- Human Footprint on Water Quality (HFWQ) Index*

Baseline analysis revealed minor water quality affectations near the agricultural cluster of Kuamut (i.e. north of Tungka) and along the Kuamut river (Figure 3.3.14a). Conservation and forest recovery efforts from 2021 to 2023 helped reduce the HFWQ index, particularly in steep slopes with recovering forests (Figure 3.27b). This has likely reduced water contamination levels, improving aquatic ecosystems. However, further work is needed to help address contamination near agricultural activities and along major tributaries of the Kinabatangan River.

Modelling results demonstrate that conservation measures and better land management practices have reduced water quality issues in the project area. Continued engagement with local communities in the project zone and promoting sustainable practices in the agricultural sector will continue to be important in addressing water contamination issues. By continuing to address water quality issues, the Kuamut project will contribute to a more climate resilient and sustainable ecosystem in the region. Figure 3.27 shows the distribution of HFWQ across the project area. Figure 3.27a shows HFWQ patterns in 2021; and Figure 3.27b shows the change in HFWQ between 2021 and 2023.

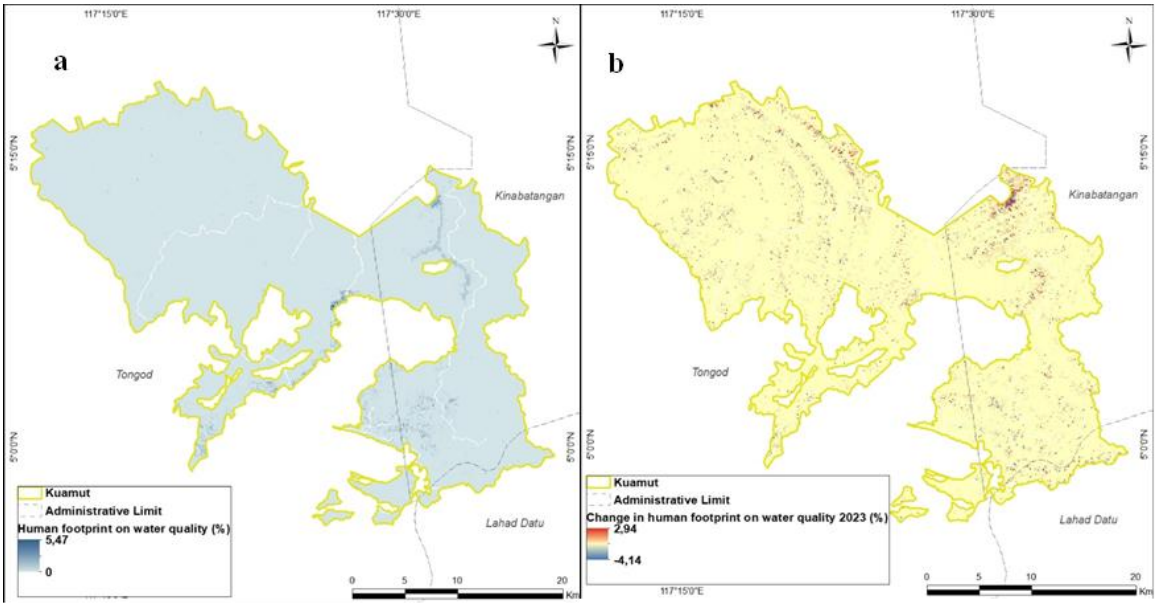



Figure 3.27. Distribution of HFWQ across the project area. a. HFWQ patterns in 2021; and b. Change in HFWQ between 2021 and 2023. Changes in HFWQ are a function of forest recovery or deforestation. Forest conservation and recovery began to reduce some minor affectations on water quality.

### 3.3.1 Activities and/or processes implemented for Adaptation (CCB, GL1.3)

The project-zone communities and biodiversity in the project area are vulnerable to the potential climate change impacts (described in the validation report) because their livelihoods and well-being are dependent on the healthy ecosystem of the surrounding forests in the project area. Although some negative impacts of climate change are inevitable, and beyond the control of the Kuamut Project, we have begun to strengthen community and biodiversity resilience by implementing adaptation options through a variety of project activities.

The project's causal model incorporates activities and component strategies designed to promote resilience, sustainability, and long-term well-being. For this monitoring period key activities include ecosystem protection and forest regeneration, improved public health and sanitation services and participatory planning and capacity building.

Specific strategies taken to enhance adaptation include avoided degradation, avoided deforestation, reforestation, fire prevention, habitat and species protection and reduction of hunting pressures, among others. Participatory planning with local communities is enabled within short- and long-term community planning integrated into formal district and regional level plans, focusing on climate-smart agriculture, alternative livelihoods, environmental education and improved public health. In addition, annual monitoring and assessment of the project's impact on forest ecosystems, water resources, and biodiversity are conducted to inform adaptive management strategies and ensure continuous improvement.

Overall, the project's activities and processes have begun to strengthen the adaptive capacity of both ecosystems and human communities in the face of climate change. By promoting a holistic and integrated approach to adaptation which includes forest conservation, landscape participatory planning and biodiversity protection, the project is enhancing ecosystem resilience, preserving local culture and traditions, and securing a more sustainable future for all stakeholders involved.

Those activities most relevant to climate change adaptation, and the causal relationship between the activity and the adaptation benefit, are summarized below in Table 3.10.

Table 3.10. Causal relationship between project activities and climate adaptation benefits

| Activity | Components | Adaptation Benefits |
|---|---|---|
| Ecosystem protection and forest regeneration | - Avoided Degradation due to logging<br>- Avoided deforestation<br>- Reforestation<br>- Fire prevention<br>- Habitat and species protection<br>- Reduction in hunting pressures | - Forest conservation and recovery have already resulted in important adaptation benefits such as more predictable water yield and reduced soil erosion.<br>- The project is ensuring better water regulation for aquatic ecosystems and human activities downstream, particularly for the Orang Sungai.<br>- The project is helping to improve the water quality downstream resulting in water filtration costs savings and the mitigation of gastrointestinal and vector diseases.<br>- Positive impacts for terrestrial and freshwater biodiversity.<br>- Reduced soil erosion is benefiting navigation services further downstream.<br>- Reduced soil erosion is avoiding additional soil carbon losses increasing the climate mitigation benefits of the project. |
| Improved Public health and sanitation services | - Improved access to clean water and sanitation facilities<br>- Improved access to public health care services | - Reduced soil erosion and sedimentation are helping improve water quality downstream of the project area, along the Kinabatangan River, for human communities and their agricultural activities.<br>- The project is helping to reduce water treatment costs by avoiding silting rivers and water treatment facilities downstream. |

| | | |
|---|---|---|
| Participatory Planning and capacity building | - Short and long terms community planning<br>- Integration within regional level plans | - The project is engaging with communities in the project zone to improve their organizational levels and promote sustainable farming activities, with sound water quality and economic benefits.<br>- The project is ensuring that lessons learned are effectively communicated with regional officials for replication in other project zone areas and beyond |

*Summary of Climate Adaptation Benefits*

The Kuamut Project is now addressing several potential impacts of climate change, as outlined in the validation report. The project has already begun to yield tangible adaptation benefits, such as enhancing water supplies and regulation by conserving and restoring forests in the uppermost areas, particularly those that connect to the iconic Danum Valley. This has resulted in significant climate adaptation and biodiversity conservation benefits. Additionally, the project has contributed to the mitigation of soil erosion, consequently reducing the influx of sediments from the project region into significant rivers like the Kinabatangan. This has had favourable consequences for communities and agricultural activities near the river and inside the crucial Kinabatangan district. Furthermore, project operations have successfully mitigated additional CO2 emissions resulting from soil carbon losses caused by soil erosion. Moreover, water quality issues within the project area have begun to improve because of increased forest cover and better land management.

These benefits suggest the project can reduce water treatment and sanitation costs downstream, leading to economic savings. Socially, the project is enhancing the availability of high-quality drinking water and water for agricultural purposes, positively impacting human health and economic activities. Enhanced water quality and regulation also provide benefits for local terrestrial and aquatic biodiversity. Lastly, by mitigating soil carbon losses and countering natural disturbances, the project contributes to increased climate change resilience in the area, thus limiting further warming.

Therefore, the project serves as a model for sustainable development in the face of climate change. Scaling up these strategies across Sabah and incorporating key elements like stakeholder engagement, particularly with farmers in the project zone, and robust monitoring, can amplify these benefits and contribute to a more sustainable and resilient future for the region. The Kuamut project's experiences and lessons learned provide valuable insights for other parts of Sabah seeking to build climate resilience and promote sustainable livelihoods. Table 3.11 shows a summary of adaptation benefits already provided by the project according to modelling results subsequently presented in the Monitoring of Adaptation Benefits section.

Table 3.11. List of Climate Adaptation Outcomes of the Project corresponding to the period 2022 – 2023

| Type | Description |
|---|---|
| Hydrological Resilience | Improved water availability by boosting fog water interception through conservation and recovery of tropical forests, particularly those that form a corridor with the emblematic forests of the Danum Valley. |
| | Increased water supply through fog water interception by 620 to 1260 Olympic swimming pools annually. |
| Soil Conservation | Soil erosion mitigation, preventing 14 to 20 Olympic swimming pool-sized amounts of sediment yearly. |
| | The mitigation of soil erosion of the project results in an additional avoidance of CO2 emissions of between 9085 to 13860 tCO2e per year. |
| | The mitigation of soil erosion and soil carbon losses could indeed be higher since rain splash erosion and gully erosion have been safely moderated as well, but unfortunately escaped the scope of the CostingNature modelling carried out here. |
| Water Quality | The project has helped to enhance water quality by reducing human impact on water quality indicators such as the Human Footprint on Water Quality (HFWQ). |
| Economic | Positive economic impacts, as the project is safely contributing to the reduction of water sanitation costs and a more reliable water supply for agriculture downstream. |
| Climate Resilience | The project is contributing to climate change adaptation through a more stable hydrological regime and carbon storage maintenance in soils resulting from lower soil erosion. |
| | Greater resilient to climate change, limiting further warming from soil carbon losses and natural disturbances. |
| Biodiversity, Communities | Interconnected environmental, social, and economic co-benefits through better land management. |

# 4 COMMUNITY

## 4.1 Net Positive Community Impacts

### 4.1.1 Community Impacts (CCB, CM2.1)

| | |
|---|---|
| **Community group** | Youth from the Karamuak cluster and Kuamut cluster |
| **Impact** | Increased employment opportunities via project; improved understanding of KRCP's role; increased skills training; improved quality of life; inclusive governance.<br>• Justification of assumptions: Number of people employed by the project (14 new FTE), number of people trained (91), decisions made by the community in the Community Development Plan (CDP). Although the numbers are not disaggregated by age groups, around 40% of the population engaging in the project are young.<br>• Rationale and methodological choices: the impact was measured through records of people employed and employment contracts, reports of training and records of meetings for the development of the CDP as well as the continuous FPIC process.<br>• Participation: Youth participated directly in impact evaluation through FPIC workshops, CDP consultations, and governance structures ensuring community input |
| **Type of benefit/cost/risk** | Actual, direct benefit<br>Additional Income from participating in KRCP activities; Attainment of new skills, Ability to engage and interact, |
| **Change in well-being** | Improved employment prospects and economic stability, leading to better quality of life. |

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| **Community group** | Hunters from the Karamuak cluster and Kuamut cluster |
| **Impact** | No impact caused by the project since hunting cessation predates project start. |

| | |
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| | • Justification of assumptions: This assumption was validated during social baseline assessments and FPIC consultations,<br>• Rationale and methodological choices: Since the establishment of the Class II Forest (timber concession) in the late 60's, hunting activity was forbidden inside the project area and later classified as Class I (protected area) at the start of the project maintaining the prohibition to hunt.<br>• Participation: Hunters from the communities participated during FPIC consultations where these conditions were discussed and agreed upon as well as through the grievance mechanism. |
| Type of benefit/cost/risk | Predicted, indirect, risk |
| Change in well-being | No change in well-being caused by the project to this group. |

| | |
|---|---|
| Community group | Karamuak cluster and Kuamut clusters |
| Impact | Increased job, economic, and training opportunities; access to clean water and health services.<br>• Justification of assumptions: Justified by documented improvements in livelihoods (257 people), jobs created (14 new FTE), training offered (91), and water pipe infrastructure,<br>• Rationale and methodological choices: The impact was measured through records of people employed and employment contracts. The need for water infrastructure was identified by the community members who also participated in the installation of water pipes and reservoirs.<br>• Participation: Community members expressed their needs in FPIC and CDP processes. These impacts were evaluated jointly with the community via workshops and community-led monitoring processes as well as through the grievance mechanism. |
| Type of benefit/cost/risk | Actual, direct benefit<br>Additional Income from participating in KRCP activities; Attainment of new skills, Ability to engage and interact, |

| | |
|---|---|
| Change in well-being | Continued empowerment opportunities through trainings, Improved economic or livelihood opportunities and benefits |

| | |
|---|---|
| Community group | Community groups not directly benefiting from project activities located further away from the 20km radius used to identify the communities participating in the project activities |
| Impact | Greater incomes among project participants could foster unanticipated animosity among other groups or communities.<br>• Justification of assumptions: This predicted risk is informed by stakeholder analysis and lessons from similar projects elsewhere.<br>• Rationale and methodological choices: Success of project activities leads to greater incomes among particular community groups, which may foster animosity among other groups or between communities<br>• Participation: While these communities did not directly participate, grievance mechanisms and communication channels ensure they can provide input and feedback. In addition, continuous FPIC process with all communities in the project zone allows informing about this potential risk. |
| Type of benefit/cost/risk | Predicted, indirect, risk |
| Change in well-being | No change in well-being caused by the project to this group. |

### 4.1.2 Negative Community Impact Mitigation (VCS, 3.19; CCB, CM2.2)

The project incorporates various strategies to mitigate negative impacts on community well-being, focusing on environmental concerns, safety of marginalized groups, and conservation efforts; The Project ensures equitable participation of all interested community members, particularly youth and women and girls in all project activities. Clear communication of limits ensures opportunities and also fosters transparency and fairness. Regular dialogues particularly during the development of the benefit sharing mechanisms period was carried out, ensuring that equitable distribution of benefits and will be able to address grievances promptly.

The Community Monitoring Plan (CMP) is a comprehensive tool that includes multiple indicators to assess potential negative impacts early on. This proactive approach allows for timely detection and mitigation of adverse effects.

The project's grievance mechanism provides a channel for community members to express concerns and seek resolution. This ensures that any negative impacts can be addressed promptly, enhancing community well-being and satisfaction.

Since the Project Area has been designated as a Class I Forest Reserve under the 1968 Forest Enactment it now enjoys the status of Totally Protected Area under state law, meaning that all

unauthorized access is prohibited together with all forms of land clearance or harvesting of natural resources. This lends full legal protection to all HCVs within the Project Area, including those of relevance to local communities such as ancestral settlements.

In this reporting period, in terms of mitigating the negative impact of declining high conservation value (HCV) attributes, the project engaged the local community through the various workshop sessions of Free Prior Inform Consent (FPIC) where description of the project was provided to the local communities of the 8 villages. The Project reiterated these facts during the co-designing of the Community Development Plan with the local communities, to build the*ir* understanding for the protection of the forest and its associated ecosystems by the local community. This is critical in protecting the HCV within the project area as the local community has put a high importance to the development of ecotourism as economic opportunities. This is critical to protect the Project Area from further degradation and allows it to regenerate naturally. This approach aligns with the precautionary principle by prioritizing conservation efforts and compliance with existing laws. The identification of ecotourism as a priority development for KRCP was reached in this monitoring period as identified in the Community Development Plan though no activities were carried out, as this was not ranked as of high importance as compared to access to continuous clean drinking water.

Overall, these actions demonstrate a commitment to mitigating potential negative impacts on community well-being and the environment while promoting sustainable development. By integrating community engagement, compliance with laws, and proactive risk management, the project aligns with the precautionary principle by prioritizing precaution and prevention in its approach.

### 4.1.3 Net Positive Community Well-Being (VCS 3.19; CCB, CM2.3, GL1.4)

The Kuamut Rainforest Conservation Project (KRCP) has demonstrably improved the net well-being of all identified community groups compared to their conditions under the without-project land use scenario. The project has created significant economic, social, and environmental benefits, fostering resilience and sustainability while addressing the challenges that local communities face. These improvements extend across multiple dimensions, including livelihoods, governance, health, education, and climate change adaptation.

Before the project, economic opportunities for local communities were scarce, leading to financial instability and a reliance on unsustainable practices. The KRCP has directly employed 38 full-time workers, including five women, and improved the income and livelihood of 257 individuals, with a significant number of women benefiting from these opportunities. Employment has been created in roles such as boat operators, enumerators, cooks, and construction workers for the gravity-fed water system. Moreover, the establishment of four community committees led by women has provided a structured platform for local decision-making, empowering women and promoting financial stability. These efforts have strengthened household well-being and gender equity within the community.

The project has also improved governance and local participation. Previously, limited community involvement in decision-making processes led to a lack of ownership and

sustainability in development efforts. Since its implementation, KRCP has conducted 22 engagement sessions covering topics such as Free, Prior, and Informed Consent (FPIC), the co-development of the Community Development Plan, and the Benefit Sharing Mechanism. Over 843 individuals, including 293 women, have participated in these sessions, leading to increased community involvement. The formation of village committees has ensured continuous engagement, with representation from all groups, fostering more inclusive governance and effective decision-making.

Health and access to clean water have also significantly improved. Prior to the project, communities faced poor healthcare access and water shortages, particularly during droughts. The KRCP addressed these issues by supporting the local clinic and incorporating community needs into the Community Development Plan. As a result, the project initiated the procurement of an emergency boat for medical evacuations and began the construction of a gravity-fed water system. This initiative engaged 138 local community members, including 24 women, and reached 30% completion by the end of 2023, with full completion expected by December 2024. A similar system in Kg Karamuak Dalam has already provided clean water to 245 individuals, demonstrating the project's positive impact on health and sanitation.

Education and skills development have also seen marked improvement. The project has conducted six training sessions on community organization, leadership, first aid, socio-economic data gathering, biodiversity analysis, and community fieldwork responsibilities. These sessions have benefited 91 local community participants, including 31 women, enhancing their skills and increasing their potential for economic mobility. By providing access to education and training, the KRCP has empowered individuals to pursue better livelihood opportunities and engage more actively in community development.

The project has played a crucial role in strengthening climate change adaptation measures. Historically, local communities have faced challenges related to water scarcity, deforestation, and economic instability, all of which are exacerbated by climate change. The KRCP has addressed these vulnerabilities by implementing a gravity-fed water system, reducing reliance on seasonal rainwater and ensuring consistent access to potable water. Additionally, the project has promoted economic diversification by creating stable jobs and reducing dependency on climate-sensitive livelihoods. The conservation and restoration of Kuamut's forests contribute to surface water regulation and improve water quality, further mitigating climate-related risks.For a detailed analysis of climate change scenarios and causality of interventions to increase resilience to communities and biodiversity, please refer to section 3.3.

Beyond these structural adaptations, the project has strengthened local governance structures to enhance climate resilience. Through community committees and engagement sessions, residents have taken an active role in decision-making, ensuring that adaptation strategies align with local needs. Improved emergency response mechanisms, such as the procurement of an evacuation boat, have increased community preparedness for climate-related emergencies. These measures collectively enhance the community's ability to cope with environmental changes, ensuring long-term sustainability.

Overall, the KRCP has delivered substantial improvements across multiple well-being indicators. Compared to the without-project scenario, where communities faced economic instability, governance weaknesses, poor health and education outcomes, and climate-related vulnerabilities, the project has significantly enhanced economic stability, social inclusion,

health infrastructure, and climate resilience. These benefits, particularly the economic empowerment of women, access to clean water, and strengthened governance, demonstrate that the net well-being impact of the project is unequivocally positive for all identified community groups.

### 4.1.4 Protection of High Conservation Values (CCB, CM2.4)

In this reporting period, the project engaged the local community through the various workshop sessions of co-designing the Community Development Plan, to build the understanding for the protection of the value of the forest and its associated ecosystems by the local community. This is critical in protecting the HCV within the project area as the local community has put a high importance to the development of ecotourism as an economic opportunity. This is critical to protect the Project Area from further degradation and allows it to regenerate naturally. This approach aligns with the precautionary principle by prioritizing conservation efforts and compliance with existing laws.

Since the Project Area has been designated as a Class I Forest Reserve under the 1968 Forest Enactment it now enjoys the status of Totally Protected Area under state law, meaning that all unauthorized access is prohibited together with all forms of land clearance or harvesting of natural resources. This lends full legal protection to all HCVs within the Project Area, including those of relevance to local communities such as ancestral settlements

The project ensures that none of the High Conservation Values (HCVs) related to community well-being in the project zone are negatively affected. Here's how:

- Legal Protection: The Project Area, designated as a Class I Forest Reserve under the 1968 Forest Enactment, enjoys Totally Protected Area status under state law. This legal framework prohibits all unauthorized access and forms of land clearance or harvesting of natural resources, providing full legal protection to all HCVs within the Project Area, including ancestral settlements. This ensures that these HCVs related to community well-being remain safeguarded throughout the project implementation.

- Risk Mitigation Measures: For other community-related HCVs in the Project Zone, the project incorporates safeguards to mitigate potential risks of negative impacts.

## 4.2 Other Stakeholder Impacts

### 4.2.1 Mitigation of Negative Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.2)

To mitigate the negative impacts on the well-being of non-community stakeholders, particularly the Sabah Forestry Department and Yayasan Sabah, the project implements various activities and processes:

- Engagement and Consultation: The project ensures active engagement and consultation with the Sabah Forestry Department and Yayasan Sabah throughout the planning and implementation stages. By involving these stakeholders in decision-making processes, their concerns and interests are considered, fostering a sense of ownership and cooperation.

- Opportunity Cost Mitigation: Recognizing that both entities are foregoing potential future revenues from logging operations and mosaic planting by reclassifying the Kuamut forest reserve as a Class I Protection Forest, the project aims to explore alternative revenue streams. This may involve exploring alternative revenue streams or compensatory mechanisms to offset potential losses incurred by engaging with the project.

- Financial Returns and Reputational Benefits: The project highlights the potential for significant financial returns and reputational benefits for the Sabah Forestry Department and Yayasan Sabah in the event of project success. By contributing to biodiversity conservation and participating in a pioneering model of conservation management, these stakeholders stand to gain both financially and in terms of enhanced reputation. Emphasizing these potential benefits incentivizes continued support and collaboration.

- Capacity Building and Training: The project may offer capacity-building initiatives and training opportunities to enhance the skills and capabilities of staff members from the Sabah Forestry Department and Yayasan Sabah. This not only improves their effectiveness in project implementation but also strengthens their resilience to potential negative impacts by diversifying their skill sets.

- Overall, by actively engaging with non-community stakeholders, mitigating opportunity costs, highlighting potential benefits, offering capacity-building initiatives, and implementing risk management measures, the project aims to minimize negative impacts on the well-being of stakeholders such as the Sabah Forestry Department and Yayasan Sabah. This collaborative approach fosters mutual understanding, cooperation, and shared responsibility for achieving project objectives.

### 4.2.2 Net Impacts on Other Stakeholders (VCS, 3.18, 3.19; CCB, CM3.3)

The project activities have not resulted in net negative impacts on the well-being of other stakeholders, including the Sabah Forestry Department and Yayasan Sabah. Here's why:

Absence of Financial Liabilities: Beyond the opportunity costs described, neither the Sabah Forestry Department nor Yayasan Sabah hold any additional financial liabilities related to the project. This absence of financial burden ensures that their financial well-being remains unaffected by project activities.

Minimal Resource Commitments: Neither entity is expected to commit significant staff or capital resources to the project. This minimizes the impact on their operational capacities and allows them to allocate resources to other priority areas without disruption, preserving their overall well-being.

Frequent Stakeholder Engagement: The project proponents continue to engage frequently with other stakeholders, including the Sabah Forestry Department and Yayasan Sabah. This ongoing dialogue ensures that these stakeholders are comfortable with their roles and responsibilities within the project and allows for any concerns or issues to be addressed promptly.

Mitigation of Opportunity Costs: While both entities are foregoing potential future revenues from logging operations and mosaic planting, the project is fulfilling all legal payments in the form of taxes, levies, and royalties. Their participation not only mitigates any negative financial impacts but also enables them to collect revenues from the project's implementation.

Shared Understanding and Cooperation: Through regular engagement and discussion of planned project implementation, there is a shared understanding among stakeholders regarding the project's objectives and their respective roles. This fosters cooperation and collaboration, contributing to the overall well-being of all parties involved.

## 4.3 Community Impact Monitoring

### 4.3.1 Community Monitoring Plan (CCB, CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

Monitoring of the impacts of project activities comprised of several mutually reinforcing methods conducted over the 2 years of this monitoring report. In the community engagement, all data or output generated from project activities were collected, collated, tracked and presented in reports for all activities. The methods to access included periodic household surveys, community level engagements to assess project's progress and smaller engagements targeting specific community groups. Information gathered during those sessions were presented into regular monitoring reports after each session and concluding into biannual and annual reports which will include outputs of all activities (including potential negative impacts identified via grievance mechanism). The summary and full reports were translated into Malay language and disseminated among project zone communities for validation.

| Stakeholder Consultation | Community Engagement | Data collation |
|---|---|---|
| In this monitoring period, the project carried out extensive consultation to enrich the monitoring process of the project. This includes:<br>1) Northern Kuamut Management Committee (NKMC)<br>2) SK Kuamut Teachers<br>3) Kuamut Rural Clinic<br><br>The NKMC meeting provided oversight of the project and was held on the 29 Sept 2022 and 25 Aug 2023. Both meetings provided | In this monitoring period, the project conducted 22 sessions of meetings, workshops, discussions and training regarding the project. The process allowed for sourcing of insights, nuances of community needs, aspiration and concerns ensuring that the project aligns with local priorities and enhances community wellbeing.<br><br>FPIC Consultation was conducted in 8 villages and 7 agreed to participate in the project. MOU was signed with 7 villages and 7 KRCP Community Committee was set up as community | The project evidence base is constructed from sharing and verbal insights from local community members, experts, documentation of evidence collected of community composition and land use patterns, demographic, income and collected via visits. The documentation includes:<br><br>1. Photographic Evidence |

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| an opportunity for the project to brief members on the progress of the project.<br><br>The Project engaged with the teachers from SK Kuamut, on the 29 Nov 2023 to introduce the KRCP project, learning about the schools' activities and how the KRCP project can contribute to the ambition of the school and vice versa. Issues of lack of economic opportunities and migration by the communities to nearby towns for jobs and education opportunities for their children were highlighted. Areas to collaborate was discussed on co-curriculum, for e.g. sports and cultural documentation.<br><br>The project visited the Rural Health Clinic in Kg Kuamut on the 29 Nov 2023. The session introduced the project and discussed on activities that can be mutually conducted and supported including vaccination, health and dental check up. | representative and focal point for the project to engage on matters related to project implementation that concerns communities. Dates of the FPIC sessions were held on 28 Sept 2022 at 1) Kg Kuamut and Kg Tangkuyan; 2) Kg Desa Permai and Kg Tulang Tulang; on 29 Sept 2022 at 3) Kg Tamoi (It is now known as Kg Kenang Kenangan); 11 October 2022 at 4) Kg Keramuak Luar; 12 Oct 2022 at 5) Kg Kermuak Dalam and on 13 Oct 2022 at Kg Tenaga Baru.<br><br>The Community Development Plan was co-designed with the local communities, with input gathering on the 22 Nov 2022 at the Kuamut Cluster, 23 Nov 2022 with the Karamuak cluster. The priority setting and consolidation of the CDP with the KRCP project was carried out on the 25 January 2023 with both communities.<br><br>The KRCP Benefit Sharing Mechanism and Priority Setting Workshop was held at Karamuak cluster on 23 May 2023 and at the Kuamut cluster community on the 24 May 2023. The session provided an opportunity for the community and the project to align on priorities and it was during those sessions that access to clean water for the Kuamut and Tangkuyan villages were paramount. It was during these sessions too that the project grievances mechanism was agreed on where it was **operated** through **direct complaints** made to field staff or PACOS Trust, recorded in a logbook. For the period of January **2022 to December 2023**, **no formal grievances were reported** by the community. | • Photographs taken during workshops, meetings, and focus group discussions to showcase community participation, including interactions between facilitators, local leaders, and villagers.<br>• Images capturing women's and men's involvement in discussions, decision-making, and capacity-building activities.<br>• Visual records of traditional ceremonies and cultural elements incorporated into the sessions.<br><br>2. Official Letters of Invitation<br>• Formal letters sent to village leaders, community representatives, and KRCP committee members inviting them to participate in key workshops and discussions.<br>• Copies of acknowledgment or acceptance letters from community leaders confirming their attendance.<br><br>3. Digital Communication Records<br>• Screenshots of invitation messages shared in dedicated WhatsApp groups for community engagement. These messages demonstrate proactive communication and outreach efforts, ensuring inclusivity.<br>• WhatsApp group messages showing reminders, agenda details, and responses from community members.<br><br>4. Hard Copy of Workshop Documentation<br>• Printed workshop materials distributed to village heads (Ketua Kampung - KK), the Village Development and Security Committee (JKKK), and Mahkamah Anak Negeri (Native Court).<br>• Copies of meeting minutes, training materials, and workshop attendance lists signed by participants as proof of their involvement. |

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| | The Social Economy Study began in June 2023 and was only completed in June 2024. As part of this study, 29 local community members were engaged as field researchers. They underwent training (21-24 June 2023) on survey methodologies, ethics in research, and questionnaire administration before being deployed to the field for data collection. The survey was done to better understand the community needs, resources and development priorities. Data collection took place between 24 June 2023 and 31 August 2023, during which a total of 383 household heads participated in the survey. The number of respondents across the 7 villages **were 1) Kg. Kenang-Kenangan** – 45 respondents; 2) **Kg. Karamuak Dalam** – 124 respondents; 3) **Kg. Karamuak Luar** – 108 respondents; 4) **Kg. Kuamut** – 35 respondents; 5) **Kg. Tangkuyan** – 54 respondents; 6) **Kg. Tulang-Tulang** – 13 respondents and 7) **Kg. Desa Permai** – 4 respondents.<br><br>*The Social Economy Baseline Findings were presented to the community in August 2024.* | |

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| | The construction of the **gravity-fed water system** which started in **September 2023**, the women folks from Kg Kuamut and Kg Tangkuyan were **directly involved in light construction tasks**, such as **collecting stones and sand**, while **men carried out the primary construction work**. This participation not only **ensured inclusivity** but also **acknowledged traditional gender roles while encouraging shared community responsibility**. Continuous engagement with the local communities via meetings and discussions began on 19 July 2023, 23 Aug 2023 and cumulated on 13 Sept 2023 where the MOA on this construction was signed. Minutes of meetings were kept and a progress updates meeting was held on the 29 Nov 2023, to provide update and progress to the larger community on the progress of work by the AJK Community committee.<br><br>Six training sessions were conducted by the project in this reporting period. The topics involved 1) Leadership as Community Organizers (9 May – 11 Aug 2022), 2) 1st Aid and Rescue was held twice (13-15 Oct 2022 and 26-28 Oct 2023), 3) Biodiversity Data Analysis workshop (14-19 January 2023), 4) Socio Economic Data collection (21-24 June 2023) and 5) Community Field Staff (23-26 Oct 2023). | |

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| | In all engagement with the local communities, information regarding the project, status and updates were shared via slide deck presentation as well as printed materials. All meeting minutes are kept and signed off, when completed and attendance recorded for each meeting held. In terms of providing feedback throughout any community engagement sessions, verbal communication by community groups of men, women and youth were collected, compiled where majority expressed support for the project at the community development plan phase and subsequent meetings. Wherever possible, project activities were carried out with whomever is available, as majority of community members carry out subsistence farming and within the Karamuak cluster, owning small plots of oil palm plantation. | |

Some of the indicators listed in this table, including the monitoring of training programs and employment opportunities, incorporate minor updates to the monitoring framework as described in Section 2.2.4 (Minor Changes to Project Description).

**Monitoring Results and Evaluation**

| Main Indicator | Specific Indicator | Aspects Measured | Results |
|---|---|---|---|
| Positive Impacts associated with the implementation of project activities | Training Program | 1. Number of training programs conducted<br>2. Number of participants trained<br>3. Number of local community members trained<br>4. Type of skills acquired<br>5. Gender distribution | 1. 6 Training sessions<br>2. 137 people trained<br>3. 91 local communities trained<br>4. Training on leadership skills, community organization, first aid application, boat rescue techniques, socio economic research and how to collect the data, biodiversity data collection and analysis<br>5. 37 women participants with 31 of them representing local communities |
| | Employment Opportunities | 6. Number of Full Time Jobs<br>7. Number of Part Time Jobs | 6. 38 people directly employed in the management, implementation and monitoring<br>7. 33 people employed on a part time basis on management, implementation and monitoring |

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| | | 8. Number of Casual Workers<br>9. Number of women employed | 8. 224 people from the local communities were engaged as casual workers<br>9. A total of 81 women were employed with 65 women (4 FTE and 61 casual workers) from the local community members |
| | Infrastructure Improvements | 10. type of Infrastructure<br>11. Number of community members benefiting<br>12. Quality and sustainability of infrastructure | 10. Construction of a Gravity Fed Water System at Kg Kuamut & Kg Tangkuyan<br>11. 30% of construction work completed as end of Dec 2023.<br>12. The building materials used are of high quality, durable and environmentally sustainable designs. It uses the community participation in the building as it is community centered, ensuring relevance and long term utility. |
| Potential negative impacts associated with the project activities | Cessation of Hunting | 13. Incidences of hunting activities recorded<br>14. Community perceptions on hunting restrictions<br>15. Alternatives provided for livelihoods | 13. As described in Biodiversity sections 5.1, and 5.3., hunting pressure is monitored through patrols by RBJ and indirectly through camera trapping activities and biodiversity surveys. Hunting pressure in this part of Sabah is thought to have remained low since the last monitoring period. This is evidenced by the absence of images of hunters on camera trap surveys in 2022 and 2023, and the lack of hunting evidence during routine security patrols by RBJ or during biodiversity surveys by the SEARRP/Permian team (only one suspected incidence of hunting was observed by RBJ). As such, the positive impacts of maintaining low hunting pressure on biodiversity through project activities, are unlikely to have significantly affected communities, as hunting levels were already low during the previous monitoring period.<br><br>.<br><br>14. Community perceptions on hunting restrictions were assessed through household surveys (383 respondents across 7 villages), village-level consultations, and NKMC meetings. The majority of respondents expressed understanding and acceptance of hunting restrictions, recognizing the ecological and long-term economic benefits through opportunities. No grievances or negative feedback on hunting restrictions were recorded during the monitoring period. |

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| | | | .<br>15. Alternatives provided for livelihoods: community members benefited from employment opportunities provided by the project, including 38 full-time jobs, 33 part-time jobs, 224 casual labor positions, and skills training activities involving 91 local participants. These opportunities helped enhance household incomes and reduce reliance on hunting |
| Impacts of changes not directly associated with the project | Government and Administration Changes | 16. Impact on project continuity and support<br>17. Community adaptation to policy changes<br>18. Engagement with new administration | 16. 2 meetings held by the Northern Kuamut Management Committee (29 Sept 2022 and 25 Aug 2023) that included government representatives and civil society members who endorsed project implementation activities during the monitoring period.<br>17. There were no policy changes relevant to the project activities reported during the monitoring period. Nonetheless, the project supported 706 community members (256 women) in governance and decision-making processes, that improved their resilience to potential policy changes.<br>18. The new head of the District of Tongod actively participated in the meetings at the NKMC that endorsed project activities. This is recorded in the meeting minutes. |
| Change in community perceptions | Perceptions on hunting and logging restrictions | 19. Community Understanding and acceptance of restrictions<br>20. Perceived impact on wildlife conservation<br>21. Contribution to sense of belonging and shared community identity | 19. Overall, positive acceptance as seen from FPIC processes and MOA signing on participation, participation in project activities.<br>20. Community recognizing the importance of restriction for conservation as long term gain for their needs for socio economic activities. (See the aspect measured 13 above related to incidence of hunting activities registered)<br>21. Increased sense of belonging and strengthened community identity through collective conservation efforts. This was measured by the number of people participating in project activities. A total of 843 individuals (293 women) participated in all the 22 community sessions. |

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### 4.3.2 Monitoring Plan Dissemination (CCB, CM4.3)

**Public Availability on the Internet**

The results of the community impact monitoring conducted under the Kuamut Rainforest Conservation Project (KRC) have been made publicly available through several means:

1. Progress Reports: Detailed progress reports summarizing activities, challenges, and outcomes have been compiled and are accessible. These reports include:
    - The Progress Report: 1 (2023), covering January to July 2023 (Pacos_progress report 1).
    - The Progress Report: 2 (2023), covering August to December 2023 (Pacos_progress report 2).
2. Online Platforms: The South East Asia Rainforest Research Partnership (SEARRP) website (www.searrp.org) hosts information and updates related to the project, ensuring broader accessibility and transparency.
3. Appendices in Reports: Appendices in the reports provide additional detailed data and power point presentations of community activities, further aiding in public dissemination

**Communication to Communities and Other Stakeholders**

Summaries and detailed results of the monitoring have been communicated to the communities and stakeholders through various methods:

1. Community Workshops: Workshops and meetings have been a primary mode of communication, where findings and plans are presented, discussed, and agreed upon with community members. Key workshops include:
    - FPIC (Free, Prior, and Informed Consent) workshops held in various villages (Bengkel FPIC Kg Tamoi/Kg Kenang Kenangan) (Bengkel FPIC Kg. Kuamut) (Bengkel FPIC Kg. Desa Permai) (Bengkel FPIC Kg. Karamuak Dalam) (Bengkel FPIC Kg. Karamuak Luar) (Bengkel FPIC Kg. Tenaga Baru).
    - Community Development Plan (CDP) workshops that involve detailed discussions and planning with community members (Pacos Progress Report 2) (CDP Workshop Report Kuamut Cluster).

2. Regular Meetings: Meetings with community committees and representatives are held regularly to update and involve them in the decision-making process. Examples include:
    - A meeting on May 23, 2023, for briefing on the benefit-sharing mechanisms (Pacos Progress report 1).
    - Meetings on July 19, 2023, on project implementation agreements (Pacos Progress report 1).
3. Surveys and Interviews: Baseline studies, feasibility surveys, and socio-economic assessments are conducted through direct interaction with community members. Results and feedback from these activities are used to refine and implement project activities, ensuring continuous community involvement and transparency (CDP Workshop Report Kuamut Cluster, Bengkel FPIC Kg. Karamuak).
4. Summary Documents and Memos: Summarized findings and important documents, such as the Memorandum of Understanding (MoU) signed with the communities, are shared and explained during workshops and meetings. This helps in keeping all stakeholders informed and involved in the project's progress (Bengkel FPIC Kg. Desa Permai) (Bengkel FPIC Kg. Karamuak).

These combined efforts ensure that monitoring results are not only available for public scrutiny but also effectively communicated to and understood by the communities and stakeholders involved in the KRC project.

## 4.4 Optional Criterion: Exceptional Community Benefits

The Project is seeking for verification for the Gold level for its exceptional community benefits.

### 4.4.1 Short-term and Long-term Community Benefits (CCB, GL2.2)

**Short-term Benefits**

**Access to Clean Water:**

Feasibility Studies and Implementation: Feasibility studies have been completed for clean water systems in several villages. The study found that the potential water source for Kg Kuamut and Kg Tangkuyan that is Sg Naping, is suitable for drinking water, and work had commenced during this monitoring period to construct the gravity feed water system for these two villages. This will address immediate needs for safe drinking water (Feasibility Report on Clean Water for KRCP). However, the feasibility study also discovered that Sg Karis Karis is not suitable due to its high turbidity content and the project is working with the local communities to identify another source of water for for Kg Tulang Tulang.

Short term employment or job opportunities were opened up for the participation of local communities in Kg Tangkuyan and Kg Kuamut to build the gravity feed water system, bringing local ownership and empowerment for the communities to take charge of what they need and how they can contribute. The Project signed a MOA on 13 Sept 2023 with the KRCP AJK Community Committee for the agreed work to be carried out and work commenced in this reporting period.

**Healthcare Access:**

Courtesy Visits and Needs Assessment: Visits to local health clinics have identified community health needs and laid the groundwork for future health initiatives. Plans for a comprehensive health baseline study are in place to address these needs effectively (Pacos Progress report 2, Courtesy Visit Report Nov2023).

**Educational Support:**

School Engagement: Activities such as donations for school events and initial engagement with local schools have been conducted to support education in the community. A detailed educational baseline is planned to further support long-term educational initiatives (Pacos Progress report 2, Courtesy Visit Report Nov2023).

**Long-term Benefits**

Agro-ecology and Food Security: Training and support for regenerative agriculture and agro-ecology practices will enhance food security and create sustainable livelihoods for smallholders (Pacos Progress Report 2) (CDP Workshop Kuamut Cluster).

**Infrastructure Development:**

Energy Access: Feasibility studies for renewable energy sources, such as solar home systems, have been completed. Electricity Feasibility Report. However, due to the state of Sabah's own expansion plans to connect villages to the grid in the next 5 years, this has now been deemed of a lesser priority to mobilise. Currently, all the villages obtain their electricity through generators, with 6 hours supply in Keramuak cluster and 18 hours in Kuamut cluster.

**Environmental and Cultural Preservation:**

Forest Conservation and Biodiversity: The project's focus on forest conservation and biodiversity aims to protect the natural environment that supports the communities' ambition to see eco-tourism happens as the forest is also providing essential ecosystem services (CDP Workshop Kuamut Cluster) (Bengkel FPIC Kg. Kuamut).

Cultural Heritage Documentation: Efforts to document and preserve traditional knowledge and cultural practices ensure that these valuable aspects of community identity are maintained and passed on to future generations (CDP Workshop_Kuamut Cluster) (Bengkel FPIC Kg. Kuamut).

**Community Empowerment and Governance:**

Capacity Building: Training programs for community organizers and the establishment of community committees enhance local governance and empower community members to take active roles in project planning and implementation (CDP Workshop Kuamut Cluster) (Bengkel FPIC Kg. Kuamut).

Participatory Decision-making: Regular workshops, meetings, and consultations ensure that community members are involved in decision-making processes, leading to more relevant and accepted project outcomes (CDP Workshop Kuamut Cluster) (Bengkel FPIC Kg. Kuamut).

### 4.4.2 Marginalized and/or Vulnerable Community Groups (CCB, GL2.4)

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|---|---|
| Community Group | Women and youth from the Karamuak cluster and the Kuamut Cluster |
| Net positive impacts | Livelihood: Being able to participate in the construction of the dam for gravity feed clean water supply, through collection of rocks and sand; Providing food and catering services for project meetings held within the village.<br><br>Education and Skills: Being able to participate in census collection after being trained on research methodologies, interview skills and for several community members who qualifies, earning a predictable amount of money as staff of the project. |
| Benefit access | Addressing Barriers: Specific workshops and training programs tailored to the needs of women and youth, ensuring they have access to resources and opportunities for economic empowerment.<br><br>Supportive Environment: Establishment of community implementation committees to represent and advocate for the interests of women and youth in project planning and decision-making processes. |
| Negative impacts | Preventive Actions: Ensuring that women and youth are included in all stages of project implementation, with dedicated sessions to address their specific concerns and aspirations, thereby preventing any negative impacts on their well-being. See Report of the FPIC, CDP and BSM discussions (Pacos Progress report 2) (Bengkel FPIC Kg. Kuamut) . |

### 4.4.3 Net Impacts on Women (CCB, GL2.5)

The KRC project has been instrumental in generating net positive impacts on the well-being of women within the community. Here is a detailed explanation of these impacts, along with evidence of women's participation in or influence over decision-making processes.

**Net Positive Impacts on the Well-being of Women**

1.Economic Empowerment

Initiatives: Identify opportunities for alternative income, including the production of turmeric.

Impacts: Interest on community woman to participate in a livelihood's improvement program.

2. Access to Clean Water

Initiatives: Implementation of water gravity systems and groundwater harvesting projects.

Impacts: Improved Water Access: 78 women have experienced increased water quality and improved access to drinking water, reducing the burden of water collection and improving overall health.

**Participation and Influence in Decision Making**

Process: Establishment of the KRC project community committees in all the villages with representation from all community groups, including women. And within that, women leading 4 small community committee groups on socio-economic.

Participation: Women's Representation: Women have been actively included in these committees, ensuring their voices and perspectives are considered in project planning and implementation.

Roles and Responsibilities: Women have taken on leadership roles within these committees, influencing decisions related to community development and project activities, especially in the 4 small community groups on socio economic for the project.

2. Focus Group Discussions (FGDs)

Process: Conducted FGDs to gather detailed input on specific aspects of the project.

Participation: Separate Sessions: Held separate sessions for women to ensure they can speak freely and comfortably about their concerns and suggestions.

Active Engagement: Women participated actively in these discussions, contributing valuable insights that shaped the project's activities and priorities.

3. Workshops and Training Sessions

Process: Organized various workshops and training sessions with specific inclusion strategies for women.

Participation: Women made up a total of one third of the participants in all the training sessions, ensuring they received equal opportunities to develop skills and knowledge. A total of 31 local community women participated in the 6 training sessions altogether.

Feedback and Evaluation: Women provided feedback during and after these sessions, influencing future training programs and project activities.

### 4.4.4 Benefit Sharing Mechanisms (CCB, GL2.6)

Described already in section 2.5.6

### 4.4.5 Governance and Implementation Structures (CCB, GL2.8)

The governance and implementation structures of the Kuamut Project have been designed to promote the full and effective participation of smallholders and community members in decision-making and implementation processes. Here's how this structure facilitates community engagement:

**Two-Level Committee Structure**

Kuamut Management Committee: This committee has oversight responsibilities, ensuring that the project aligns with its overall objectives and that the community's needs and voices are effectively represented. Its role includes endorsing decisions made at lower levels of the governance structure, thereby acting as the final checkpoint before any implementation actions are taken.

Steering Committee: Positioned below the Kuamut Management Committee, the Steering Committee approves the outcomes of discussions from the Technical Working level. This committee ensures that decisions are in line with the project's strategic direction and operational feasibility.

**Local Community Involvement at the Village Level**

Community Engagement: At the village level, the involvement of local community members is coordinated by PACOS Trust, a project partner known for its deep community ties and expertise in community-driven development. This approach ensures that project design and implementation reflect the real-world experiences, challenges, and aspirations of the community members.

Feedback Mechanism: By engaging community members directly in the project design, PACOS Trust collects valuable insights and feedback that are crucial for tailoring the project to meet local needs effectively.

**Project Technical Working Level**

Collaborative Planning and Review: This level serves as a collaborative platform where project partners and implementing partners come together to discuss, deliberate, and agree on the project workplan and timelines. The involvement of these partners ensures a multifaceted perspective on how the project should proceed, considering technical, social, and environmental aspects.

Alignment with Project Design and Development (PDD): Decisions at this level are made based on the established Project Design and Development guidelines, which are crafted to align with community needs and sustainable development principles.

**Escalation and Endorsement Process**

Integration of Community Input: Decisions made at the Technical Working level, which incorporate community input gathered at the village level, are escalated to the Steering Committee and ultimately to the Kuamut Management Committee for endorsement.

Ensuring Relevance and Responsiveness: This structured escalation and endorsement process ensures that all project activities remain relevant to the community's needs and are responsive to the dynamic environmental and social landscapes.

### 4.4.6 Smallholders/Community Members Capacity Development (CCB, GL2.9)

The KRC project has implemented several initiatives to develop the capacity of community members, and relevant local organizations or institutions. This has enabled them to participate effectively and actively in project design, implementation, and management. A total of 6 training sessions were organized by the KRCP Project in this reporting period, empowering a total of 137 individuals of which 37 were female, out of which 91 were local community members including 31 female.

For the community component of the project, Community Organising and leadership skills was the 1st training session conducted from 9 May to 11 August 2022 and participated by 4 community members, of which 2 are female. First Aid and field safety was another training session that was conducted twice in this reporting period. The first session held from 13 – 15 October 2022 was attended by 32 participants of which 3 were female. The second session of first aid training was held from 26 – 28 October 2023 with 25 participants, of which 3 were female.

In terms of biodiversity data management and analysis, the KRCP project organized a training session from 14 – 19 January 2023, benefiting 20 participants of which 5 were female. The KRCP project also organize a training session for local community members to be enumerators to collect socio economic data from the 21- 24 June 2023 and benefitted 47 local community members, of which 19 were female. The KRCP Project recognized the importance of building local community members skillset to support the implementation of the community program and as such conducted training from the 23-26 October 2023 for its community component of field staff.

A total of 16 sessions of workshops, meetings and discussions other than trainings were conducted in this monitoring period involving 509 local community members, of which 180 were women. This includes 1) the Free Prior Informed Consent (FPIC) workshops held in 6 villages engaging a total of 232 individuals, of which 85 were women. Two locations of the FPIC workshops combined two villages i.e. Kg Kuamut with Kg Tangkuyan and Kg Desa Permai with Kg Tulang Tulang, due to the low number of community members in these villages; 2) The Community Development Plan co-designing workshop with 102 local community members participating, of which 50 were women.The CDP workshop was held in each cluster of Kuamut and Karamuak and a final consensus building of the CDP workshop was held on the 25 January 2023; 3) A Benefit Sharing Mechanism briefing session was organized in each cluster, which saw the total participation of 77 local community members, of which 24 were women; 4) The Development of the Gravity Feed Water system in Kg Kuamut and Kg Tangkuyan saw a total of 4 meetings held where a total of 98 local community participated, of which 21 were women. These 4 meetings saw the agreement by the KRCP Project with the representative of the community members through the KRCP AJK Community Committee on the costings, delivery and workforce by the local community members. The construction of the gravity feed water system was managed by the local community themselves and a reporting back meeting on the progress of the gravity feed water system was held on 29 Nov 2023.

A summary of the KRCP Project activities with the local community is as below:

| No | Activities | Date | Male | Female | Total |
|---|---|---|---|---|---|
| 1 | **Training** – Community Organizing and Leadership training | 9 May – 11 August 2022 | 2 | 2 | 4 |
| 2 | FPIC Workshop on KRCP at Kg Kuamut and Kg Tangkuyan | 28 Sept 2022 | 36 | 34 | 70 |
| 3 | FPIC Workshop on KRCP for Kg Desa Permai and Kg Tulang Tulang | 28 Sept 2022 | 9 | 5 | 14 |
| 4 | FPIC Workshop on KRCP for Kg Tamoi (It is now known as Kg Kenang Kenangan) | 29 Sept 2022 | 22 | 8 | 30 |
| 5 | FPIC Workshop on KRCP for Kg Keramuak Luar | 11 Oct 2022 | 30 | 18 | 48 |
| 6 | FPIC Workshop on KRCP for Kg Kermuak Dalam | 12 Oct 2022 | 17 | 13 | 30 |
| 7 | FPIC Workshop on KRCP for Kg Tenaga Baru | 13 Oct 2022 | 33 | 7 | 40 |
| 8 | **Training** – 1st Aid | 13-15 Oct 2022 | 29 | 3 | 32 |
| 9 | CDP Workshop for KRCP for Kuamut Cluster | 22 Nov 2022 | 17 | 20 | 37 |
| 10 | CDP Workshop for KCRP for Karamuak cluster | 23 Nov 2022 | 9 | 10 | 19 |
| 11 | Training - Biodiversity Data and Analysis | 14 – 19 Jan 2023 | 15 | 5 | 20 |
| 12 | CDP Presentation Workshop for KRCP Overall with Kuamut and Karamuak cluster | 25 Jan 2023 | 26 | 20 | 46 |
| 13 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Karamuak cluster | 23 May 2023 | 20 | 12 | 32 |
| 14 | KRCP Benefit Sharing Mechanism and Priority Setting Workshop at Kuamut Cluster | 24 May 2023 | 33 | 12 | 45 |
| 15 | **Training** – Socio Economic Data collection | 21 – 24 June 2023 | 28 | 19 | 47 |
| 16 | Meeting with Local Community from Kg Kuamut and Kg Tangkuyan on gravity feed water system installation | 19 July 2023 | 15 | 5 | 20 |
| 17 | Meeting with KRCP Community for Gravity Feed Water System at Kg Kuamut and Kg Tangkuyan | 23 Aug 2023 | 17 | 7 | 24 |

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|---|---|---|---|---|---|
| 18 | Meeting and MOA signing for installation of gravity feed water system for Kg Kuamut and Kg Tangkuyan with KRCP AJK Community Committee | 13 Sept 2023 | 21 | 1 | 22 |
| 19 | **Training** – Community Field Staff | 23 – 26 Oct 2023 | 4 | 5 | 9 |
| 20 | **Training** – 1st Aid | 26 – 28 Oct 2023 | 22 | 3 | 25 |
| 21 | Progress Meeting with local communities of Kuamut Cluster on Gravity Feed Water System | 29 Nov 2023 | 24 | 8 | 32 |
| 22 | Kuamut Rainforest Conservation Solidarity Sports event | 15 – 17 Dec 2023 | 121 | 76 | 197 |
| | TOTAL | | 550 | 293 | 843 |

# 5 BIODIVERSITY

## 5.1 Net Positive Biodiversity Impacts

### 5.1.1 Biodiversity Changes (VCS, 3.19; CCB, B2.1)

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| Change in Biodiversity | **Gradual dispersal of Rare, Threatened or Endangered (RTE) species throughout the Project Area.** Note that we define RTE species as those listed as either (1) threatened under IUCN Red List Criteria, which include the status' of Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) on the IUCN Red List (https://www.iucnredlist.org), (2) species listed on CITES Appendix I and II (https://cites.org/eng), (3) species that are endemic to Borneo, as well as (4) species that are listed as Schedule 1 (totally protected) on the State of Sabah Wildlife Conservation Enactment 1997 (https://sagc.sabah.gov.my). Certain RTE species are also referred to as 'trigger' species, and their presence qualifies the site as a Key Biodiversity Area (KBA). For example, this includes the presence of at least a single individual listed as Critically Endangered (CR) or Endangered (EN), or the presence of at least 30 individuals or 10 pairs of a species listed as Vulnerable (VU). In addition, 'RTE species' are also referred to as 'HCV 1' (High Conservation Value Class 1) species. |

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| | For this estimated change in biodiversity described in the PDD, we have identified two monitored changes:<br>1. **Bornean Orangutan (*Pongo pygmaeus, CR*) population change** – Monitoring orangutan population trends over time helps assess whether individuals are dispersing into the Project Area (i.e., from the surroundings) and establishing in new areas of the reserve.<br>2. **Continued presence of other RTE species** – The consistent detection of RTE species across different parts of the Project Area suggests their movement and sustained presence. If camera trapping rates (CTR) or encounter incidences increase over time then this reflects this may indicate population growth, range expansion through dispersal, or increased use of regenerating habitat.<br>Full dispersal and population expansion (i.e., reaching carrying capacity) into the Project Area as it regenerates is likely to take a much longer time scale than the current monitoring period, and so we do not explicitly examine this. Instead, we have collected data that will act as a proxy for dispersal and will form the baseline for future monitoring. Over time, these monitored indicators will provide evidence of species using and expanding within the habitat, supporting the assumption that the project is facilitating gradual dispersal of RTE species. |
| Monitored Change | <u>Bornean Orangutan (*Pongo pygmaeus;* key trigger species) population change:</u><br>Based on the results of empirical aerial nest surveys of the Bornean Orangutan population within the Kuamut Project Area in November 2023, we estimate that there were approximately 868 (95% CIs = 468-1610) individuals within the Project Area during the survey period. This corresponds to an average population density of 1.04 individuals per km² (95% CIs = 0.56-193). These values were estimated using the same calculations as Simon *et al*. (2019) so that we could qualitatively compare our results to those presented in the last monitoring report. See '**Final_ overview report _Kuamut_OU_2024_Oram.pdf**' report led by Dr Felicity Oram in the '**Presence of HCV 1 species**' supporting evidence files for detailed methods and results of the aerial orangutan nest surveys in 2023.<br>During 2014-2017, Simon *et al*. (2019) estimated that the population of orangutans within Northern Kuamut (West), Kuamut (West) and Northern Kuamut (East) was estimated at 193 (95% CIs = 128-292), 20 (95% CIs = 13-31) and 417 (95% CIs = 281-619) individuals, respectively, corresponding to densities of 0.38 (95% CIs = 281-619), 0.28 (95% CIs = 281- |

619) and 1.08 (95% CIs = 281-619) individuals per km², respectively. These three areas covered 96,310 ha in total and roughly corresponded to the size of Project Area (83,381 ha). Hence, during the time of surveying, it was estimated that there were approximately 630 individuals (summed 95% CIs = 422-942) within the Project Area (Simon *et al*., 2019), and this was the value cited in the last monitoring report. Therefore, the 2023 results suggest that there is a substantial and important population of orangutan within the Project Area, which has remained stable since the previous monitoring period.

Continued presence of other RTE species:

As part of the project monitoring activities, camera traps and bioacoustic recording devices were deployed at a number of different locations within the Project Area during 2022 and 2023 to monitor RTE species. See **section 5.3**, and supporting evidence in the '**Presence of HCV 1 species**' folders for detailed methods and results of the camera trap and bioacoustic monitoring. From the camera trap monitoring during 2022 and 2023, 36 RTE species were detected in total (comprising 11 birds, 23 mammals and 2 reptiles), including two listed as CR (Bornean Orangutan: *Pongo pygmaeus* and Sunda Pangolin: *Manis javanica*) and six listed as EN (Asian Elephant: *Elephas maximus*, Banteng: *Bos javanicus*, Borneo Bay Cat: *Catopuma badia*, Long-tailed Macaque: *Macaca fascicularis*, Otter Civet: *Cynogale bennettii* and Southern Pig-tailed Macaque: *Macaca nemestrina*). The bioacoustic monitoring is still in progress, as we are currently validating and developing classifier models for the automatic detection of RTE species of interest. From this monitoring, we aim to detect and track population changes of RTE species such as Helmeted Hornbill (*Rhinoplax vigil*, CR) and Wrinkled Hornbill (*Rhabdotorrhinus corrugatus*, EN).

Our monitoring results provide evidence that there is a diverse community of bird and mammal species within the Kuamut Project Area and that populations of RTE species have continued to remain present since the last monitoring period as their habitat has been protected. For example, species such as the Sun Bear (*Helarctos malayanus*, VU), Sunda Clouded Leopard (*Neofelis diardi*, VU), Sunda Pangolin (*Manis javanica*, CR), Great Argus (*Argusianus argus*, VU), Bearded Pig (*Sus barbatus*, VU) and the Southern Pig-tailed Macaque (*Macaca nemestrina*, EN) were detected by camera trapping conducted within the Project Area in 2015/2016 (see research papers by Mohamed *et al*., 2021; Tilker *et al*., 2019), and have since been detected in our camera trap monitoring during 2022 and/or 2023 at more than one location (see '**Kuamut Project MR2 - Camera Trapping**

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| | **Report.docx**' report in the '**Presence of HCV 1 species: Camera trapping 2022 and 2023**' supporting evidence folders ). Also see '**Records and status update of RTE species during 2nd MR period KRCP 20240805.xls'** file in the **'Presence of HCV 1 species'** folder for a detailed status update on each of the RTE species found within the Project Area during the 2022-2023 monitoring period. |
| Justification of Change | Bornean Orangutan (*Pongo pygmaeus*; key trigger species) population change:<br><br>The orangutan population with the Kuamut Project Area has remained stable for two main reasons that can be attributed to the project's implementation:<br><br>1. **Termination of logging activities and prevention of conversion to mosaic plantings** – the Project Area was reclassified from Class II (Production) Forest Reserve to a Class I (Protection) Forest Reserve in 2015/2016, which meant that all logging operations were halted and conversion to mosaic plantings was avoided. Unsustainable logging practices are thought to have a negative impact on orangutan populations, which have higher abundance in less disturbed, better-quality forests (when hunting pressure is low; Ancrenaz *et al*. 2005). Mosaic planting is likely to have severe negative impacts on biodiversity, including the orangutan population, since the actively planted portion of the mosaic requires the near-complete removal of natural vegetation and thus of natural habitats for these forest dependent species. The results of our satellite monitoring (see Climate **section 3.1.3**) have shown that there have been no instances of illegal logging or forest clearance during the 2022-2023 monitoring period, which has allowed for forest regrowth and regeneration, particularly in heavily degraded areas. This evidenced by consistent vegetation growth and an overall increase in aboveground biomass across the Project Area (see Climate **section 3.1** for details). We therefore predict that forest regeneration will likely result in increased orangutan numbers in the long term, i.e., due to a higher availability of food resources etc. The Project Area may also act as a refuge for male orangutans moving away from disturbance (e.g., logging activities) in other parts of the landscape. However, given the short monitoring period and the relatively long lifespan of orangutans (35-40 years; https://orangutan.com/), we would not expect to see dramatic changes in the orangutan population during the timeframe of our first few monitoring periods, but instead |

would predict small increases in orangutan density, in part through increased dispersal of individuals into the Project Area over the next decade or so.

2. **Continued low hunting pressure** – hunting pressure is thought to be generally low in this part of Sabah and within the Project Area (e.g., see previous research by Tilker *et al*., 2019), and project activities such as regular routine patrols and security gate monitoring have ensured that these levels have not increased and are likely to deter further hunting activities. There was one instance of suspected hunting recorded on RBJ security patrols in 2022 (fresh tire tracks were observed), but this was dealt with promptly by constructing a guard post in the area (see reports in '**Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023**' supporting evidence folders for details). Aside from this particular incident, there were no encounters with hunters or evidence of snares, bullet cartridges, or illegal campsites documented by the KRCP teams conducting various activities in the area during the monitoring period, including biodiversity monitoring activities or security patrols (see **section 5.3** for details of such monitoring)

<u>Continued presence of other RTE species:</u>

Our camera trap and bioacoustic monitoring results have demonstrated the continued presence of a number of RTE species within the Project Area (see **section 5.3** and supporting evidence for detailed methods and results of the camera trap and bioacoustic monitoring). This includes species such as the Sun Bear (*Helarctos malayanus*, VU), Sunda Clouded Leopard (*Neofelis diardi*, VU), Sunda Pangolin (*Manis javanica,* CR), Great Argus (*Argusianus argus*, VU), Bearded Pig (*Sus barbatus*, VU), Southern Pig-tailed Macaque (*Macaca nemestrina*, EN) and Banded Civet (*Hemigalus derbyanus*, NT) that were recorded in the Project Area during 2016 by Tilker *et al*., (2019). See '**Records and status update of RTE species during 2nd MR period KRCP 20240805.xls'** file in the **'Presence of HCV 1 species'** folder for a detailed status update on each of the RTE species that inhabit, or which are thought to inhabit, the Project Area. Again, the continued presence of these RTE species within the Project Area can be attributed to two main factors resulting from the project's implementation:

1. **Termination of logging activities and prevention of conversion to mosaic plantings** – as described above, the continued presence of a number of RTE species is likely a result of the protection of forest within the Project Area and

the prevention of forest disturbance through continued logging activities and conversion to mosaic plantings. Certain species, particularly some forest specialists, have been shown to be negatively affected by logging (see extensive review on logging impacts by Meijaard *et al*., 2005), due to changes in forest structure and resource availability etc. The conversion to mosaic plantings would also have resulted in the loss of natural forest habitat in some areas and so disturbance sensitive species would be adversely affected and unlikely to persist in the long term in these habitats. This would likely include species such as the Sun Bear (*Helarctos malayanus,* VU), which has been shown to have higher occupancy in less disturbed forest habitats (Guharajan *et al*., 2021), as well as the Great Argus (*Argusianus argus,* VU), which prefer undisturbed forests (Winarni *et al*., 2002). We predict that as the forest within the Project Area regenerates, populations of forest specialists will stabilize and possibly increase due to improved habitat quality, especially in the absence of hunting pressure, allowing for greater dispersal into newly suitable areas. When standardized biodiversity data has been collected from across a longer time period, trends in the abundance, occupancy and/or Camera Trapping Rate (CTR) of a number of RTE species within the Project Area will be examined in subsequent monitoring reports.

2. **Continued low hunting pressure** – as described above, hunting pressure has thought to have remained relatively low within the Project Area during the monitoring period, evidenced by the absence of images of hunters on camera trap surveys in 2022 and 2023, and the lack of hunting evidence during routine security patrols by RBJ or during biodiversity surveys by the SEARRP/Permian team. Hence, the Project Area likely provides a refuge for species that are severely affected by hunting in other parts of Borneo. In particular, this includes the Sunda Pangolin (*Manis javanica,* CR) and Helmeted Hornbill (*Rhinoplax vigil,* CR), both of which are declining rapidly due to hunting for commercial trade and habitat loss (see: https://www.iucnredlist.org/). We predict that the very low threat of hunting within the Kuamut Project Area combined with natural forest regeneration, will allow populations of these CR species to recover over time. Once more data on these species have been collected from a longer time series, trends in abundance, occupancy and/or Camera Trapping Rate (CTR) within the Project Area will be analyzed.

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| Change in Biodiversity | **Natural forest regeneration leads to increase in mature forest habitats** |
| Monitored Change | Aboveground biomass – reflecting forest structure and quality:<br><br>The data provided in the Climate **section 3.1.3**, shows that there has been relatively consistent vegetation growth and an overall increase in aboveground biomass since the last monitoring period in 2015-2021, particularly in areas that were severely degraded by intensive logging. An overall increase in aboveground biomass reflects natural forest regeneration within the Project Area, which over time will lead to an increase in the area covered by high quality forest habitats, or habitats that are ecologically more similar to old-growth ('primary') forest. However, full recovery or regeneration of forest habitat following disturbance can take many years, depending on the severity of the initial degradation. We will continue to monitor forest regeneration over time, but these initial results are encouraging and suggest that the habitat is recovering from high intensity logging activities in previous decades. |
| Justification of Change | Aboveground biomass – reflecting forest structure and quality:<br><br>We assume that increases in aboveground biomass will accumulate over time as a result of natural forest regeneration (e.g., see Philipson *et al*., 2020). We predict that this will result in an increase in better 'quality' forest habitat within the Project Area, which can subsequently support higher levels of biodiversity. We define forest (or vegetation) quality as a biodiversity indicator that incorporates overall forest structure and composition, including the height, size, composition and diversity of trees, the canopy cover and the diversity of the forest strata (i.e., tree layers; see Whitmore, 1975), along with other structural and ecological aspects of the vegetation. In degraded, heavily logged forest habitats, such as those found within many parts of the Kuamut Project Area (especially at lower elevation), aboveground carbon is substantially lower compared to unlogged and undisturbed forests (e.g., see Asner *et al*., 2018), as is the canopy height (Okuda et al., 2019). This is because structurally important, large trees such as dipterocarps are removed during progressive logging cycles. Dipterocarps are not only essential for the structure and function of SE Asian forests (see review by Brearley *et al*., 2016), but they are also important stores of aboveground carbon (Slik *et al*., 2013). Hence, within the logged forest of the Kuamut Project Area, aboveground biomass (i.e., carbon |

density) is an excellent proxy for forest quality, as higher levels of carbon will reflect habitats with larger trees (i.e., taller canopies) and structural attributes more similar to old growth or undisturbed forests. While low stature, degraded forests can have high biodiversity value (Edwards *et al*., 2011), more structurally complex or undisturbed habitats are needed to support many forest specialists (Peh *et al*., 2005; also see review by Meijaard *et al*., 2005), and contribute to improved ecosystem functioning (e.g., Slade *et al*., 2011).

The increase in aboveground biomass brought about by natural forest regeneration with the Kuamut Project Area can be attributed to two main factors resulting from the project's implementation:

1. **Termination of logging activities and prevention of conversion to mosaic plantings** – the reclassification of the Project Area from Class II (Production) Forest Reserve to a Class I (Protection) Forest Reserve in 2015/2016, halted all legal logging operations and prevented conversion to mosaic planting. This reclassification has prevented further forest degradation, such as the removal of large, commercially valuable dipterocarp tree species, which reduces canopy height and significantly alters habitat structure. As no areas were converted to mosaic plantings, no natural vegetation was removed to make way for fast-growing plantation tree species (i.e., that would form part of the mosaic plantings), allowing the forest to naturally regenerate.
2. **Minimal forest disturbance** – instances of forest disturbance within and just outside the boundaries of the Project Area were monitored using recent satellite imagery from across the monitoring period (see Climate **section 3.1.3** for full details of the analysis). Forest disturbances can include fire, non-fire forest disturbance and logging. There were no instances of fire or logging activities within the Project Area during the monitoring period, nor any significant natural disturbances (e.g., major landslides or hurricanes). However, there was an extremely small amount of flooding recorded during the monitoring period that resulted in a small number of trees dying (see **'2023 flooding event.pdf'** in the **'Patrolling and threat monitoring: Flooding event 2023'** folders for supporting evidence). This may have negatively impacted the biodiversity in very localized areas by reducing vegetation growth, but as the flooding event was on a very small-scale, the impact on overall biodiversity is



thought to have been minimal. Overall, the reclassification of the area to a Class I (Protection) Forest Reserve, along with routine patrols and security gate monitoring by project collaborators RBJ (see reports in the **'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023'** supporting evidence folders for details), have ensured minimal anthropogenic disturbance within the Project Area, allowing the forest to naturally regenerate.

### 5.1.2 Mitigation Actions (VCS, 3.19; CCB, B2.3)

The activities and processes implemented to mitigate negative impacts on biodiversity and measures taken for the maintenance and/or enhancement of High Conservation Value (HCV) attributes in the Project Area are described below. Given that the Project Area contains high numbers of RTE species (HCV 1; see **sections 5.1.** and **5.3**), is part of a large, Intact Forest Landscape (IFL) (HCV 2), contains rare and threatened ecosystems (e.g., some very small areas of kerangas forest - kerangas is the Malaysian term for Sundaland heath forest; HCV 3) and provides many ecosystem services (i.e., the protection of water catchments, control of erosion of vulnerable soils and slops etc.; HCV 4) (see https://www.hcvnetwork.org/hcv-approach), the whole forested area can be considered as supporting HCVs and is treated as such.

**Mitigation of Negative Impacts on Biodiversity**

Reclassification of the Project Area: The Project Area was reclassified from a Class II (Production) Forest Reserve to a Class I (Protection) Forest Reserve in 2015/2016. This change in classification ensures that the area is designated for protection rather than production, providing an immediate and substantive mitigation of potential negative impacts on biodiversity, which includes:

1. Cessation of logging operations: Logging operations within the Project Area ceased upon protection. Heavy and unsustainable logging is a significant threat to biodiversity as it can lead to habitat destruction, fragmentation, and degradation. By stopping logging activities, the project prevented these adverse impacts, allowing the forest to maintain its ecological integrity and, over time, regenerate.

2. Avoidance of mosaic plantings: Mosaic planting, which involves planting short rotation timber trees in lower-lying areas, and results in the fragmentation and disruption of natural habitats and ecological processes. By avoiding this practice, the project helps preserve the continuity, integrity and quality of the forest ecosystem.

**Maintenance and Enhancement of HCV Attributes**

Preventing further biodiversity losses from illegal activities**:** To prevent illegal activities, such as logging and hunting/poaching from occurring within the Kuamut Project Area, there have been a number of activities conducted by project partners RBJ. This includes surveillance of the Project Area boundary using helicopters, vehicles and on foot, which occurred regularly throughout the monitoring period (see **section 5.3** and reports in the '**Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023'** folders in the supporting evidence for details of these patrols). Guard posts were also established at the main access points and security personnel were stationed at two strategically placed security gates to monitor vehicles in/out of the Yayasan Sabah Concession Area, including the Kuamut Forest Reserve. The gates are located at Km 11, Jalan Danum and Haranky.

Remote sensing tools have also been used to continuously monitor the Project Area, providing near real-time information on the forest condition during the monitoring period (see Climate **section 3.1.3** for further information). NASA-FIRMS (https://firms.modaps.eosdis.nasa.gov/map/) and Global Forest Watch (https://www.globalforestwatch.org/) fire and deforestation alerts were set up to provide near real-time information that was used as a guide for the RBJ, SEARRP and/or Permian field teams to check specific locations where deforestation and/or logging activities may be occurring. In addition to the automatic earth observation (EO) alerts, the Permian technical team conducted weekly assessments of the Project Area using Planet high-resolution (3 meters per pixel) imagery. There were no instances of logging within the Project Area during the 2022-2023 monitoring period. Therefore, we are confident that due to the reclassification and subsequent patrolling and real-time monitoring of the forest within the Project Area, anthropogenic forest degradation has been prevented, allowing the area to regenerate naturally since the project's inception. Natural regeneration supports the recovery of native forest species and the restoration of ecological processes, contributing to the resilience and sustainability of the forest ecosystem.

Biodiversity monitoring: SEARRP and Permian Global field teams have conducted regular biodiversity monitoring activities within the Project Area, including deploying camera traps and bioacoustic devices (i.e., Song Meters), orangutan surveys, laying pitfall traps to capture dung beetles, and assessing the integrity of the forest using the Forest Integrity Assessment (FIA) tool (see **section 5.3**). By conducting these biodiversity and forest quality surveys, we are monitoring the health of the forest ecosystem and the species within it, paying particular attention to forest specialists and species of conservation concern (i.e., RTE species). Continuous monitoring allows for the early detection of any negative trends in biodiversity and the implementation of timely interventions, upholding the precautionary principle by taking preemptive action based on available data. We are currently at the start of our biodiversity monitoring timeseries, and much of the work completed during this period has ensured that the methods and protocols implemented are robust, standardized and replicable in order to accurately document biodiversity trends over time and during subsequent monitoring periods.

**Consistency with the Precautionary Principle**

The actions taken in the Project Area are consistent with the precautionary principle, as articulated in the 1992 Convention on Biological Diversity. This principle emphasizes that the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. Specifically:

1. Assumption of species presence: The assumption that species documented in the surrounding landscape are likely to be present in the Project Area, given the similar forest type, supports the need for protection even in the absence of full scientific certainty. This approach aligns with the precautionary principle by erring on the side of caution to protect biodiversity.

2. Proactive protection measures: The reclassification and protection of the Project Area and the cessation of potentially harmful activities such as logging and mosaic planting are proactive measures that prevent environmental harm. These actions demonstrate a commitment to protecting biodiversity based on available evidence and precautionary reasoning.

By implementing these activities and processes, the project not only mitigates negative impacts on biodiversity but also actively enhances the HCV attributes of the Project Area, ensuring long-term ecological stability and compliance with international conservation principles.

### 5.1.3 Net Positive Biodiversity Impacts (VCS, 3.19; CCB, B2.2, GL1.4)

Since the reclassification of the Project Area from a Class II (Production) to a Class I (Protection) Forest Reserve in 2015/2016, the project has provided immediate biodiversity benefits by protecting key forest habitats, ecosystems, and their functions. This protection extends to numerous floral (see **section 5.3** for a list of RTE tree species) and faunal species (see **'Records and status update of RTE species during 2nd MR period KRCP 20240805.xls'** file in the **'Presence of HCV 1 species'** folder for a complete list of RTE bird, mammal and reptile species) and is primarily due to the termination of all legal logging activities and the prevention of habitat conversion to mosaic plantings. Intensive, repeated logging alters the structure of forest habitats, leading to the loss of some forest specialists and changes to community composition (Dumbrell & Hill 2005; Edwards *et al*., 2009; Lambert & Collar, 2002; also see review by Meijaard *et al*., 2005), as well as adverse impacts on ecosystem functioning (Slade *et al*., 2011). Further biodiversity declines would also have occurred with the conversion of natural forest to mosaic plantings, as natural vegetation in many parts of the Project Area would have been cleared to plant fast-growing timber species. This conversion would have drastically changed habitat structure, replacing a diverse array of tree species with only a few timber species, severely impacting biodiversity at all levels. While pockets of retained natural vegetation in mosaic areas (albeit subject to continued selective logging) may have served as refugia for some generalist and wide-ranging species, the overall mosaic landscape would be severely compromised in terms of biodiversity. Conversion to mosaic plantings would have

negatively impacted local biodiversity (including many RTE/HCV 1 species), ecological integrity (such as recovery and recruitment within embedded forest patches), and the capacity for maintaining essential ecosystem functions, including pollination and microbial cycling of soil nutrients etc. In particular, this type of land use, is unlikely to support viable populations of orangutans (our key trigger species), as many resident females are likely to disappear following continued disturbance (Marc Ancrenaz pers. coms.).

Throughout the lifetime of the project, natural regeneration of heavily degraded forest areas will result in an increase in the total area of habitat with characteristics and properties more similar to old growth forests. Such improvements to forest quality through natural restoration will be beneficial for forest dependent species, or species that primarily rely on old growth forest, and will result in increased ecological resilience (Thompson *et al*., 2024). Better quality habitat is also likely to be more resilient to climate change impacts through increasing landscape connectivity and reduce forest fire risk etc. Given that the forest in the Project Area is contiguous with much larger areas of protected primary forests to the South and East (e.g., the Danum Valley Conservation Area), the project will provide a buffer area and ultimately an expansion – as forests recover – of suitable habitats for RTE species in central Sabah. This will ultimately enhance landscape-level connectivity for forest dependent species within the central part of Sabah. Furthermore, if species need to track climate change as low lying forest habitat becomes too warm, good quality forest habitat linking lowland to upload forests will be vital for facilitating range shifts (e.g., see Scriven *et al*., 2015). Overall, the project's net positive impacts on biodiversity are substantial compared to a without-project land use scenario, where the forest would have experienced further anthropogenic disturbance and degradation with little to no regeneration. The table below outlines the main habitat types within the Project Area (classified by elevation), provides examples of some of the RTE species they support, and demonstrates how project implementation has positively affected these species and habitats. Additionally, **section 5.2.2** provides more detailed information on the net positive biodiversity impact of the project

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| Species and habitat | The project contains a number of different habitat types that support extremely high numbers of RTE species, this includes at least 34 threatened tree species (see **section 5.3**). The Project Area consists primarily of (1) lowland (<300 m asl) and (2) hill and submontane (300-900 m asl) forest (definition used by Phillips & Phillips, 2020), of which the low lying areas are much more accessible and in some parts more degraded. We briefly describe both the lowland and upland habitats in this table, give some examples of the RTE species they support and explain how they have not been negatively impacted by any of the project activities. For a list of RTE bird, mammal and reptile species that are within the Project Area and an update on |

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| | their status during this monitoring period see **'Records and status update of RTE species during 2nd MR period KRCP 20240805.xls'** file in the **'Presence of HCV 1 species'** folder. |
| **Areas needed for habitat connectivity** | The Project Area is important for landscape-level connectivity in central Sabah as it is continuous with a number of other forest reserves. No areas that are important for connectivity have been impacted by project activities. Project implementation has resulted in natural forest regeneration and restoration, which is likely to enhance landscape-level connectivity for forest dependent species as forest quality within the Project Area improves, facilitating species' movement and dispersal. |
| **Lowland forest habitat** | Description of lowland habitats and RTE species they support: Much of the Kuamut Project Area comprises lowland habitats (<300 m asl), which are dominated by 'lowland mixed dipterocarp forest', 'lowland seasonal freshwater swamp forest' and 'lowland mixed dipterocarp and kerangas forest' (as depicted on the forest formations/ecosystem types map created by Sabah Forestry Department Forest Research Centre: see **'Scriven 202303 Representative Points for BioD Sampling.pdf'** in the **'Other documents'** folder for details). Note that the 'lowland mixed dipterocarp and kerangas forest' habitat is primarily lowland mixed dipterocarp forest with only very small areas of kerangas forest. Lowland mixed dipterocarp forests are some of richest ecosystems in Borneo and hold exceptional concentrations of flora and fauna, including many plant and tree species, including numerous emergent dipterocarps (Whitmore, 1975).<br><br>Lowland dipterocarp forests are characterized by RTE vertebrate species such as the Great Slaty Woodpecker (*Mulleripicus pulverulentus,* VU; one of the focal species in our bioacoustic monitoring), the Bornean Bristlehead (*Pityriasis gymnocephala*, VU; one of the focal species in our bioacoustic monitoring), the Bornean Orangutan (*Pongo pygmaeus*, CR; a population of approximately 868, 95% CIs = 468 – 1610, individuals reside within the Project Area from our recent surveys) and the Sun Bear (*Helarctos malayanus*, VU; detected on our camera trap surveys in 2022-2023).<br><br>Positive biodiversity impacts: As in many parts of Sabah, much of these low-lying forest areas have been subject to intensive and repeated logging (Reynolds *et al*., 2011) |

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| | resulting in disturbed habitats where most large trees (i.e., Dipterocarps) have been removed. These degraded habitats can still support high numbers of RTE species (see Edwards *et al*. 2011) but will benefit from regeneration and recovery of native tree species, as well as restoration of ecological processes resulting from project implementation. For example, the orangutan population within the Project Area is thought to be stable (see **section 5.3**) and is likely to increase over coming years due to forest regeneration and low incidences of hunting. Hunting pressure is thought to be relatively low in this part of Sabah (see Tilker *et al*. 2019) and the patrols and staffed security gates maintained by RBJ are a deterrent for illegal activities within the Project Area. Low hunting pressure and levels of anthropogenic disturbance to the forest habitat are likely to result in substantial biodiversity benefits, particularly for threatened vertebrates such as the Helmeted Hornbill (*Rhinoplax vigil*, CR) and Sunda Pangolin (*Manis javanica,* CR), whose populations are under severe threat from hunting in other parts of Southeast Asia (https://www.iucnredlist.org). Through the project's biodiversity monitoring, species population trends over time will be monitored when enough data have been collection from over a longer time period.<br><br>Ensuring no negative biodiversity impacts: A number of camera traps and bioacoustic recorders have been deployed at a variety of lowland sites. Dung beetle and Forest Integrity Assessment (FIA) surveys were also conducted at the same sites during 2022, where possible. When conducting the biodiversity monitoring, there will be no negative impacts on biodiversity within the Project Area. Field teams will collect all equipment between survey periods, not leave any rubbish when camping and limit trail cutting wherever possible to minimize damage to the habitat. No other project activities will adversely impact any lowland habitats or the RTE species they support. In addition, no locations or specific coordinates of heavily threated RTE species in the lowland habitats will be made publicly available. |
| **Hill and submontane forest habitat** | Description of the hill and submontane forest habitats and RTE species they support: The hill and submontane forest habitats (300-900 m asl) are largely found within the south and southeastern part of the Project Area and contain a number of different forest types that primarily include: |

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| | 'upland ultramafic forest', 'upland mixed dipterocarp forest' and 'upland mixed dipterocarp and kerangas forest' as depicted on the forest formations/ecosystem types map created by Sabah Forestry Department Forest Research Centre: see **'Scriven 202303 Representative Points for BioD Sampling.pdf'** in the **'Other documents'** folder for details). Note that kerangas or heath forests are classified as a threatened or critical ecosystem due to their rarity (HCV Malaysia Toolkit Steering Committee, 2021.); however, there are only very small areas of upland kerangas forest within the 'upland mixed dipterocarp and kerangas forest' habitat.<br><br>Mixed dipterocarp hill forest in this part of Sabah has been shown to contain many emergent dipterocarps, such as those within the *Shorea* family, as well as other non-dipterocarp emergent species (Suratman *et al*., 2011). As elevation increases, tree height decreases. In submontane forest (over approximately 800 m asl) Dipterocarps and other common lowland families such as Leguminosae, Euphorbiaceae and Myristiceae begin to diminish and are replaced by species from tree families such as Myrtaceae, Fagaceae and Lauraceae (Suratman *et al*. 2011). Few areas of forest within the Project Area are over 900 m asl, and so we do not describe these as they are inaccessible to the field team.<br><br>Hill and submontane forest is usually characterized by RTE vertebrate species such as Bulwer's Pheasant (*Lophura bulweri*, VU; detected within the Project Area in 2016), Blue-banded pitta (*Erythropitta Arquata*, Borneo endemic) and Bornean Banded Pitta (*Hydrornis schwaneri*, Borneo endemic) (both likely to be within the Project Area and which we hope to detect through the camera trap monitoring). The Borneo Bay Cat (*Catopuma badia*, EN; detected in our camera trap surveys in 2023) is also characteristic of upland hill forests (see Hearn *et al*. 2018).<br><br>Positive biodiversity impacts: Many parts of these upland forests are less degraded and have higher aboveground biomass (see Climate **section 3.1.3**) compared to the lower lying parts of the Project Area as they are much more difficult to access. They are therefore likely to provide refugia for some disturbance sensitive, hunted or interior-forest species that can tolerate higher elevations (e.g., Banteng: *Bos javanicus*, EN; Journeaux *et al*., 2018). These upland habitats will still benefit from project implementation as all logging activities have been |

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| | terminated, and any areas that have been previously logged and/or degraded will be able to recover and regenerate. This will be beneficial for the forest specialists they support.<br><br>Ensuring no negative biodiversity impacts: A number of camera traps and bioacoustic devices have been deployed in some of the upland habitats in 2022-2023. Monitoring will not cause any negative impacts on biodiversity within these upland habitats. Field teams will collect all equipment between survey periods, not leave any rubbish when camping and limit trail cutting wherever possible to minimize damage to the habitat. No other project activities will adversely impact any upland habitats or the RTE species they support and no locations or specific coordinates of heavily threated RTE species in the upland habitats will be made publicly available. |

### 5.1.4 High Conservation Values Protected (CCB, B2.4)

The Kuamut Forest Reserve supports environmental HCVs 1, 2, 3, and 4 (also see **section 5.1.2**). The entire forested area of the project (83,381 ha) contains and supports populations of RTE species and those classified under HCV 1, and should therefore be designated as HCV 1. This includes RTE flora and fauna species dependent on mature, undisturbed forest habitats, such as felids, mustelids, and certain primates in the southern and eastern parts of the Project Area. Additionally, the area supports RTE species that are more tolerant of forest disturbance, including ungulates, some primates, bird species, and the Asian Elephant (*Elephas maximus*). The entire forested area should be classified as HCV 2, as it forms a landscape-level ecosystem of mixed dipterocarp forest that is contiguous with a larger protected forest landscape, particularly to the east and south. The Project Area also contains rare and threatened ecosystems, including some very small areas of kerangas forest remnants, which support HCV 3. Furthermore, the qualifying attributes of HCV 4, essential ecosystem services, are present. These include riparian areas around the Kuamut and Melian rivers, which play a crucial role in erosion control, as well as water catchments in higher-elevation hill forests that provide a clean water supply to the Kuamut and Karamuak village clusters. To demonstrate that no forest/area that support HCVs related to biodiversity in the Project Area have been negatively affected by the project, the following measures are being implemented:

**1. Protection commitment and measures to ensure HCV enhancement**

The project has a clear commitment to protecting all HCV values present in the Project Area and this will be fulfilled in part due to its increased protection to a Class I Forest Reserve. This commitment is crucial to ensuring that no negative impacts on biodiversity values occur due to project activities. The project's measures to protect HCVs include:

Regular monitoring: Routine patrols conducted by RBJ in the forest/HCV areas ensure that if illegal activities such as hunting and logging are detected, they are addressed promptly, minimizing their impact on biodiversity. Evidence of these patrols (dates, frequency etc.) can be found in the '**Patrolling and** threat **monitoring: RBJ patrol reports 2022 and 2023**' supporting evidence folders. Additionally, any forest disturbances within and around the Project Area are tracked using near-time satellite imagery by the Permian Global team (see Climate **section 3.1.3** and **sections 5.1.2** and **5.1.3** for details of this analysis). If any forest disturbances are detected during the inspection and analysis of the remotely-sensed satellite imagery, then SEARRP or RBJ field teams can be deployed immediately to check and deal with any illegal activities should they occur. For example, this included an event of forest disturbance that was detected and relayed to the RBJ team by the Permian Global technical team on 3rd July 2023. The RBJ team then further identified locality information and were deployed to the site between the 3rd – 7th of July to check the disturbance, which on the ground was a small area of flooding. See '**2023 flooding event.pdf**' in the **'Patrolling and threat monitoring: Flooding event 2023'** folders for supporting evidence.

Annual biodiversity monitoring has been conducted using camera traps and bioacoustic devices between 2022-2023 to collect data on vertebrate populations (see **section 5.3**, and supporting evidence in the **'Presence of HCV 1 species'** folders for camera trap and bioacoustic monitoring methods and results). This data has been collected so that the continued presence of RTE species within the Project Area can be examined. In addition, forest integrity (using the Forest Integrity Assessment (FIA) tool; Suggitt *et al*., 2021) and dung beetle monitoring was conducted in 2022. The focus of the FIA and dung beetle pilot surveys was to trial the field methodology and train the field team in data collection, dung beetle identification etc. Monitoring of forest integrity and dung beetle communities will recommence in 2025. Furthermore, the Bornean Orangutan (*Pongo pygmaeus*) population (and the project's key trigger species), is separately monitored every 3-5 years through helicopter surveys to track population trends. See reports in the **'Presence of HCV 1 species: Orangutan monitoring 2023: Final reports by Dr Felicity Oram'** supporting evidence folders for full details of the orangutan helicopter surveys and **section 5.3** for summaries of the biodiversity monitoring activities.

- Strict implementation of conservation practices: Adherence to conservation practices that are designed to protect biodiversity includes controlled access to the forest/HCV areas (i.e., via security checkpoints and gates; see **section 5.3** for details) and the prohibition of harmful activities such as logging and hunting activities through the protection of the Project Area.

**2. Evidence of no negative biodiversity impact**

To substantiate the claim that no forest areas/HCVs related to biodiversity have been negatively affected, the following evidence can be provided:

- Monitoring data: From the routine patrols conducted by RBJ there has been very few instances of suspected hunting activities (e.g., bullet cartridges, illegal campsites etc., see **section 5.3**. and reports in the '**Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023**' folders in the supporting evidence for details). Equally, there were no records of any hunting activities captured on the camera trap images during 2022-2023, or during biodiversity monitoring activities, suggesting that instances of hunting within the Project Area have remained low. The satellite-based monitoring of forest disturbances also showed that there have been no instances of logging during the Project Area during 2022-2023, providing evidence that the forest habitat has not been damaged by anthropogenic activities. An overall increase in aboveground biomass since the last (2015-2021) monitoring period (see Climate **section 3.1.3**) also reflects the natural regeneration of the Project Area and evidences that vegetation health has not been negatively impacted by project implementation.

  The biodiversity monitoring conducted by the SEARRP and Permian Global field teams (see **section 5.3**) detected a large number of RTE species within the Project Area and evidences the continued persistence of these species. For example, from the camera trap surveys conducted in 2022-2023, 36 RTE species were detected (two listed as CR: Bornean Orangutan: *Pongo pygmaeus* and Sunda Pangolin: *Manis javanica*) and six listed as EN (Asian Elephant: *Elephas maximus*, Banteng: *Bos javanicus*, Borneo Bay Cat: *Catopuma badia*, Long-tailed Macaque: *Macaca fascicularis*, Otter Civet: *Cynogale bennettii* and Southern Pig-tailed Macaque: *Macaca nemestrina*). A number of these RTE species were detected by camera trapping conducted within the Project Area by external studies during the period of the first monitoring report (2015-2021; see research papers by Tilker *et al*. 2019; Mohamed *et al*. 2021), hence evidencing their continued presence. The continued presence of these species is likely a result of the protection of the forest habitat (i.e., the with-project scenario) and relatively low hunting pressure within the Project Area. The results of the orangutan monitoring conducted by Dr Felicity Oram and Pravind Segaran, and funded directly by the project have shown that the population of Bornean Orangutan (*Pongo pygmaeus*) has remained stable since the surveys were conducted in 2014-2017 (Simon *et al*., 2019), further evidencing that no changes to this HCV 1 species within the Project Area have been impacted by project activities.

### 5.1.5 Species Used (VCS, 3.19; CCB, B2.5, 2.6)

As stated in the PDD, the degraded parts of the Project Area have the capacity to regenerate naturally under the condition of full protection, and so no planting activities

have taken place.

| Species introduced | Classification | Justification for use | Adverse effects and mitigation |
|---|---|---|---|
| Not Applicable. | | | |

### *5.1.6* Invasive Species (VCS, 3.19; CCB, B2.5)

No non-native species have been used in the Project Area or Zone. No project activities involved the risk of introducing novel or invasive species into either the Project Area or Project Zone.

| Existing invasive species | Mitigation measures to prevent spread or continued existence of invasive species |
|---|---|
| Not Applicable. | |

### 5.1.7 GMO Exclusion (CCB, B2.7)

The project has not and will not utilize GMOs in any form.

### 5.1.8 Inputs Justification (VCS, 3.19; CCB, B2.8)

Project activities have not necessitated the additional use of chemical fertilizers, pesticides or biological control agents.

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| Name | Not Applicable. During this period the project did not use or promote the use of fertilizers, chemical pesticides, biological control agents or other inputs |
| Justification of Use | Not Applicable. |
| Adverse Effect | Not Applicable. |

## 5.2 Offsite Biodiversity Impacts

### 5.2.1 Negative Offsite Biodiversity Impacts (CCB, B3.1) and Mitigation Actions (CCB, B3.2)

| Negative Offsite Impact | Mitigation Measure(s) |
|---|---|
| There is a possibility that hunting activities could be refocused to other forest reserves outside of Project Area/Zone following the | The displacement of any hunting activities immediately outside of the Project Area is currently thought to be unlikely, as hunting pressure in this part of central Sabah is considered to be relatively low (e.g., see |

| | |
|---|---|
| reclassification of the area to a Class I (Protection) Forest Reserve and implementation of regular security patrols by RBJ. | research paper by Tilker *et al*., 2019). This is also in part likely to be due to RBJ patrols and security gate cover across the broader Yayasan Sabah Foundation Management Area (see Reynolds *et al*., 2011), limiting hunting access.<br><br>During the current monitoring period, RBJ's mitigation actions include security patrols around the Project Area and its surroundings (see **section 5.3.1**), as well as the deployment of staff at checkpoints and key access points. These measures are thought to restrict forest access within the whole Yayasan Sabah Foundation Management Area, and are likely to limit the leakage of hunting and other illegal activities (i.e., logging) into surrounding areas.<br><br>However, while hunting displacement into immediate surrounding areas is unlikely, we are unable to systematically enforce or monitor hunting displacement over a larger scale. Hunting activities outside of the project's jurisdiction fall under broader regional enforcement efforts, and any potential shifts in hunting pressure would require wider-scale monitoring beyond the scope of this project.<br><br>Hence, given the perceived low risk of hunting displacement in the Project Area and immediate surrounding area, we have not implemented specific mitigation measures to reduce the possible displacement of hunting activities during this monitoring period. However, we have established a framework to support livelihood enhancement opportunities moving forwards, which may help reduce any potential future reliance on hunting both inside and outside the Project Area. Specific community activities will be detailed in future monitoring reports. |

### 5.2.2 Net Offsite Biodiversity Benefits (VCS, 3.19; CCB, B3.3)

**Evaluation of negative impacts on biodiversity outside the Project Area/Zone:**

Historically, hunting activities linked to staff from past logging contractors in the Project Area have had detrimental effects on wildlife populations outside the Project Zone. However, since then various studies have shown that hunting pressure in central Sabah is now relatively low. For example, Tilker *et al*. (2019) found that hunting levels were low in this part of Sabah compared to other parts of Southeast Asia and that canopy closure was the main predictor of faunal occurrence in degraded sites in the absence of hunting. Gardner & Goossens (2017) also showed that the number of illegal activity events recorded in the Kuamut Forrest Reserve

was relatively low compared to other areas of forest. In addition, Brozovic *et al*. (2018) and Guharajan *et al*. (2021) also evidence the low level of hunting within and around the Project Area. The results of these studies are further supported by the results of the security patrols and biodiversity monitoring activities conducted by the Kuamut Rainforest Conservation Project teams (RBJ, SEARRP and Permian Global) during the 2022-2023 period. The project employs staff from RBJ to conduct anti-poaching patrols, deterring logging and poaching activities. These patrols involves surveys on foot, in 4WD vehicles, boats and helicopters (see '**Patrol Monitoring Reports Summary 2022/2023.docx**' files in the '**Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023'** supporting evidence folders for a summary of these patrols). There was only one incidence of suspected hunting activities detected during the 2022-2023 patrols and no evidence of hunting was detected upon the camera trap images or during the biodiversity monitoring activities (see **section 5.3**). While the likelihood is minimal that hunting activities may be refocused to other forest reserves outside the Project Area/Zone, the referenced studies and our recent patrols and monitoring suggest that recent hunting pressure is thought to be low and is unlikely to have had any significant impacts on wildlife populations.

**The project's biodiversity benefits within the Project Area/Zone**

The project has implemented several measures to directly enhance biodiversity within the Project Area, and these benefits are outlined below:

- Habitat protection and regeneration: The project's reclassification of the forest from a Class II (Production) to a Class I (Protection) Forest Reserve transitioned it to a fully protected status. This reclassification prohibits timber harvesting or other extractive commercial exploitation, but permits activities such as ecotourism, research, and trading in ecosystem services like carbon. Reclassification and subsequent forest protection have prevented further habitat degradation from logging and conversion to mosaic plantings. This has directly benefited biodiversity within the Project Area at all levels, as structural damage from logging activities and loss of natural forest habitat to make way for timber tree species are extremely detrimental to forest species and the ecosystem functions these forests provide (see **section 5.1**). By protecting the forest and minimizing activities that negatively impact biodiversity, such as logging, natural regeneration and habitat quality is improving (evidenced by an increase in aboveground biomass; see Climate **section 3.1.3**). This regeneration will benefit communities of forest species, as well as ecosystem functioning as the extent of high-quality habitat increases over time and becomes more similar to old growth or primary forest habitats.

- Enhanced landscape connectivity: At a larger spatial scale the protection and regeneration of the forest within the Kuamut Project Area will enhance overall landscape connectivity through central Sabah as the Project Area is strategically situated within close proximity of, and provides crucial connectivity between, a number of other forest reserves (e.g., Deramakot, Malua and Ulu Segama Forest Reserves), as well as areas of protected primary forest (e.g., Danum Valley, Maliau Basin and Imbak Canyon Conservation Areas). For many

species such as those with wide ranges (e.g., large mammals and birds), habitat connectivity is important for maintaining adequate species dispersal, genetic diversity and population stability (e.g., see MacDonald *et al*., 2018 for research on Sunda Clouded Leopard: *Neofelis diardi* in Sabah). Enhanced connectivity and species movement will allow for greater gene flow between populations, which reduces the risks of inbreeding and genetic drift, resulting in continued population persistence (Goossens *et al*., 2004). Habitat connectivity, especially over large scales and encompassing a range of elevational gradients, is especially important in the face of climate change, as it will enable species to move to more suitable habitats as temperatures warm and environmental conditions shift (Scriven *et al*., 2015).

- Stable populations of trigger species: As a result of the forest protection and regeneration, our monitoring results suggest that the populations of key trigger species, the Bornean Orangutan (*Pongo pygmaeus*), have remained stable since project inception (see **sections 5.3** and **5.4** for further details and evidence). This stability can be attributed to project implementation and the prevention of habitat conversion to mosaic plantings.

- Continued presence of many RTE species: The camera trap and bioacoustic monitoring conducted by the SEARRP and Permian Global teams during 2022-2023 have documented the continued presence of many RTE species within the Project Area (see **section 5.3**). The protection of the forest within the Project Area, combined with the low level of hunting, likely means that the Project Area serves as a refuge for many RTE species, thus contributing to their population recovery. This is particularly the case for species that are severely hunted elsewhere, such as the Sunda Pangolin (*Manis javanica*) and Helmeted Hornbill (*Rhinoplax vigil*) (both CR; https://www.iucnredlist.org).

- Minimal anthropogenic disturbance/degradation: Security patrols have been conducted regularly by RBJ throughout the 2022-2023 monitoring period. These patrols are likely to deter logging and hunting activities within the Project Area. Few instances of illegal activities were detected during these patrols suggesting that threats to biodiversity from hunting and logging is low. We have summarized patrol reports RBJ in the '**Patrol Monitoring Reports Summary 2022/2023.docx**' files in the '**Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023**' supporting evidence folders, which also gives details of the one incidence of suspected hunting in 2022 (also see **section 5.3**).

**Justification for Positive Net Effect on Biodiversity**

The project's net positive impacts on biodiversity are substantial when compared to the without-project land use scenario, where the forest would have experienced further anthropogenic disturbance and degradation with little or no habitat regeneration. The proactive measures implemented as a consequence of the project, including reclassification to fully protected status, anti-poaching patrols and continuous monitoring, have demonstrated significant benefits to biodiversity within the Project Area and outweigh any potential negative impacts

outside the Project Zone (i.e., the displacement of hunting activities).

While there is potential for hunting activities to be refocused outside the Project Zone, recent studies along with our routine patrols and biodiversity monitoring indicate that any offsite negative impacts are minimal as hunting levels are thought to have remained low. The stable orangutan population and continued presence of many threatened RTE species is a strong indicator of the project's positive impact on biodiversity and that the net effect of the project on biodiversity is positive, with minimal offsite negative impacts. Overall, project implementation has protected habitat critical for conservation, promoting natural regeneration and improvements to habitat quality and connectivity that will ultimately lead to higher ecosystem resilience at a landscape-scale. Enhanced connectivity supports species dispersal and genetic diversity, which are crucial for population-level adaptation to climate change and other anthropogenic threats. Project implementation and activities have created a robust conservation framework, which not only mitigates potential negative biodiversity consequences but also provides enhancements at a landscape scale, thereby justifying the project's positive net biodiversity impact.

## 5.3 Biodiversity Impact Monitoring

### 5.3.1 Biodiversity Monitoring Plan (CCB, B4.1, B4.2, GL1.4, GL3.4)

During this monitoring period, the project has implemented an extensive biodiversity monitoring program following the Biodiversity Monitoring plan (see "**Kuamut Biodiversity Monitoring Plan 20220708 (submitted for validation).pdf**" in the '**Other documents**' supporting evidence folder) The Biodiversity Monitoring Plan has three key objectives:

1. Secure critical orangutan habitats and populations.
2. Fill knowledge gaps on the use of the project area by RTE and HCV species (e.g., elephants, gibbons, helmeted and other hornbill species, endemic trees and other plant species).
3. Secure habitat for other wide-ranging species and buffer the western flank of the Danum Valley Conservation Area – the only significant area of lowland primary forest remaining in Sabah.

In the PDD, we state that biodiversity indicators will include the pressure, state and response variables most relevant to biodiversity, such as (1) vegetation quality, (2) presence of HCV 1 species, (3) signs of anthropogenic disturbance, and (4) the status of hunting activities. In **Table 5.1** and in the text below, we present a summary of the methods, results and evaluation of the biodiversity monitoring for each of these indicators. Note that for a number of the specific biodiversity indicators, this was the start of our monitoring and so the focus was to and establish a baseline against which to evaluate the impact of protection and other management interventions, rather than to compare results with the previous (2015-2021) monitoring report

or analyze trends over time.

Biodiversity monitoring activities were conducted by SEARRP and Permian Global field teams. Security patrols were conducted by RBJ at varying locations within and around the Project Area. Wherever possible, biodiversity monitoring for dung beetles, forest integrity and RTE vertebrates (camera trapping and bioacoustic monitoring) were conducted at the same plot locations in 2022 (i.e., camera traps were placed in the same location as the bioacoustic devices, dung beetle traps and where the start of the FIA assessments took place).

In 2022, 49 biodiversity monitoring sites or 'plots' (also called 'camera trap stations') were primarily in riparian areas due to ease of access (**Fig. 5.1a**), allowing the team to test the deployment methodologies etc. After a thorough external review of the biodiversity monitoring plot locations in 2023 by external consultant Dr Sarah Scriven (who is now employed by Permian Global), some biodiversity monitoring plot locations were moved (**Fig. 5.1b**). These new plot locations were chosen to encompass a greater elevation range, different forest and soil types, and variations in aboveground biomass, with many in less accessible parts of the Project Area. The Permian Global and SEARRP teams visited 31 plots during the 2023 monitoring period (**Fig. 5.1b**), but will visit new locations to the eastern side of the reserve during the next monitoring period, following road repair. For full details of how the new site locations were selected, see '**Scriven 202303 Representative Points for BioD Sampling.pdf'** in the '**Other documents**' supporting evidence folder.

For conciseness and clarity, we have included separate reports detailing the methods, full results and evaluation of the biodiversity monitoring completed by Permian Global and SEARRP as supporting evidence to this monitoring report. This includes reports on the FIA surveys, camera trapping and dung beetle monitoring that can be found in the '**Presence of HCV 1 species'** supporting evidence folder (see below for further details). Additionally, external reports written by project collaborators for the orangutan monitoring (by Dr Felicity Oram and Pravind Segaran) and bioacoustic analyses (by Dr Joshua Taylor), are also provided as separate documents in the '**Presence of HCV 1 species**' supporting evidence folder (see below for further details). These provide a detailed extension to the summary information presented in **Table 5.1** and this section of the monitoring report.

Table 5.1. Biodiversity monitoring activities conducted during the 2022-2023 MR period, which relate to biodiversity indicators outlined in the PDD, biodiversity monitoring plan and which are also summarized in section 5.3.1.

| Biodiversity indicator | Monitored change | Activity/ methods | Dates conducted during 2022 –2023 | Frequency | Location | Results and evaluation | MR section and/or supporting information |
|---|---|---|---|---|---|---|---|
| **Vegetation quality** | Aboveground biomass (AGB) | Measuring carbon plots, remote sensing and statistical modelling | Difference in AGB computed between 2016-2021 and 2022-2023 | Computed annually | Whole Project Area | • Relatively consistent AGB growth rates during 2016-2021 and 2022-2023.<br>• This is a result of project implementation and natural forest regeneration. | Climate **section 3.1.3** and Biodiversity **section 5.3.1** |
| **Vegetation quality** | Canopy height | Remote sensing and statistical modelling | Canopy height change computed between 2015-2023 | Computed annually | Whole Project Area | • Mean canopy height change was 0.18 m yr-1 (standard deviation = 0.25 m yr-1).<br>• The majority of the Project Area (58.5%) has been growing since the start of the project as a result of project inception. | Climate **section 3.1** and Biodiversity **section 5.3.1** |
| **Vegetation quality** | Forest Integrity Assessment (FIA) Score | FIA surveys conducted at biodiversity monitoring sites (plots) | 10/09/2022-16/09/2022 | Will be conducted annually from 2025 | 49 sites | • Results from the 2022 pilot survey suggest that there was variation in FIA scores across sites, but a number had relatively high forest integrity.<br>• These sites are thought to support important forest biodiversity and ecosystem functioning. | Biodiversity **section 5.3.1** and '**Kuamut Project MR2 - FIA Report.docx**' report |
| **Presence of HCV 1 species** | Bornean Orangutan population change | Aerial nest surveys via helicopter | 02/11/2023-03/11/2023 | Conducted every 3-5 years | Over 167.8 km in the Project Area and | • Across the survey period, 4382 orangutan nests were detected in the Project Area, corresponding to a mean density of 1.04 individuals per $km^2$ (95% CIs = 0.56–1.93), and an | Biodiversity **sections 5.3.1** and **5.4.1.**, |

| Biodiversity indicator | Monitored change | Activity/ methods | Dates conducted during 2022 –2023 | Frequency | Location | Results and evaluation | MR section and/or supporting information |
|---|---|---|---|---|---|---|---|
| | | | | | 60.5 km to the South | estimated population size of 868 (95% CIs = 468–1610) individuals.<br>• The results indicate that the population has remained stable since the last monitoring period. | and reports in '**Final reports by Dr Felicity Oram**' folder |
| **Presence of HCV 1 species** | Continued presence of ground dwelling mammals and birds | Camera traps deployed at biodiversity monitoring sites | 09/09/2022-25/11/2022 and 11/05/2023-22/10/2023 | Annually; with two deployments a year from 2025 | 49 sites in 2022 and 31 sites in 2021 | • Across all sites and years, 61 species were detected, corresponding to 36 RTE species (11 birds, 23 mammals and 2 reptiles).<br>• The continued presence of many RTE species since the last monitoring period suggests that persistent populations reside in the Project Area. | Biodiversity **section 5.3.1** and '**Kuamut Project MR2 - Camera Trapping Report.docx'** report |
| **Presence of HCV 1 species** | Continued presence of selected bird and mammal species | Song Meters deployed at biodiversity monitoring plots | Song Meters were deployed at the same time as camera traps | Annually; with two deployments a year from 2025 | 49 sites in 2022 and 31 sites in 2021 | • Classification accuracy of AI models passed the 95% confidence-score threshold for six bird species of interest.<br>• Development of AI classifier models for other species of interest is in progress. | Biodiversity **section 5.3.1** and '**D021-04-01_Kuamut_bioacoustics_report_final.pdf**' report |
| **Presence of HCV 1 species** | Dung beetle richness, abundance and community composition | Dung beetle trapping | 11/09/2022-18/09/2022 | Annually from 2025 | 49 sites | • During the 2022 pilot survey, 42 dung beetle species were recorded in the ground pitfall traps and eight in arboreal traps (44 species in total).<br>• Of these species, 17 were associated with old growth and/or logged forest habitats, and 12 were endemic to Borneo. | Biodiversity **section 5.3.1** and '**Kuamut Project MR2 - Dung Beetle Report.docx**' report |

| Biodiversity indicator | Monitored change | Activity/ methods | Dates conducted during 2022 –2023 | Frequency | Location | Results and evaluation | MR section and/or supporting information |
|---|---|---|---|---|---|---|---|
| | | | | | | • The results provide a baseline for understanding the biodiversity value of the area for these invertebrates. | |
| **Presence of HCV 1 species** | RTE plant species richness | Carbon plots analysis | Carbon plots were remeasured in 2021-2022 | Every 3-5 years | 46 sites (carbon plots) | • A total of 34 threatened tree species were found during the 2015-2016 and 2021-2022 surveys, which included six CR species, five EN species and 23 VU species.<br>• Project intervention has ensured the full protection of the Project Area, resulting in the protection of these RTE trees. | **Climate section 3.1.1,** Biodiversity **section 5.3.1** and the **'plot-iucn-sp.xls' file in the 'Vegetation quality'** folder. |
| **Signs of anthropogenic disturbance** | Forest disturbances (e.g., fire, logging, flooding) | Satellite monitoring | 01/01/2022-31/12/2023 | Continuous/ near real time | Whole Project Area | • There have been no anthropogenic forest disturbance >2.5 ha detected within the Project Area during 2022-2023.<br>• This has enabled regrowth and regeneration particularly in heavily degraded areas. | Climate **section 3.1.3** and Biodiversity **section 5.3.1** |
| **Signs of anthropogenic disturbance** | Presence/ frequency of illegal activities (e.g., logging) | Security patrols | 01/01/2022-31/12/2023 | Monthly | Entry/exit points, other routes through the Project Area | • No illegal activity was recorded during the monitoring period in the Project Area.<br>• As a result of project inception and reclassification of the area to a Class 1 Forest Reserve, there has been no anthropogenic forest disturbance during 2022-2023. | Climate **section 3.1.3**, Biodiversity **section 5.3.1** and files in **'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023'** folders. |

| Biodiversity indicator | Monitored change | Activity/ methods | Dates conducted during 2022 –2023 | Frequency | Location | Results and evaluation | MR section and/or supporting information |
|---|---|---|---|---|---|---|---|
| **Status of hunting activities** | Presence/ frequency of hunting activities | Security patrols | 01/01/2022-31/12/2023 | Monthly | Entry/exit points, other routes through the Project Area | • In January 2022, there was one incidence of suspected hunting activity and a guard post was constructed on the road to Comp. 139 in response.<br>• Results from these patrols suggest that the incidences of hunting within the Project Area are very infrequent. | Biodiversity **section 5.3.1** and files in **'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023'** folders |
| **Status of hunting activities** | Presence/ frequency of hunters recorded on camera traps | Camera traps deployed at biodiversity monitoring sites | 09/09/2022-25/11/2022 and 11/05/2023-22/10/2023 | Annually; with two deployments a year from 2025 | 49 sites in 2022 and 31 sites in 2023 | • There were no instances of hunting activities detected by the camera traps, and no evidence or instances of hunting activities were recorded by the KRCP team.<br>• These results suggest that the threat of hunting within the Project Area is low. | Biodiversity **section 5.3.1** and '**Kuamut Project MR2 - Camera Trapping Report.docx'** report. |

Figure 5.1. Map of biodiversity monitoring sites (i.e., camera trap stations) within the Project Area in 2022 and 2023. In 2022, there were 49 sampling sites from which data were collected and these were primarily in low elevation, riparian areas surrounding the Kuamut and Melian rivers (a) (note that there is only data for 48 camera trap sites as one camera malfunctioned in the field). In 2022, activities included camera trapping, bioacoustic monitoring, dung beetle monitoring and forest integrity assessments. In 2023, there were 31 biodiversity monitoring sites that covered higher elevation areas further into the reserve; camera trapping and bioacoustic monitoring activities were conducted at these sites (b). Camera traps and bioacoustic monitoring devices were placed in the same location. Wherever possible, dung beetle traps and forest integrity assessments were within close proximity (i.e., with a hundred or so meters) from the camera trap depending on the local vegetation etc. In the next monitoring period, we plan to conduct our biodiversity monitoring activities at approximately 50 sites, and a number of new monitoring sites will be added to the eastern side of the Project Area.

### 1. Vegetation quality

**Aboveground biomass and canopy height data were collected by the Permian Global technical team; see Climate section 3.1 for full details.**

Vegetation quality (also termed 'health') was identified as a key biodiversity variable because anthropogenic disturbances, such as the removal of large trees via logging activities, can significantly alter forest quality and structure. Such disturbances can lead to a decline in both the abundance and diversity of forest species, especially for those with restricted ranges, such as endemics (e.g., Morris, 2010). We use canopy height and aboveground biomass as proxies for vegetation quality and provide a justification in section 5.1.1. as to why these metrics are reasonable indicators of vegetation (or forest) quality in logged forest settings.

Canopy height

*Methods:* The Machine Learning (ML) derived Canopy Height Maps (CHMs) described in the climate **section 3.1** were used to evaluate the spatial extent and rate of canopy height change across the Project Area. The mean predicted annual canopy height for the years 2015:2023 were combined into a single raster where canopy height bands were sequenced by year.
For every 30x30 m in this raster stack, a linear model was fit with time as the control variable and canopy height as the response. The slope coefficient and corresponding confidence intervals were extracted. To increase confidence in the predicted values, a composite of these values was derived where:

- If the model (for a given cell) was not significant (at the 95% confidence level), a value of zero was assigned assuming no change;
- If the model was significant and greater than zero, the lower confidence limit of the slope

was used.

- If the model was significant and less than zero, the upper confidence limit of the slope was used.

Following this step, a secondary median spatial focal filter was applied to the map of statistically significant change to remove noise/outliers. The resulting map is presented in **Fig. 5.2**.

To calculate the project-level statistics for the canopy height change, the raster was masked with the Project Area boundary, excluding cells outside of the Project Area. At this stage, the mean canopy height change and standard deviation were derived for the whole area.

The masked canopy height map was then converted to a spatial vector (polygon) with three classes, growth (where change rates were > 0), degradation/deforestation (where change rates were < 0 and stable (where change == 0). The features in this polygon were dissolved by class and then intersected with the Project Area polygon. This step is important to exclude extruding cell edges (resulting from the vectorization of the raster) around the Project Area boundary. Finally, the areas of the three polygon classes were calculated.

*Results:* The map of canopy height change is shown in **Fig. 5.2**. Growth predominates with larger growth rates observed in the northwest of the site where historic degradation was most severe. The limited extent of degradation is predominantly located in the central Kuamut valley, where some limited deforestation events occurred during the early years of the project and were documented as part of the deforestation monitoring in the climate **section 3.1**. The mean canopy height change was estimated to be 0.18 m $yr^{-1}$ with a standard deviation of 0.25 m $yr^{-1}$. **Table 5.2** shows the summary of areas of the different forest change states. The majority of the area (58.5%) has been growing since the start of the project. Only 2.7% of the project area has experienced forest degradation during this period.

Table 5.2. Summary tables showing the extent of growing, stable and degrading forest across the project area.

| Canopy Change Type | Area (ha) | Area (%) |
|---|---|---|
| Growth | 49,620.45 | 58.5 |
| Stable | 32,871.18 | 38.8 |
| Degradation/deforestation | 2,307.46 | 2.7 |

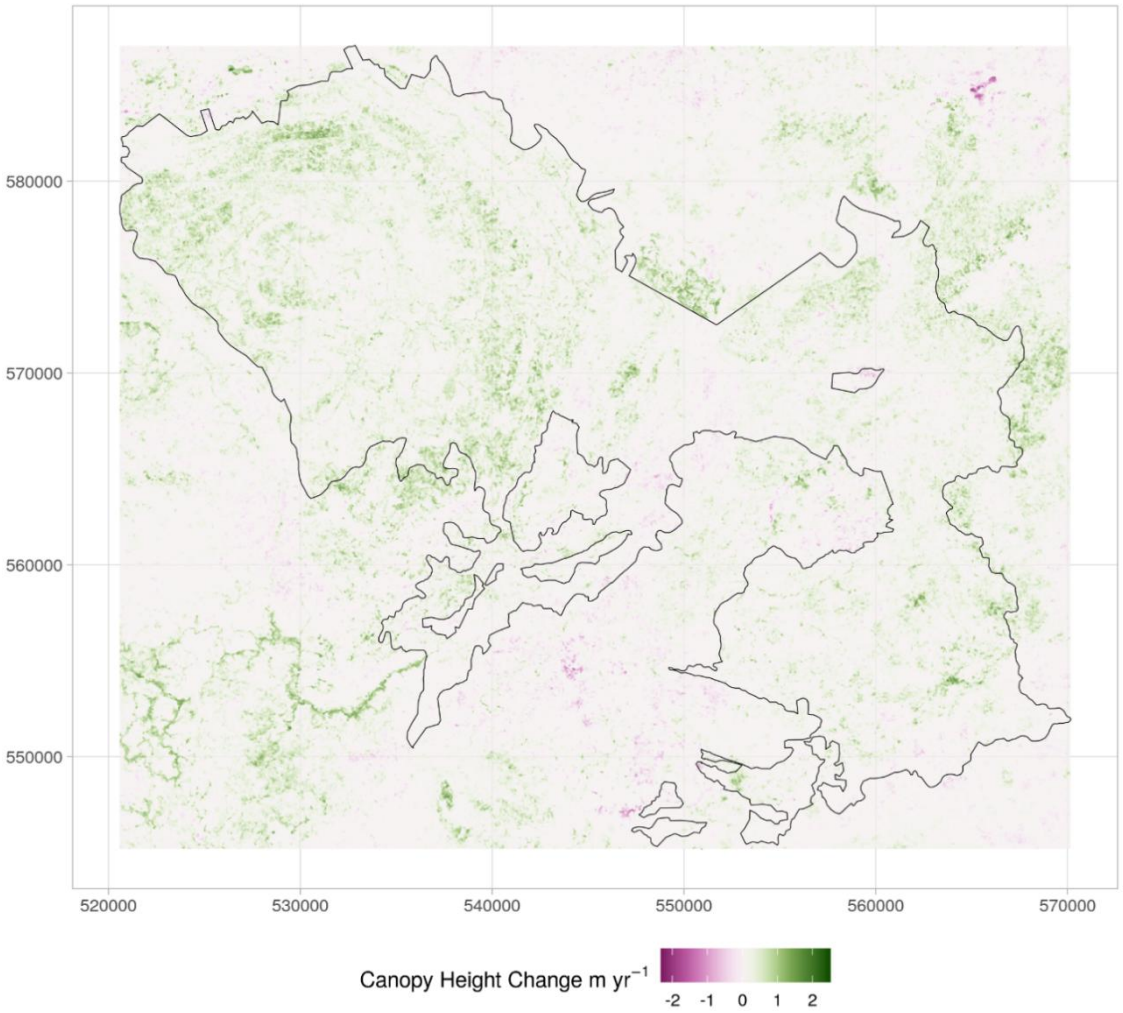



Figure 5.2. Map of the rate of canopy height change across the Project Area (boundaries are shown by the black line).

*Explanation:* Canopy structure plays an important role in the biodiversity and resilience of forest ecosystems (Nakamura *et al*., 2017). The Kuamut Project Area has undergone extensive historic timber extraction and, consequently, parts of the project were severely degraded in terms of forest structure condition. With the protection of the forest, these degraded areas appear to be recovering, with the fastest growth rates being observed in these historically degraded areas. This enhanced forest structure is likely to have multiple benefits for wider biodiversity, due to increased habitat availability. These recovering forest areas may also contribute to the available habitat of priority species such as Great Argus (*Argusianus argus*; Winarni *et al*., 2002), Sun Bear (*Helarctos malayanus;* Guharajan *et al*., 2021) and a number of hornbill species (Kuar *et al*., 2020).

Although some areas of the Project Area have experienced degradation, the extent is very limited. It is to be expected that degradation will occur due to a range of natural processes, which could explain some of these observed impacts. However, the highest concentration of degradation was located in the central Kuamut valley, where there has been known illegal forestry activity at the start of the project (i.e., pre-2022). Furthermore, this region comprises lower-stature, sparse forest, which may provide favorable browsing habitat for species such as elephants (see Evans *et al*., 2020), potentially reducing the survival of young trees or saplings. Additionally, the close proximity of this area to the Kuamut River may make it more prone to short-term inundation, which could explain the limited recovery observed in the area.

Aboveground biomass:

*Methods:* See Climate **section 3.1.3** for detailed methods of how aboveground biomass growth rates were calculated during the monitoring period using a combination of remotely sensed and forest plot data from the Kuamut Project Area.

*Results:* The data provided in Climate **section 3.1.3** shows that there has been relatively consistent aboveground biomass growth rates during both the last (2016-2021) and current (2022-2023) monitoring periods. Adjusted growth rates ranged from 1.98-2.84 Mg C/ha (depending on the management strata) during 2016-2021 and 2.03-2.98 Mg C/ha (depending on the management strata) during 2022-2023. These results show that there has been an annual increase in the aboveground biomass since the project's inception in 2015/2016. It is important to note that to some extent these growth rates reflect historic management practices within the Project Area. For example, steeper areas that have received less previous disturbance display lower overall growth rates compared to less steep (flatter) areas where logging activities are likely to have been more intensive. See Climate **section 3.1.3** for full details of the results relating to the aboveground biomass growth rate calculations.

*Explanation:* The reported increase in aboveground biomass is a result of natural forest regeneration following the full protection of the Project Area in 2015/2016. We anticipate that, over time, this will lead to an expansion of high-quality forest habitats, or habitats that are ecologically more similar to old-growth ('primary') forests, which harbor more disturbance-sensitive species compared to degraded forests (Dumbrell & Hill, 2005; Peh *et al*., 2005).

Although the full recovery or regeneration of forest habitats following disturbance can take many years—depending on the severity of the initial degradation—these results represent a positive step towards that goal. Forest regeneration in the most degraded parts of the Kuamut Project Area will benefit populations of forest dependent and disturbance-sensitive species by providing more suitable, good-quality, habitats. Aboveground biomass and diversity trends over time will be examined in subsequent monitoring periods to identify any potential relationships.

Forest Integrity Assessment (FIA) summary:

**FIA data were collected by the SEARRP and Permian Global teams, for full details of the FIA methods and results see 'Kuamut Project MR2 - FIA Report.docx' report and supporting data in the 'Vegetation quality: FIA surveys 2022' supporting evidence folders.**

*Methods*: To assess forest integrity, FIA pilot surveys were carried out by the Permian Global and SEARRP teams at 49 sites close to the camera trap stations (wherever possible) (see **Fig. 5.1a**) during 10/09/2022 and 16/09/2022 using the FIA tool (Suggit *et al*., 2021). FIA score has been shown to correlate with measures of forest condition, which include biodiversity vegetation structure, aboveground carbon, as well as aspects of ecosystem function (Suggit *et al*., 2021). A mean FIA score was calculated for each site and results were summarized.

*Results:* Initial results suggest that there is some variation in FIA score across sites, whilst average FIA score appeared slightly lower than those recorded in logged and primary forest sites in other forest reserves in Sabah (logged and primary forest data were collected by Suggitt *et al*., 2021; see **'Kuamut Project MR2 - FIA Report.docx'** report; **Fig. 3**). Nevertheless, some of our monitoring sites did have comparable scores to the logged and primary forest areas sampled by Suggitt *et al*. (2021). Note that some variation will be explained by different surveyors, as variation across individual surveyors can be high (see Suggitt *et al*. 2021). In addition, there also appeared to be a positive trend between mean FIA score and aboveground biomass in 2023 (see **'Kuamut Project MR2 - FIA Report.docx'** report; **Fig. 4**).

*Explanation:* Our results suggest that a number of our monitoring sites had relatively high forest integrity and are therefore likely to support important forest biodiversity and ecosystem functioning. FIA scores comparable to the areas of logged and primary forest are likely to be a direct consequence of project implementation, whereby the forest within the project area has been protected resulting in the termination of all logging activities and the prevention of the conversion to mosaic plantings. The forest within the Project Area is regenerating naturally, and we predict that FIA score is likely to increase over time. A positive trend between FIA score and aboveground biomass in 2023 is also encouraging, and further supports our assumption that carbon density in these disturbed forest settings reflects forest or vegetation quality. Following this pilot survey, where the focus was primarily on training staff and testing the methodology, FIA assessments will commence in 2025 so that forest integrity can be monitored over time.

**2. Presence of HCV 1 species**

Orangutan population monitoring summary:

**Orangutan population monitoring was led by Dr Felicity Oram and Pravind Segaran from SEARRP. For full details, see reports in the 'Presence of HCV 1 species: Orangutan monitoring 2023: Final reports by Dr Felicity Oram' folders. Additional supporting evidence in the form of a raw data excel file detailing nest locations is also provided**.

*Methods*: The Kuamut Project Area has a significant population of Bornean Orangutan (CR; *Pongo pygmaeus*) (Ancrenaz *et al*., 2005; Simon *et al*., 2019), which are thought to be in rapid decline in other parts of Borneo (Santika *et al* 2017), largely due to habitat loss and agricultural expansion, as well as hunting in recent decades (Voigt *et al*., 2018). Orangutans are therefore the main focus of the biodiversity monitoring program and the project's key trigger species (see **section 5.4**). Between 02/11/2023 and 03/11/2023 2023, orangutan nest surveys were conducted by helicopter and covered approximately 6% of the Kuamut Project Area (83,381 ha), as well as approximately 4.5% of a smaller area (400.39 ha) immediately south of the Project Area. See **Fig. 1** in the '**Final_Methodology_Kuamut_OU_2024_Oram.pdf**' report for a map of the seven helicopter line transects. Initial nest counts were converted to nest densities (taking into account inter-observer variables, weather, habitat type and habitat suitability, where relevant), and these nest densities were then used to estimate orangutan population numbers within the Project Area. It should be noted that orangutan densities are not uniform in space or time, and so these estimates reflect the most likely number of individuals within the Project Area at the point of surveying in November 2023. For this reason, we only qualitatively compare results with the previous statewide orangutan survey conducted by Simon *et al*. (2019), the results of which are cited in the first monitoring report.

*Results*: Across the survey period, 4382 orangutan nests were detected over 167.8 km of aerial line transects over the Project Area, whilst 1490 nests were detected over 60.5 km of aerial line transects in the forest immediately to the south of the Project Area. This final survey effort was 6.04% of the 83,381 ha of the Kuamut Project Area and 4.53% of the 40,039 ha reconnaissance area to the south. During these aerial surveys, 14 orangutans were observed, including a mother with an accompanying baby and adolescent. Following the same parameters as used by Simon *et al*. (2019) in their density calculations, the 2023 results corresponded to a mean density of 1.04 individuals per km$^2$ (95% CIs = 0.56–1.93), and an estimated population size of 868 (95% CIs = 468–1610) individuals across the whole Project Area (83,381 ha). Mean orangutan density was slightly higher in the area directly south of the Kuamut Project Area, at 1.09 individuals per km$^2$ (95% CIs = 0.59–2.03). Which corresponded to an estimated population size of 437 (95% CIs = 236–811) individuals within this area to the south (40,039 ha), see text in '**Final_ overview report _Kuamut_OU_2024_Oram.pdf**' report for a full breakdown of results.

*Evaluation*: The 2023 results are consistent with, and albeit slightly higher than, the orangutan population size estimated during the statewide survey by Simon *et al*. (2019) conducted between 2014 and 2017. These results by Simon *et al*. (2019) were cited in the previous (2015-2021) monitoring report. In the 2014-2017 survey, the population of orangutans within Northern Kuamut (West), Kuamut (West) and Northern Kuamut (East) was estimated at 193

(95% CIs = 128-292), 20 (95% CIs = 13-31) and 417 (95% CIs = 281-619) individuals, respectively, which corresponds to densities of 0.38 (95% CIs = 281-619), 0.28 (95% CIs = 281-619) and 1.08 (95% CIs = 281-619) individuals per $km^2$, respectively. When summed, the Simon *et al*. (2019) results suggest that at the time of surveying there was approximately 630 individuals (summed 95% CIs = 422-942) across an area of 96,310 ha, which was roughly the same size as the Kuamut Project Area. By qualitatively comparing our results to the those from the Simon *et al*. (2019) statewide survey conducted in 2014-2017, we are confident that the orangutan population within the Kuamut Project Area has remained stable since the last monitoring period, and that there is no evidence to indicate a significant population decline. This stability is likely a direct consequence of project implementation, and the reclassification of the area to a Class I (Protection) Forest Reserve in 2015/2016, where all logging activities have been terminated and further disturbance from land conversion to mosaic plantings has been avoided. Consequently, the population of orangutans and their habitat are able to recover naturally.

It is important to note that the population density of orangutans in the smaller area to the south of the Kuamut Project Area was also high, and this may be due to increasing social pressure on the orangutan community in that area due to continued disturbance from active logging operations and/or vegetation clearance (see **Fig. 5.3**). This may suggest active movement by male orangutans away from such areas that are close to the vicinity of the Project Area. This is discussed further in the report by Dr Felicity Oram (see **'Final_ overview report _Kuamut_OU_2024_Oram.pdf**' in the supporting evidence), but emphasizes the importance of the Project Area for conserving orangutans in this part of central Sabah.

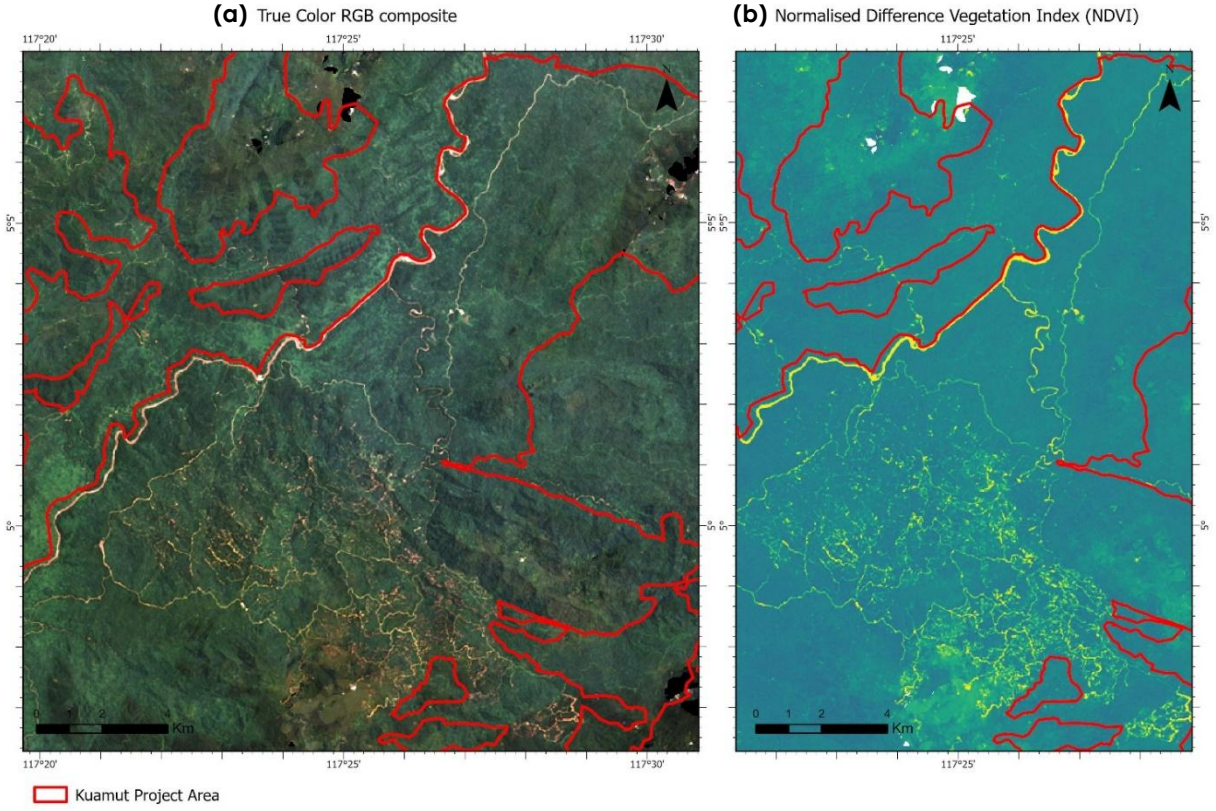



Figure 5.3. Reference map showing the active logging operations on the project's southern border. The True-Color composite (a), and the derived NDVI map (b), were generated with Landsat 8-9 and Sentinel-2 imagery acquired from 01/01/2024 - 07/03/2024. In (b), blue areas = high NDVI, whilst yellow areas = low NDVI, suggesting active disturbance within these areas from logging and/or vegetation clearance.

Camera trapping summary:

Camera trap data were collected by the SEARRP and Permian Global teams, for full details of the camera trap methods and results see 'Kuamut Project MR2 - Camera Trapping Report.docx' report in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023' folders. Summarized camera trap records are also provided in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023: Camera trap data 2022 and 2023' folders. A subset of raw camera trap images and videos from 2023 can also be found in these supporting evidence folders.

*Methods:* To monitor the community of ground-dwelling birds and mammals within the Project Area the SEARRP and Permian Global field teams deployed a network of camera traps in 2022 and 2023. In 2022, 49 camera traps (Bushnell 119987M) were deployed as part of a pilot survey (**Fig. 5.1a**), so that the team could be trained in camera trap deployment and data collection. These traps were deployed primarily in the riparian areas along the Melian and Kuamut rivers due to their accessibility. Data were summarized and analyzed from 48 sites in

2022 across a 77-day period from 09/09/2022 - 25/11/2022 (**see Fig. 1** in '**Kuamut Project MR2 - Camera Trapping Report.docx**' report). In 2023, 31 camera traps were deployed; 13 camera traps stayed in the same location as 2022, whilst 18 traps were moved to new locations further into the Project Area (**Fig. 5.1b**). This change was so that biodiversity monitoring sites would encompass a greater elevation range, different forest and soil types, and variations in aboveground biomass. Data were summarized and analyzed from the 31 sites across a 164-day period from 11/05/2023 - 22/10/2023. For each species, we summarized the number of locations it was found at, the number of independent capture events along with the Camera Trapping Rate (CTR). The CTR is an index of activity that takes into account sampling effort; see Rovero & Marshall, 2009 and '**Kuamut Project MR2 - Camera Trapping Report.docx**' report for details). It is also referred to as Trap Success Rate (RTS) or Photographic Capture Rate (PCR), but we use CTR throughout this document and supporting information. We also examined species accumulation curves across the 2022-2023 data to determine whether the number of species captured reached asymptote, and examined any preliminary trends in site-level species richness in 2023 and aboveground biomass. Note that we analyzed the data separately for 2022 and 2023 due to differences in sampling methods, and so we qualitatively compare the results.

*Results:* In total, across all sites and camera trap days during 2022 and 2023, we detected 61 species, which corresponded to 36 RTE species (comprising 11 birds, 23 mammals and 2 reptiles). This included two species listed as CR (Bornean Orangutan: *Pongo pygmaeus* and Sunda Pangolin: *Manis javanica*), six listed as EN (Asian Elephant: *Elephas maximus*, Banteng: *Bos javanicus*, Borneo Bay Cat: *Catopuma badia*, Long-tailed Macaque: *Macaca fascicularis*, Otter Civet: *Cynogale bennettii* and Southern Pig-tailed Macaque: *Macaca nemestrina*) and 13 listed as VU (Asian Small-clawed Otter: *Aonyx cinereus*, Bearded Pig: *Sus barbatus*, Binturong: Arctictis binturong, Black Hornbill: *Anthracoceros malayanus*, Bornean Crested Fireback: *Lophura ignita*, Bornean Ground-cuckoo: *Carpococcyx radiatus*, Crested Partridge: *Rollulus rouloul*, Great Argus: *Argusianus argus*, Horsfield's Tarsier: *Cephalopachus bancanus*, Sambar (deer): *Rusa unicolor*, Smooth-coat Otter: *Lutrogale perspicillata*, Sun Bear: *Helarctos malayanus* and Sunda Clouded Leopard: *Neofelis diardi*). For a list of RTE bird, mammal and reptile species that are within the Project Area and an update on their status during this monitoring period see **'Records and status update of RTE species during 2nd MR period KRCP 20240805.xls'** file in the **'Presence of HCV 1 species'** folder for details. Species accumulation curves for 2022 and 2023 appeared to be approaching, although did not quite reach, asymptote (see **Figs 4 & 9** in the **'Kuamut Project MR2 - Camera Trapping Report.docx'** report).

Across both years of sampling, the species with the highest CRT included the Sambar (deer) (*Rusa unicolor*, VU), Bornean Crested Fireback (*Lophura ignita*, VU), Southern Pig-Tailed Macaque (*Macaca nemestrina*, EN). Overall, these species were also found at the highest number of sites, along with the Sun Bear (*Helarctos malayanus*, VU) (see **Tables 2 & 3** in the **'Kuamut Project MR2 - Camera Trapping Report.docx'** report). Two CR species were recorded on multiple occasions, these included the Bornean Orangutan (*Pongo pygmaeus*) that was

detected at 2 and 5 sites in 2022 and 2023, respectively, and the Sunda Pangolin (*Manis javanica*) that was detected at 5 and 6 sites in 2022 and 2023, respectively. Whilst five out of the six EN species, including the Asian Elephant (*Elephas maximus*), Banteng (*Bos javanicus*), Long-tailed Macaque (*Macaca fascicularis*), Otter Civet (*Cynogale bennettii*) and Southern Pig-tailed Macaque (*Macaca nemestrina*), were found at more than one location in during 2022 and/or 2023. The Borneo Bay Cat (*Catopuma badia*) was only found at one location in one independent capture event during the 2023 monitoring (see **Tables 2 & 3** in the **'Kuamut Project MR2 - Camera Trapping Report.docx'** report). There appeared to be a positive trend between raw site-level species richness and estimated site-level species richness (i.e., to account for differences in site-level sampling effort) and aboveground biomass (see **Fig. 10** in the **'Kuamut Project MR2 - Camera Trapping Report.docx'** report). However, further analysis will be needed with more data to determine whether this relationship is statistically significant.

*Explanation:* Throughout our camera trap monitoring, we have detected a number of species of conservation concern, which included two critically endangered (CR) species, the Bornean Orangutan (*Pongo pygmaeus*) and the Sunda Pangolin (*Manis javanica*). Repeated captures of both these CR species across both years of monitoring suggests that there are likely to be persistent populations residing within the Project Area. For the Bornean Orangutan (*Pongo pygmaeus*), this assumption is further supported by the helicopter nest surveys and population monitoring that took place in 2023 (see **section 5.4**). The high number of other RTE species found within the Project Area, also suggests that the Project Area is of extremely high biodiversity value for forest wildlife. A number of the species detected, including the Sun Bear (*Helarctos malayanus*, VU), Sunda Clouded Leopard (*Neofelis diardi*, VU), Sunda Pangolin (*Manis javanica*, CR), Great Argus (*Argusianus argus*, VU), Bearded Pig (*Sus barbatus*, VU), Southern Pig-tailed Macaque (*Macaca nemestrina*, EN) and Banded Civet (*Hemigalus derbyanus*, NT), were recorded in the Project Area during camera trapping in 2016 by Tilker *et al*. (2019) (results are reported in the first monitoring report). The continued presence of many of these RTE species is encouraging and likely a direct result of project implementation. In the without-project scenario, we predict that many ground-dwelling bird and mammal species would have declined or been negatively impacted due to continued logging and conversion of much of the area to mosaic plantings. This would have had particularly negative impacts on forest specialists that are associated with high-quality or interior forest habitats. As evidenced through the continuous patrols by project partners RBJ and the satellite monitoring (see points 3 & 4 below), we are confident that threats of hunting and forest disturbance within the Project Area are minimal. We therefore assume that populations of many RTE species have remained relatively stable given that the forest is regenerating naturally following previous disturbances before the area became a Class I (Protection) Forest Reserve. The systematic camera trap monitoring conducted in 2023 will form a baseline over which we can examine species presence, activity rates and/or abundance over time and against which we can assess the impact of project management interventions.

Bioacoustic monitoring summary:

Acoustic data were collected by the SEARRP and Permian Global team with guidance from Dr Joshua Taylor from Social Environment CIC, who is currently analysing the results. The aim of the bioacoustic monitoring work was to use state-of-the-art technology to train and develop acoustic classifier (or 'AI') models that can detect bird, mammal and amphibian species of interest from their unique calls or vocalizations. For full details of the bioacoustic methods and results see 'D021-04-01_Kuamut_bioacoustics_report_final.pdf' Phase 1 report by Social Environment CIC in the 'Presence of HCV 1 species: Bioacoustics 2022 and 2023' supporting evidence folders. The project proposal document 'Q21-03-001-A00 Kuamut Bioacoustics Proposal.pdf' as well as other interim/progress reports are also found in this supporting evidence folder.

*Methods:*

Data collection: Audio data were collected using bioacoustic monitoring devices (Song Meters; Wildlife Acoustics Song Meter Micro) that were deployed in the same locations as the camera traps and during the same time period in 2022 and 2023 (see above section). This consisted of 49 sampling site locations in 2022 (see **Fig 5.1a**) and 31 sampling site locations in 2023 (see **Fig 5.1b**). Acoustic recorders were set to record at different sampling durations during 2022-2023, in order to test which sampling intervals were most appropriate for future analyses (i.e., detecting the most vocalisations from species of interest, whilst conserving battery life). In 2022, acoustic recorders were set to record continuously between 11/09/2022 and 23/10/2022. Whilst in 2023, recorders were set to record for either two hours at both dawn and dusk or for five minutes per hour so that we could examine these sampling intervals against vocalisation frequency for the species of interest. As bioacoustic monitoring is an emerging field within ecology, the primary aims of the 2022-2023 surveys were to test the methodology and train the team in the deployment of the acoustic devices. Acoustic data were subsequently cleaned, which involved removing any audio data that was unreadable or not part of the survey.

Exploratory analyses overview: Analyses were conducted for the 2022-2023 monitoring period by Dr Joshua Taylor. These included: (1) assessing existing acoustic classification models and selecting the most appropriate; (2) creating a reference library of audio recordings (i.e., training data) for each species/species group of interest; (3) performing the validation for automatic classifications and audio clips that will be used to train new classifiers; and (4) training classifier models and performing visual inference analyses on the full set of audio data collected from the Project Area during 2022-2023 for each species of interest. Note that a range of these activities were still in progress at the end of the current monitoring period (December 2023) and remain ongoing at the time of writing (August 2024); therefore, we present a summary of points 1-3 below. The 20 focal species/species groups initially chosen

for bioacoustic monitoring are shown in **Table 5.3**.

Choosing appropriate classifier models (1): The BirdNET multi-label bioacoustics classifier developed by the University of Cornell (Kahl et al., 2021) and the Google Perch multi-label bird classification model published by Google Research in March 2023 (Google Research, 2023; see https://github.com/google-research/perch) were chosen as appropriate classifier models to evaluate. We examined unvalidated detection counts for focal species within the audio data collected in the field using these models. This allowed us to determine which focal species the models could recognize. Note that further validation will be required by human experts to determine whether classifications were in fact true detections of the focal species (see below). These expert validations are currently underway.

Acquiring training data (2): As the BirdNET and Google Perch classifiers used weakly-labelled training data, reference audio recordings were required for all species of interest to use as training data. Reference audio recordings of species of interest were obtained from a variety of sources including bioacoustics libraries and research databases. A target was set to find 100 unique audio samples for each of the 20 species.

In-person validation of training data (3): Unvalidated classifications have not yet undergone a thorough verification process by human experts to confirm accuracy or reliability. Therefore, unvalidated classifications from the BirdNET model for focal species, along with associated training data, were validated during an in-person workshop in Kota Kinabalu (Sabah, Malaysia) during December 2023 by a panel of local wildlife experts. The aim of the workshop was to reject incorrect (false positive) detections from the BirdNET classifier. Full details of the in-person validation workshop are in the report by Social Environment CIC in the supporting evidence. Validated classifications will subsequently be used to calibrate the automatic classifications made by the AI classifiers.

*Preliminary results:*

Choosing appropriate classifier models (1): The BirdNET and Google Perch classifier models are trained to recognize thirteen out of the 20 focal species/species groups. Using these unvalidated models, we examined when these species were detected in the audio data collected during 2022-2023. By inspecting these unvalidated detection counts in relation to the time of day they were recorded, we were able to visually examine when species were likely to be the most vocal. It appeared that many species were vocal throughout the day (and night for the nocturnal owl species), and so we decided that setting the bioacoustic monitoring devices to record for 5 mins per hour was more efficient than recoding for an hour or two at dusk and dawn. This was a compromise between capturing as many calls as possible from the species of interest and prolonging both battery life and SD card memory.

Acquiring training data (2): Following our search for appropriate training data, a sufficient number of audio samples were found for a range of species, which included Wrinkled Hornbill (*Rhabdotorrhinus corrugatus,* EN), Great Slaty Woodpecker (*Mulleripicus pulverulentus*, VU),

Black-and-yellow Broadbill (*Eurylaimus ochromalus*, NT; chosen as a common forest species), Chestnut-rumped Babbler (*Stachyris maculata*, NT; chosen as a common forest species) and Northern Gray Gibbon (*Hylobates funereus*, EN). The Helmeted Hornbill (*Rhinoplax vigil*, CR), Wrinkled Hornbill (*Rhabdotorrhinus corrugatus,* EN) and Wreathed Hornbill (*Rhyticeros undulatus*, VU) had a marginal number of audio samples, but ideally more training data will be required for accurate classification. We could not source any reference data for the Sabah Grizzled Langur (*Presbytis sabana*, EN) and there were very few samples available for known frog species. These species/species groups will either have to be dropped as species of interest, or additional training data will need to be sourced – with decisions made during the next monitoring period.

In-person validation of training data (3): Following the in-person validation of the BirdNET model's automatic classifications, subsequent calibration was performed on these model classifications. Classification accuracy was found to be generally poor for the majority of species of interest. However, classification accuracy passed the 95% confidence-score thresholds (i.e., where 95% of the validated data points are true positives) for six species of interest, which included Wrinkled Hornbill (*Rhabdotorrhinus corrugatus*, EN), Rhinoceros Hornbill (*Buceros rhinoceros*, VU), Black Hornbill (*Anthracoceros malayanus*, VU), Great Slaty Woodpecker (*Mulleripicus pulverulentus*, VU), Black and yellow Broadbill (*Eurylaimus ochromalus*, NT) and Chestnut-rumped Babbler (*Stachyris maculata*, NT).

*Explanation:* These exploratory bioacoustic analyses are novel and complex, and take considerable time and technical insight to develop. We have presented some preliminary results of our exploratory analyses that were conducted during the monitoring period, as well as some of the key decisions made during the initial analyses. We have researched and selected appropriate species of interest and acoustic classifier models, examined unvalidated detection counts for focal species within audio data collected in the field, collected acoustic training data for a number of species of interest, used-in person validation to check the accuracy of unvalidated classifications from the BirdNET model classifier and calibrated automatic classifications made by the BirdNET classifier for a number of species. This represents significant progress in being able to accurately identity species of interest from acoustic data collected within the Kuamut Project Area using AI technology. The next steps are to improve the quality of training data for species of interest where audio data are lacking, validate the outputs of classifier models trained on this data and develop new classifier models for species where existing classifier models have low accuracy. We will also perform model inference for the full set of survey audio data recorded in the Project Area during 2022 and 2023 for species of interest for which we have accurate AI models. Full results of which will be presented in future monitoring reports.

Table 5.3. List of focal species initially selected for the bioacoustic monitoring. Species were selected based on their vocalisations (species need to have unique calls and be relatively vocal), their IUCN Red List status (CR and EN species were prioritised) and their ecology (e.g., many Hornbills require large trees and good quality forest for breeding). Some more common species were also included to help ensure that our classifier models were performing properly across monitoring sites.

| Common Name | Latin Name | IUCN Red List Category | Ebird Code |
|---|---|---|---|
| Helmeted Hornbill | *Rhinoplax vigil* | Critically Endangered | helhor1 |
| White-crowned Hornbill | *Berenicornis comatus* | Endangered | whchor2 |
| Wrinkled Hornbill | *Rhabdotorrhinus corrugatus* | Endangered | wrihor1 |
| Rhinoceros Hornbill | *Buceros rhinoceros* | Vulnerable | rhihor1 |
| Wreathed Hornbill | *Rhyticeros undulatus* | Vulnerable | wrehor1 |
| Black Hornbill | *Anthracoceros malayanus* | Vulnerable | blahor1 |
| Straw-headed Bulbul | *Pycnonotus zeylanicus* | Critically Endangered | sthbul1 |
| Great Slaty Woodpecker | *Mulleripicus pulverulentus* | Vulnerable | grswoo1 |
| Large-billed Blue-flycatcher | *Cyornis caerulatus* | Vulnerable | lobblf1 |
| Bornean Bristlehead | *Pityriasis gymnocephala* | Vulnerable | borbri1 |
| Reddish Scops-owl | *Otus rufescens* | Near Threatened | resowl1 |
| Bornean Peacock-pheasant | *Polyplectron schleiermacheri* | Endangered | bopphe1 |
| Bulwer's pheasant | *Lophura bulweri* | Vulnerable | bulphe1 |
| Black-and-yellow Broadbill | *Eurylaimus ochromalus* | Near Threatened | baybro1 |
| Chestnut-rumped Babbler | *Stachyris maculata* | Near Threatened | chrbab1 |
| Bornean Orangutan | *Pongo pygmaeus* | Endangered | - |
| Northern Gray Gibbon | *Hylobates funereus* | Endangered | - |
| The Red Langur | *Presbytis rubicunda* | Vulnerable | - |
| Sabah Grizzled Langur | *Presbytis sabana* | Endangered | - |
| Frogs | Anura (order) | - | - |

Dung beetle survey summary:

**Dung beetle data were collected by the SEARRP and Permian Global teams with assistance and guidance from Dr Eleanor Slade and Dr Li Yuen Chiew from Nanyang Technological University, Singapore. For full details of the dung beetle monitoring methods, results and evaluation see 'Kuamut Project MR2 - Dung Beetle Report.docx' report in 'Presence of HCV 1 species: Dung beetle surveys 2022' folders. Raw dung beetle survey results are also provided in these supporting files.**

*Methods:* Dung beetles are an excellent focal taxa to use for examining diversity, ecosystem functioning and the impacts of habitat disturbance in tropical forest systems (Nichols *et al*., 2007; Slade *et al*., 2011). To assess the dung beetle community within the Project Area and train the team in dung beetle collection methods, ground and arboreal dung-baited traps were deployed during 11/09/2022 and 18/09/2022. Ground-baited pitfall traps were laid during 2022 at 49 sites close to the camera traps wherever possible (see **Fig. 5.1a**), whilst arboreal traps were placed at five of the sampling sites (see **Fig. 1** in the '**Kuamut Project MR2 - Dung Beetle Report.docx**' report for map of trap locations). For every site, we calculated the species richness and overall abundance of dung-beetles captured at each. Whilst for the ground traps, we calculated Shannon-Weiner and Simpson diversity indices (two commonly used diversity indices).

*Results:* During the 2022 pilot dung beetle study, a total of 42 dung beetle species were recorded in the ground pitfall traps and eight species detected in the arboreal traps (44 species in total). Overall, 17 dung beetles species were found that are associated with either old growth and/or logged forest habitats, as well as 12 that are endemic to Borneo (of which one species is endemic to Sabah) (see **Table 1** and **Fig. 3** in the '**Kuamut Project MR2 - Dung Beetle Report.docx**' report). At least one forest or endemic species was found at 44 (89%) of the sampling sites.

*Explanation:* Our preliminary findings suggest that the Project Area holds high biodiversity value for dung beetles, and likely for the mammals whose dung they feed upon. This is evidenced by the relatively high number of forest specialists identified across the sampling sites, as well as the detection of all three functionally important, large roller species known to Sabah (*Paragymnopleurus sp.*), which have been shown to be associated with high-quality forest sites (Senior, 2014). Additionally, a healthy population of forest indicator species (e.g., *Catharsius dayacus*) were also detected, which are associated with old growth and logged forests (Slade *et al*., 2011). The results from this pilot survey provide a baseline for understanding the biodiversity value of the area for these invertebrates. However, we aim to track changes in the presence and abundance of key forest dung beetle species, as well as the assemblage composition of the dung beetle community, over time in order to determine the impact of forest regeneration and recovery on invertebrate biodiversity within the Project Area.

RTE plant species summary:

**RTE tree species data were collected by the SEARRP and Permian Global teams since the start of the project (2015-2022). For full details of field plot measurements in the Kuamut project area during the monitoring period see climate section 3.1.1. For a list of RTE tree species found during the climate monitoring, see the 'plot-iucn-sp.xls' file in the 'Vegetation quality' supporting evidence folder.**

*Methods:* During 2015-2016, Permian Malaysia conducted a survey to monitor the IUCN red list status' of all the tree species in all 46 field sites (as used for the climate data; see Climate **section 3.1.1** for details). These sites were remeasured (including new botanical work) between 2021 and 2022, with the majority of field plots assessed in 2022. The data, therefore, spans both the last and current monitoring period. We expect that this assessment of tree species will not have changed between 2022 and 2023 as very limited forest disturbance has occurred within the monitoring period (see points 1 and 3).

*Results*: A total of 34 threatened tree species were found during our previous surveys in 2015-2016 and those in 2021-2022, which included six CR species, five EN species and 23 VU species. The species list, including the number of individuals, is provided in **Table 5.4**, and the full survey results are available to the auditors.

*Explanation:* Project intervention has ensured the full protection of the Project Area, resulting in the avoidance of logging and other forms of anthropogenic disturbance, such as conversion to mosaic plantings. As a result, RTE tree species in the Project Area have been fully protected, and their populations have been able to reproduce and recover from previous disturbances. Large, commercially important tree species, such as many dipterocarps (e.g., *Dipterocarpus, Hopea, Shorea sp*.), which are frequently the target of selective logging (Saner et al., 2012), have persisted within the Project Area. Therefore, many adult trees that would have otherwise been removed through selective logging have been preserved.

Table 5.4. List of threatened tree species which have been identified within the Kuamut Project Area, based on botanical analysis of the forest field plots in 2015-2016 and 2021-22. Note that IUCN status' of all tree species are reflective of March 2024.

| Scientific Name | Number Of Individuals | Red List Category |
|---|---|---|
| *Alangium havilandii* | 7 | Vulnerable |
| *Anisoptera laevis* | 2 | Vulnerable |
| *Aquilaria beccariana* | 2 | Vulnerable |
| *Artocarpus anisophyllus* | 4 | Vulnerable |
| *Artocarpus tamaran* | 2 | Vulnerable |
| *Chisocheton pauciflorus* | 2 | Vulnerable |
| *Dillenia borneensis* | 2 | Vulnerable |
| *Diospyros daemona* | 1 | Vulnerable |
| *Dipterocarpus conformis* | 7 | Endangered |
| *Dryobalanops beccarii* | 17 | Endangered |
| *Durio grandiflorus* | 1 | Vulnerable |
| *Durio kutejensis* | 5 | Vulnerable |
| *Eusideroxylon zwageri* | 8 | Vulnerable |
| *Hopea beccariana* | 1 | Vulnerable |
| *Hopea ferruginea* | 9 | Critically Endangered |
| *Hopea nervosa* | 8 | Critically Endangered |
| *Hopea plagata* | 24 | Critically Endangered |
| *Hopea sangal* | 9 | Vulnerable |
| *Madhuca elmeri* | 3 | Endangered |
| *Palaquium maingayi* | 1 | Vulnerable |
| *Shorea acuminatissima* | 2 | Vulnerable |
| *Shorea atrinervosa* | 8 | Vulnerable |
| *Shorea faguetiana* | 18 | Endangered |
| *Shorea falciferoides* | 5 | Vulnerable |
| *Shorea ferruginea* | 6 | Vulnerable |
| *Shorea gibbosa* | 9 | Critically Endangered |
| *Shorea guiso* | 2 | Vulnerable |
| *Shorea johorensis* | 22 | Critically Endangered |
| *Shorea leptoderma* | 3 | Critically Endangered |
| *Shorea mecistopteryx* | 21 | Vulnerable |
| *Shorea pauciflora* | 21 | Endangered |
| *Shorea smithiana* | 1 | Vulnerable |

| | | |
|---|---|---|
| *Shorea superba* | 7 | Vulnerable |
| *Shorea symingtonii* | 3 | Vulnerable |

### 3. Signs of anthropogenic disturbance

**Signs of anthropogenic disturbance were monitored in different ways. The Permian technical team uses near real-time satellite imagery to monitor forest disturbances (see Climate section 3.1.3), whilst the RBJ team conducts security patrols, and records any instances of anthropogenic disturbance. RBJ patrol reports, along with summaries of each report, can be found in the 'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023' folders.**

Satellite monitoring summary

*Methods:* To monitor forest disturbances (e.g., fire, non-fire forest disturbances plus logging), aboveground biomass and forest regrowth data were complemented with analyses of optical data products (Landsat 8 (OLI) & Sentinel-2). More specifically, NASA-FIRMS (https://firms.modaps.eosdis.nasa.gov/map/) and Global Forest Watch (https://www.globalforestwatch.org/) fire and deforestation alerts were set up to provide near real-time information that was used as a guide for the RBJ, SEARRP and/or Permian field teams to check specific locations where deforestation and/or logging activities may be occurring. In addition to the automatic earth observation (EO) alerts, the Permian technical team conducted weekly assessments of the Project Area using PlanetLab high-resolution imagery. These products have a proven capability for deforestation detection and some capacity for degradation detection. Data were monitored to assess the current monitoring period between 2022-2023, and the full methodological details are described in detail in Climate **section 3.1.3**.

*Results:* Our evaluation of recent satellite data have shown that there have been no instances of anthropogenic forest disturbance larger than 2.5 ha detected within the Project Area during 2022-2023. Hence, no major forest fires or logging activities have occurred during the monitoring period. However, there was one instance of forest disturbance in 2023 that was a result of flooding, where a small number trees died. Once detected by the Permian technical team, RBJ were notified and deployed to the area of concern immediately (i.e., on the same day) to check that this was not from any illegal activity. Not that on the day that the RBJ team received the notification, they were already patrolling a nearby area and so could respond straight away. See '**2023 flooding event.pdf**' in the **'Patrolling and threat monitoring: Flooding event 2023'** folders in the supporting evidence.

*Explanation*: As a result of project inception, there have been no instances of anthropogenic forest disturbance through logging, land clearing or fires during the monitoring period, evidenced by our analyses of available remotely sensed data. This has enabled forest regrowth and regeneration within the Project Area, particularly in heavily degraded areas, which has been evidenced by overall increases in aboveground biomass (see point 1 above). Forest regeneration will result in improved forest quality, biodiversity and ecosystem functioning in the long term. Should any incidences of anthropogenic disturbances occur in future, we are confident that these will be dealt with swiftly and appropriately by the RBJ team on the ground.

Security patrols

*Methods:* During 2022 and 2023, the RBJ team conducted monthly routine patrols, with reports subsequently provided to Permian Global (see **Patrolling and threat monitoring: Flooding event 2023'** folders for patrol reports). The schedule and dates of these patrols varied each month to prevent potential offenders from predicting their timing and locations. Patrols covered all entry and exit points and other possible routes that illegal operatives might use. The team utilized 4WD vehicles, boats, and helicopters for these patrols, supplemented by near real-time monitoring with satellite data and drones (see Climate **section 3.1.3** for details). Monitoring efforts included checking for encroachment, observing logging activity, and noting the presence of wildlife (primarily in 2023).

*Results:* During the first quarter of 2022, one incidence of land encroachment occurred at Camp Silam (a small area of 80x80 square meters), which was outside the Kuamut Project Area and promptly referred to the Sabah Forestry Department. From April to June, a collapsed bridge affected vehicle patrols, necessitating patrols on foot and by boat. No illegal activity was recorded during this period or until the end of the year.

During the 2023 monitoring period, very limited signs of illegal activity were detected. During an aerial survey in March, outsiders believed to be from nearby communities were spotted on the Kuamut River using boats to harvest resources from the forest and river. Wildlife presence was recorded in most months, either through direct sightings or evidence of their activity.

*Explanation*: As a result of project inception and the reclassification of the area to a Class 1 (Protection) Forest Reserve, there have been no instances of anthropogenic forest disturbance through logging, land clearing or fires within the Project Area during the 2022-2023 monitoring period. This is not only evidenced by our analyses of remotely sensed data, but also from the limited signs of anthropogenic disturbance documented during the regular RBJ security patrols. Should any disturbances occur, they will be dealt with promptly so that appropriate action can be taken. Minimizing anthropogenic disturbance to the forest habitat will enable forest regrowth and regeneration.

4. Status of hunting activities

**Signs of anthropogenic disturbance were monitored in different ways. The RBJ team conducts security patrols, and record any instances of suspected hunting activities. RBJ patrol reports, along with summaries of each report, can be found in the 'Patrolling and threat monitoring: RBJ patrol reports 2022 and 2023' folders. Camera trapping was also conducted by the SEARRP and Permian teams and details are provided in section 5.3, with supporting evidence in the 'Presence of HCV 1 species: Camera trapping 2022 and 2023 ' folders.**

Security patrols

*Methods:* See point 3 above and patrol reports in the supporting evidence folders for details of the security patrols conducted by RBJ.

*Results:* In January 2022, there was one incidence of suspected hunting activity and a guard post was constructed on the road to Comp. 139 in response.

*Explanation*: Results from these patrols suggest that the incidences of hunting within the Project Area are very infrequent. However, should they arise, they will be quickly dealt with by reporting any suspected activities to Sabah Forestry Department or appropriate relevant authorities.

Camera trap surveys

*Methods:* See above and the supporting evidence for a summary of the camera trapping methods.

*Results:* Across 241 days of camera trapping between 09/09/2022 - 25/11/2022 (77 days; 48 sites) and 11/05/2023 - 22/10/2023 (164 days; 31 sites) there were no instances of hunting activities detected on the camera trap images. Furthermore, no evidence or instances of hunting activities were recorded by the KFRC team when carrying out biodiversity monitoring activities during 2022 and 2023.

*Explanation*: These results support the findings of previous studies (e.g., Tilker *et al*., 2019), as well as the RBJ patrol data and provide further evidence that the threat of hunting to biodiversity within the Project Area is currently thought to be low.

### 5.3.2 Biodiversity Monitoring Plan Dissemination (CCB, B4.3)

During the 2022-2023 period, the specific methodologies for biodiversity data collection were established, and the logistical requirements for deploying a field team over a large and relatively inaccessible area were assessed. Initial delays due to the Covid-19 pandemic meant that many of these activities were postponed and took place during the current (2022-2023) monitoring period instead of the previous one (2015-2021). Hence, the results of the 2022-2023 biodiversity monitoring have only recently been analyzed. Now that these results are

finalized, they will be disseminated in more detail on the Permian Global and SEARRP websites. They will also be disseminated to local communities and all relevant stakeholders (e.g., RBJ, Sabah Forestry Department, local NGOs) in due course. Outlined below are the details of the biodiversity monitoring activities that have been made public, along with dissemination activities that have currently been done. We also mention possible plans for future dissemination of the biodiversity work.

Publicly available information:

The Kuamut Rainforest Conservation Project (KRCP) Biodiversity Monitoring Plan was developed and submitted for validation along with the Kuamut Project Description Document (PDD) and 1st Monitoring Report (MR1) on July 8th, 2022. All of these validation and verification documents for KRCP are publicly available on the VERRA website (https://registry.verra.org/app/projectDetail/CCB/2609). General information about the KRCP can also be found on the Permian Global (https://permianglobal.com/projects/kuamut-rainforest-conservation-project/) and SEARRP (https://www.searrp.org/) websites. Biodiversity monitoring activities have occasionally been featured on social media, such as the Permian Global LinkedIn page (https://www.linkedin.com/company/permian-global/mycompany/), the KRCP Instagram page (@kuamurcp), as well as on the SEARRP (e.g., https://www.searrp.org/category/news/page/3/) and Permian Global websites. For example, Permian Global biodiversity staff Dr. Sarah Scriven and Dr. Sunarto have discussed some of the biodiversity monitoring work on the company podcast on the Permian Global website (https://permianglobal.com/category/podcast/). Project partners have also occasionally promoted the biodiversity monitoring activities that they have been involved in (e.g., Dr Eleanor Slade and Dr Li Yuen Chiew from Nanyang Technological University, Singapore: https://teelabntu.wixsite.com/home/post/kuamut-rainforest-conservation-project-biodiversity-data-management-and-analysis-workshop).

Dissemination to stakeholders and communities:

Some informal dissemination of biodiversity monitoring activities has been done with NGOs, village leaders, and communities during field visits by SEARRP, Permian Global, and PACOS. This includes a Community Development Plan (CDP) workshop hosted by PACOS in November 2022. Although the workshop's focus wasn't biodiversity monitoring, species conservation within the Project Area was discussed (see the '**Dissemination: Stakeholders and communities**' folders in the supporting evidence for workshop details). Additionally, the KRCP biodiversity field team also met with the local leaders in both Kuamut and Karamuak village clusters before and during every fieldwork period to coordinate activities on the ground. Some village members are directly involved as part of the field team, serving as field assistants, boatmen, and in other supporting roles. While traveling to field sites and conducting fieldwork, the KRCP biodiversity team stayed within the villages, either with a local family (in Kuamut) or in the community forestry center. This facilitated direct interactions with villagers (including village leaders) and open discussions about the biodiversity monitoring work and other project activities whenever

opportunities arose. Some village leaders and selected members of the community from Kuamut and Karamuak village clusters were also invited and participated in the field safety training organized by the KRCP biodiversity team (reports on this training can be found in the '**Dissemination: Stakeholders and communities**' folders).

A thorough and more systematic outreach plan for disseminating biodiversity monitoring activities and results at the community level will be developed during the next monitoring period by Permian Global, SEARRP and appropriate collaborators. This will include activities such as an annual workshop with Project Zone communities (in partnership with PACOS) to present findings from the program and discuss indigenous or traditional knowledge of biodiversity in the Project Area. If possible, specific community outreach activities on orangutan behavior and ecology will be conducted during the next monitoring period, with an annual workshop addressing issues related to orangutan conservation within the Project Area. Training programs can also be conducted with RBJ and Sabah Forestry Department on recognizing and addressing specific threats to the orangutan population in the Project Area.

With regard to project stakeholders, the biodiversity monitoring plan and associated activities have been discussed during both the Kuamut Management Committee meetings. Kuamut Management Committee meetings took place annually during the 2022-2023 monitoring period, and meeting notes are provided in the supporting evidence (see the 'Dissemination: **Stakeholders and communities**' folders). These meetings are attended by representatives from project stakeholders and partners, including RBJ, Yayasan Sabah, Sabah Forestry Department, and SEARRP, among others. Agenda items included field monitoring and protection, along with biodiversity surveys, which were discussed with partners and stakeholders (meeting reports can be found in '**Dissemination: Stakeholders and communities**' folders). KRCP Partner meetings will commence during 2024 and are planned to take place several times a year. These meeting will be an opportunity to regularly update partners and the wider stakeholder community in Sabah with regards to the biodiversity monitoring activities and the status of biodiversity within the Project Area.

## 5.4 Optional Criterion: Exceptional Biodiversity Benefits

### 5.4.1 Trigger Species Population Trends (CCB, GL3.2, GL3.3)

Through our biodiversity monitoring, we found a total of three Critically Endangered (CR; two mammals and one bird) and 12 Endangered (EN; 9 mammals, two birds and one reptile) vertebrate species during the 2022-2023 monitoring period. These were identified either on the camera trap images or were observed during fieldwork by the SEARRP and Permian Global field teams, who have extensive knowledge of local wildlife and RTE species identification. See the '**Confirmed RTE Species List for MR2 2022-2023.xls'** file in the **'Presence of HCV 1 species'** supporting evidence folder for a list of trigger species (i.e., CR, EN listed species) detected during this monitoring period and **Figure 5.4** at the end of this section for selected images of these species. Due to the large number of RTE species within the Project Area, this section

focuses specifically on the bird and mammal species listed as Critically Endangered (CR) and Endangered (EN). Our biodiversity monitoring evidence shows the presence of at least one individual of these species within the Project Area. Our key trigger species is the Bornean Orangutan (*Pongo pygmaeus*), and we have included detailed population estimates for this species in the table below. For additional details on other RTE species that either inhabit (or are thought to inhabit) the Project Area, see the '**Records and status update of RTE species during 2nd MR period KRCP 20240805.xls**' file in the **'Presence of HCV 1 species'** supporting evidence folder. This also includes species listed as Vulnerable (VU) that are not mentioned in the table below, but which are still classed as threatened and of conservation concern.

| | |
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| Trigger Species | **Bornean Orangutan** (*Pongo pygmaeus).* Population estimates were determined from helicopter surveys targeted at the Project Area. |
| With-project Scenario | Actions taken to maintain/enhance the population: The reclassification of the Project Area to a Class I (Protection) Forest Reserve has resulted in the termination of all logging activities and has prevented much of the area from being converted to mosaic plantings (i.e., the without-project scenario). Orangutans are negatively impacted by habitat disturbance in the long term, especially if natural vegetation is removed or severely degraded (Ancrenaz *et al*., 2005). Project implementation has ensured that the existing orangutan population has remained stable (see **section 5.3**). The Project Area may also act as a refuge for other individuals in the wider landscape that are moving away from logging and forest clearing. It is likely that the population will increase over time following forest regeneration, making efforts to monitor and maintain low levels of anthropogenic threat (i.e., hunting etc.) are crucial.<br><br>Actions taken to reduce threats: Regular monitoring through population surveys every 3-5 years will allow us to assess whether the population is decreasing, increasing or remaining stable. These surveys will help us detect any signs of population decline or emerging threats. Near real-time forest monitoring using satellite imagery helps us identify and address illegal activities promptly (e.g., logging events). Effective communication between the Permian Global technical team analyzing the satellite imagery and the RBJ field team ensures that any areas of concern are checked on the ground swiftly and promptly. Additionally, regular security patrols by the RBJ team can monitor and respond to incidents of illegal activities (e.g., hunting and logging), and take appropriate action. Close partnerships with local enforcement agencies (e.g., Sabah Forestry Department) will ensure that any illegal |

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| | activities are dealt with quickly and effectively. Where possible, community engagement and outreach programs will also be implemented during future monitoring periods by the KRCP biodiversity team to raise awareness about the importance of orangutan conservation and disseminate the results of the population surveys.<br><br>Changes in population status and/or threats: As detailed in **section 5.3** and described in the detailed reports by Dr Felicity Oram (see the '**Presence of HCV 1 species: Orangutan monitoring 2023**' supporting evidence folders), the orangutan population within the Project Area is thought to have remained stable since the last monitoring period. During 2014-2017, the approximate number of individuals that were estimated to be within an area slightly larger (96,310 ha) than the Kuamut Project Area was approximately 630 (summed 95% CIs = 422-942) (see Simon *et al*., 2019). In the most recent orangutan monitoring, the estimated number of individuals is now thought to be approximately 868 (95% CIs = 468-1610). Although this estimate is likely to be conservative and depends on the specific values used to convert nest densities to population numbers (see supporting evidence). We used the same values as used by Simon *et al*. (2019), so that we could qualitatively compare results across monitoring periods. Overall, this is an encouraging result, as we would not expect to see dramatic increases in the orangutan population during the timeframe of our monitoring given the relatively long life span of the species (35-40 years; https://orangutan.com/).<br><br>There appear to be no changes in the anthropogenic threats to the orangutan community since the last monitoring period. There have also been no logging activities detected within the Project Area during 2022-2023 and only one instance of suspected hunting in 2022 recorded on patrols by the RBJ team. Therefore, these threats are considered minimal. |
| **Trigger Species** | **Other CR and EN mammals** – where at least one individual was documented within the Project Area during the monitoring period. **Sunda Pangolin** (*Manis javanica*, CR; via camera trapping), **Asian Elephant** (*Elephas maximus*, EN; via camera trapping and observed during fieldwork), **Banteng** (*Bos javanicus*, EN; via camera trapping), **Borneo Bay Cat** (*Catopuma badia*, EN; via camera trapping), **Large Flying-fox** (*Pteropus vampyrus*, EN; observed during fieldwork), **Long-tailed Macaque** (*Macaca fascicularis*, EN; via camera trapping and observed during fieldwork), **Northern Gray Gibbon** |

| | |
|---|---|
| | (*Hylobates funereus*, EN; observed during fieldwork), **Otter Civet** (*Cynogale bennettii*, EN; via camera trapping), **Sabah Grizzled Langur** (*Presbytis sabana*, EN; observed during fieldwork), and **Southern Pig-tailed Macaque** (*Macaca nemestrina*, EN; via camera trapping and observed during fieldwork). See **section 5.3** for further details of those species detected by the camera trap monitoring. |
| **With-project Scenario** | Actions taken to maintain/enhance the population: As described in the section above, reclassification of the Project Area to a Class I (Protection) Forest Reserve has resulted in the termination of forest conversion, disturbance and degradation (i.e., the without-project scenario). This reclassification will likely benefit and enhance communities of many RTE/trigger mammal species, especially those that primarily rely on forest habitats for survival (e.g., Borneo Bay Cat: *Catopuma badia* and Otter Civet: *Cynogale bennettii*). Natural forest regeneration of the Project Area and improvements to habitat quality will likely benefit these species' populations in the long term. For those species that utilize variety of habitats (e.g., Sunda Pangolin: *Manis javanica*, Asian Elephant: *Elephas maximus*, Banteng: *Bos javanicus*, Long-tailed Macaque: *Macaca fascicularis*, Southern Pig-tailed Macaque: *Macaca nemestrina*), the termination of logging activities and prevention of forest conversion (i.e., the without-project scenario) is likely to benefit these species as there are less opportunities for human-wildlife conflicts (see https://www.iucnredlist.org for species' habitat associations).<br><br>Actions taken to reduce threats: Regular biodiversity monitoring is required to assess whether these species are persisting within the Project Area over time. This will be primarily achieved through the deployment of camera traps at various locations throughout the Project Area. Many of these species are elusive and rare (e.g., Borneo Bay Cat: *Catopuma badia*, Otter Civet: *Cynogale bennettii*), so improving our understanding of their ecology will help us to determine their main threats. The actions taken to reduce threats for the Bornean Orangutan (*Pongo pygmaeus,* see above), such as satellite monitoring and regular patrols, apply to all RTE/trigger mammal species listed. Community outreach and dissemination during future monitoring periods can include information on the importance of these RTE mammal species and their conservation. However, care needs to be taken not to disclose locations of heavily trafficked species such as the Sunda Pangolin (*Manis javanica*). |

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| | Changes in population status and/or threats: As detailed in **Section 5.3** and the supporting evidence we do not have explicit data on the population status of these RTE/trigger mammal species (except for orangutans, see above). However, evidence from the 2022-2023 camera trap surveys and or field observations indicates the presence of at least one individual of each of these RTE/trigger mammal species within the Project Area. The presence of many RTE mammal species within the Project Area is encouraging, and we predict that forest regeneration combined with minimal anthropogenic disturbance will enhance many of these species' populations over time. In subsequent years of monitoring, we aim to gather enough data from our camera trap surveys to estimate occupancy and/or abundance for certain species and examine populations trends over a longer time series. Since the 2022-2023 period marked the start of our camera trap monitoring, we have now established a baseline for future comparisons. Continued monitoring will allow us to track changes in population status, identify any emerging threats, and adapt our conservation strategies accordingly.<br><br>There appear to be no new anthropogenic threats to the RTE/trigger mammal species since the last monitoring period. |
| **Trigger Species** | **CR and EN birds** – where at least one individual was documented within the Project Area during the monitoring period. These include: the **Helmeted Hornbill** (*Rhinoplax vigil*, CR; identified during orangutan nest surveys and observed during fieldwork), **Storm's Stork** (*Ciconia stormi*, EN; observed during fieldwork) and **Wrinkled Hornbill** (*Rhabdotorrhinus corrugatus*; identified during bioacoustic analyses). Following the precautionary principle (section 5.1.2), we assume that the **Straw-headed Bulbul** (*Pycnonotus zeylanicus*, CR) is likely present within the Project Area. While direct evidence from the project team is still lacking, some community members have reported occasionally hearing the species in the area. Given these reports and the suitability of the habitat, we consider its presence to be likely. |
| **With-project Scenario** | Actions taken to maintain/enhance the population: As described above, reclassification of the Project Area to a Class I (Protection) Forest Reserve has halted forest conversion, disturbance and degradation (i.e., the without-project scenario). This change is expected to benefit and enhance communities of many RTE/trigger bird species, particularly those that depend on forest habitats for survival (e.g., the |

Helmeted Hornbill: Rhinoplax vigil; see https://www.iucnredlist.org for habitat association). For example, many hornbill species require large trees for breeding (Kuar *et al*., 2020). If logging activities had continued, extracting these large trees, or if much of the natural forest habitat had been converted to mosaic plantings (i.e., the without-project scenario), the availability of nesting sites would have decreased, directly affecting these species. However, natural forest regeneration, where younger trees in more disturbed areas can reach full size and maturity, is likely to benefit a number of RTE/trigger hornbill species. This process will enhance their populations over the long term by providing more suitable habitats and resources.

Actions taken to reduce threats: As previously mentioned, regular biodiversity monitoring is essential to track the persistence of RTE/trigger bird species in the Project Area over time. For these species, monitoring will primarily involve using bioacoustic methods. This approach collects audio data from sampling sites and uses AI classifier models to identify the presence of species of interest. Additionally, some RTE ground-dwelling birds, such as the Great Argus (*Argusianus argus*, VU), will be monitored using camera traps. Satellite monitoring and regular patrols will also help to alleviate anthropogenic pressure on all RTE and trigger bird species listed (see **section 5.3.1** above). During future monitoring periods, community outreach and dissemination efforts can include information on the importance of these RTE and trigger bird species and their conservation. However, it is crucial to handle this information carefully, avoiding the disclosure of locations for heavily trafficked species like the Helmeted Hornbill (*Rhinoplax vigil*).

Changes in population status and/or threats: As detailed in **Section 5.3** and the supporting evidence, we currently lack explicit data on the population status of these RTE/trigger bird species. However, field observations during 2022 to 2023 have confirmed the presence of at least one individual of each RTE/trigger bird species listed above within the Project Area. We anticipate that forest regeneration, combined with minimal anthropogenic disturbance, will contribute to the enhancement of these species' populations over time. In future monitoring years, we aim to gather sufficient data from our bioacoustic surveys on a number of bird species to estimate species occupancy and abundance, and to analyze population trends over a longer time series.

Currently, we are collaborating with Dr Joshua Taylor from Social Environment CIC to develop accurate classifier models

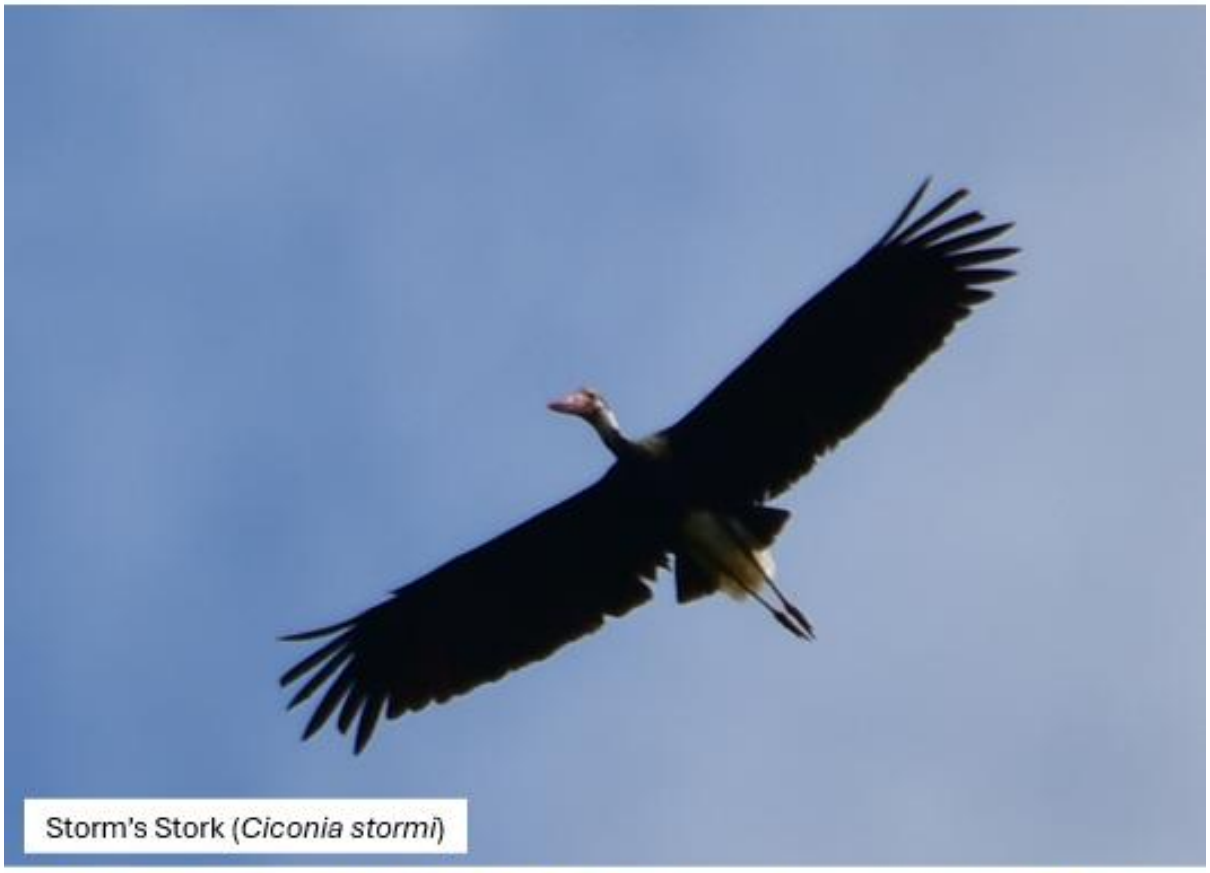
| | |
|---|---|
| [redacted] | for additional species of interest, including both RTE birds and mammals. This ongoing work employs cutting-edge scientific techniques that are being co-developed with Social Environment CIC to track the presence and activity of these species over time.<br><br>There appear to be no new anthropogenic threats to the RTE/trigger bird species since the last monitoring period. |

Figure 5.4. Selected images of some of the RTE/HCV 1 species recorded during 2022-2023 either from camera trap surveys or direct observations by the field team.


Critically Endangered (CR)
CORE Cam046 77°F 25°C 09/22/2022 23:23:20
Sunda Pangolin (Manis javanica)
CORE Cam037 87°F 30°C 09/25/2022 14:16:39
Bornean Orangutan (Pongo pygmaeus)


Endangered (EN) page 1
Southern Pig-tailed Macaque (Macaca nemestrina)
Sabah Grizzled Langur (Presbytis sabana)
Long-tailed Macaque (Macaca fascicularis)
Otter Civet (Cynogale bennettii)
Asian Elephant (Elephas maximus)
CORE Cam015
77°F 25°C
09/30/2022 12:03:23

# Endangered (EN) page 2






# Endangered (EN) page 3



Large Flying-fox (*Pteropus vampyrus*)




Bay Cat (*Catopuma badia*)




Banteng (*Bos javanicus*)

# VULNERABLE (VU) Page 1













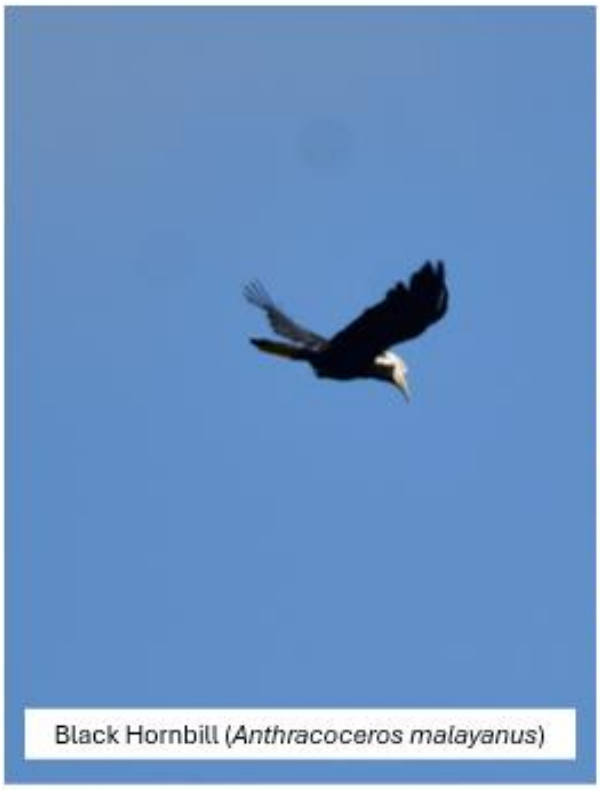




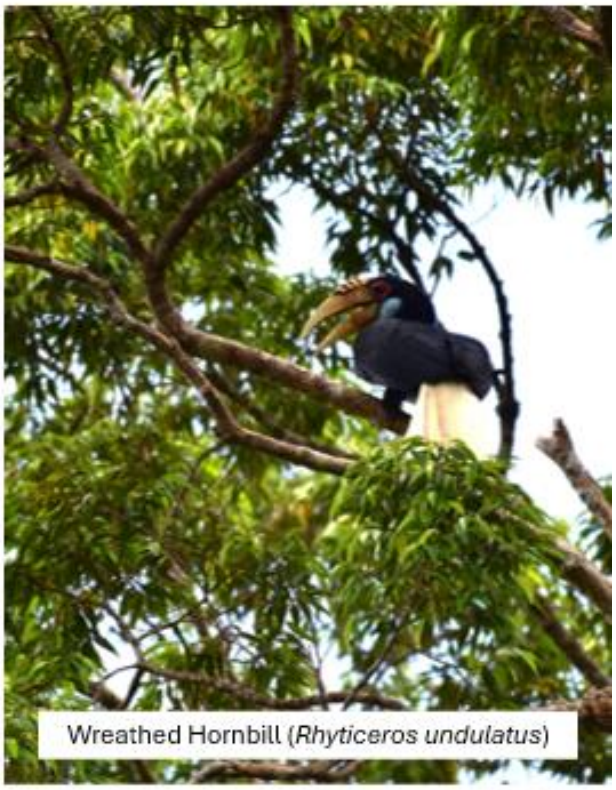




# VULNERABLE (VU) Page 2



Black Hornbill (*Anthracoceros malayanus*)



Wreathed Hornbill (*Rhyticeros undulatus*)



Rhinoceros Hornbill (*Buceros rhinoceros*)

# VULNERABLE (VU) Page 3




Great Argus *Argusianus argus*

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# APPENDIX 1: changes to the baseline due to the use of more accurate and up-to-date datasets

As described in 2.2.4, the approach for biomass mapping has been updated with new more accurate and up-to-date datasets. These more accurate maps have been used to update the 2016 timber volume maps. As these volume maps are used to produce the timber harvest plan and estimate the Mean volume of extracted timber under the baseline ($V_{EX,j,i|BSL}$), this value and all subsequent calculations have changed slightly.

More detailed information was obtained on tree protected species. This affects the species conservation factor deduction from both merchantable timber and ongoing growth in the project scenario, and therefore all the tables have been updated and reported here.

This annex therefore updates and replaces part of section 3.1.4 (part of the section titled "Initial stratification of the project area" and the section titled "Forest inventory to determine the biomass per hectare potentially available for harvest") and the whole of section 3.2.1 of the PD.

In the methodology, the analysis for leakage due to market effects (section 8.3.2 of the methodology) depends on the net greenhouse gas emissions in the baseline scenario. Therefore, the market leakage section of section 3.2.3 of the PD has also been updated in this Annex.

## Modelling the baseline scenario

### *Initial stratification of the project area (starting below figure 26)*

As noted in 3.1.3, the size of the project area in the official shapefile is slightly larger than the area gazetted as the class I forest reserve (shapefile area is 84800 ha while the gazetted area is 83381 ha). For the purpose of the calculations, the areas of the different strata have therefore been adjusted (by reducing the area of each strata by 1.67%) so the project area in the calculations matches the gazetted area. The adjusted areas of the strata are indicated in Table 12 below.

*Table 12: Area of each stratum*

| | Area (ha) | Corrected Area (ha) | Proportion Of Project Area |
|---|---|---|---|
| **Stratum 1 (Inoperable)** | 5135 | 5049 | 0.06055 |
| **Stratum 2 (Natural Forest Management)** | 35029 | 34443 | 0.41308 |
| **Stratum 3 (selective logging within Mosaic Planting)** | 7176 | 7056 | 0.08462 |
| **Stratum 4 (planting areas within Mosaic Planting)** | 37460 | 36833 | 0.44174 |
| **Total** | 84800 | 83381 | 1 |

***Forest inventory to determine the biomass per hectare potentially available for harvest:***

The monitoring of the annual carbon stock change in aboveground biomass of trees involves remote sensing in combination with targeted remeasuring of field plots.

**Field Inventory:**

A total of 46 circular 30-meter radius (each 0.28 ha) permanent sample plots (PSPs) were set up within the Kuamut area between the 9th of October 2015 and the 3rd of August 2016 according to a modified field protocol from the Carnegie Airborne Observatory (a more detailed description is available for validation in a Standard Operational Procedure). We use 2 foot of rebar driven into the ground the mark the centre of the plot. In each of these sample plots, the tree height and DBH of all trees above 10 cm DBH were measured. When buttress roots prevent measuring the diameter at 1.3m, the diameter of the trunk was measured higher up, where the measurement reflects the trunk size. Lianas and dead trees where recorded and marked in the 'comments' column of the datasheet as "AL" or "DS" but are conservatively not included in the analysis. The trees are also marked with permanent metal numbered tags which are carefully nailed into each tree.

We recorded taxonomic information, taking leaf samples wherever possible. More than 75% of the individuals were identified to Genus, and more than 50% of the individuals have been identified to Species level. Average wood density values were estimated for each genus using the Global Wood Density Database (Chave et al. 2009) [37]. Using these values, we then calculated a plot-level basal area weighted average and assigned it to any individuals lacking botanical information.

[37] Chave, J., Coomes, D., Jansen, S., Lewis, S. L., Swenson, N. G. & Zanne, A. E. 2009. Towards a Worldwide Wood Economics Spectrum. Ecology Letters (12): 351-366

Biomass was calculated according to equation 4 from Chave et al. (2014) [38] utilising the measured diameter and heights, and the estimated wood density. This means that the taxonomic information is incorporated via the wood density, so while one equation is used – the estimated biomass will be quite different for different species of the same dimensions. The equations of Chave et al. (2014) are widely regarded as more accurate than species specific allometric (which also do not exist for the majority of species diverse tropical regions). We estimated timber volume from the calculated biomass using a BCEF-R of 1.89. The plot level timber volume was derived by summing the timber volume of all trees above the defined cutting limit (40 cm DBH for the NFM areas, and 31 cm DBH for the Mosaic Planting Approach areas).

The project started remeasuring the plots during 2021, but due to heavy movement control orders, and access difficulties, we did not complete the plot remeasure until March 2022. All 46 of the field plots were re-measured. Tree's height where originally measured in the field plots in 2016 as there was no local tree height model for Sabah. The tree height and DBH data from Kuamut in 2016 has now been combined with other datasets and used to produce a local height model for Sabah, and are published (Philipson *et al.*, 2020). We therefore used tree height modelled from DBH. Plot photos were originally taken to show the existence of a plot, but do not add anything when repeated. Slope measurements were originally taken as a backup, but average slope from the LiDAR measurements proved more useful for slope correction. Due to access difficulties for the plot remeasure, time was limited at the plots, and minimising these three items of data collection allowed more careful data collection for the critical DBH measurements. These updates are described in v1.1 of the field measurements SOP. As all 46 of the field plots were re-measured, the field plot validation dataset therefore includes a total of 92 (two measurements of 46) field plots.

### Biomass Mapping

When the field inventory was taking place in 2016, the Carnegie Airborne Observatory (CAO) and Sabah Forest Department undertook an ambitious project to map the Aboveground Carbon Density across the entire state of Sabah. The Kuamut project directly collaborated with this carbon mapping project, firstly by sharing the field inventory data and secondly by commissioning additional intensive LiDAR acquisition for the Kuamut project area (see Figure ).

[38] Chave *et al* (2014).Improved allometric models to estimate the aboveground biomass of tropical trees. Global Change Biology. Volume20, Issue10, October 2014, Pages 3177-3190.

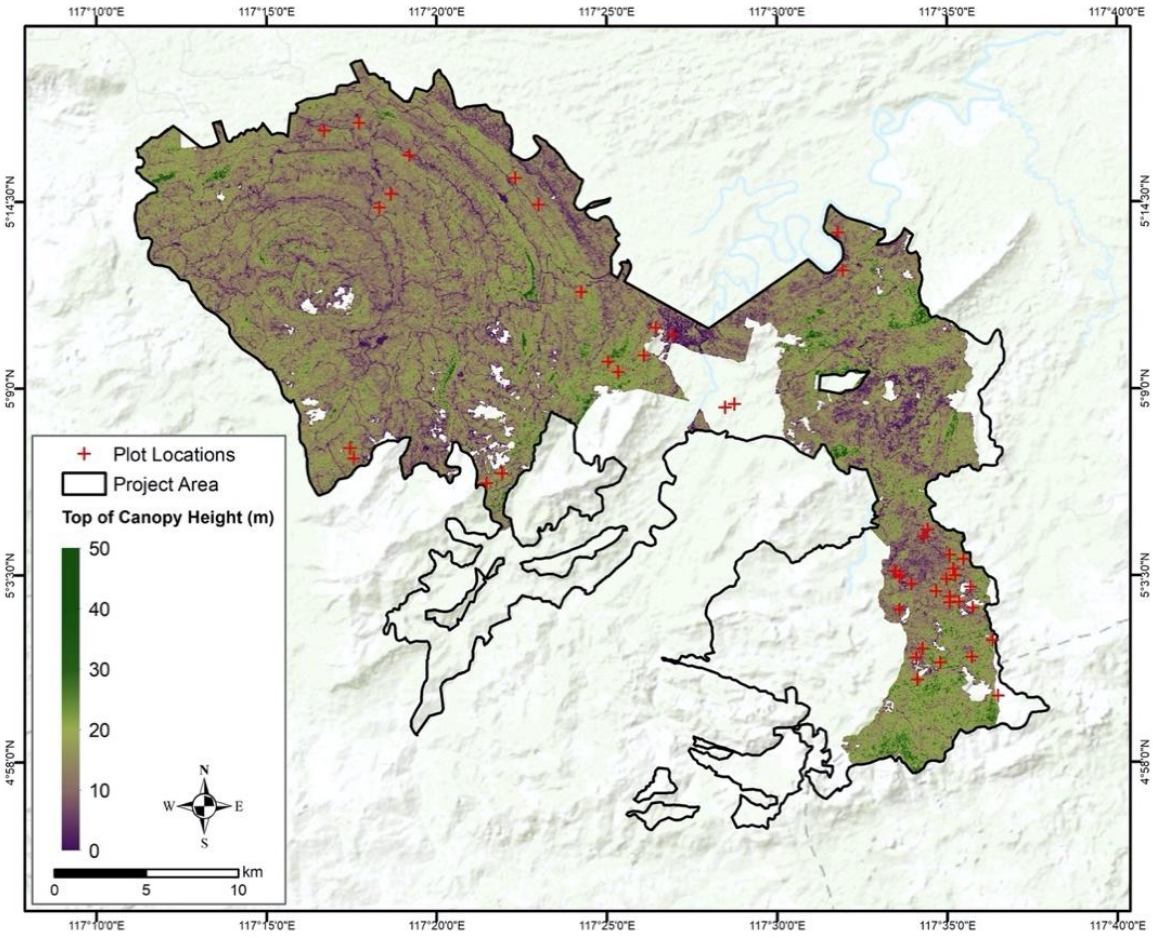



*Figure 13.Height is presented at a 30-meter pixel resolution derived from the LiDAR point clouds. Field plot locations are represented with red crosses. Areas where no LiDAR point cloud is available are empty, showing the DEM hillshade, and thus no TCH colour scale.*

To accurately estimate any emissions from small amounts of deforestation or degradation, the project has developed a multi-temporal modelling approach to estimate the spatial variability and distribution of aboveground biomass. The modelling approach adopted a machine learning workflow that uses the following data sources: aerial LiDAR scan (ALS) data describing canopy height, optical (Landsat 8) and Synthetic Aperture Radar (SAR) satellite imagery and forest plot data, all datasets acquired on the same year (2016). The combination of remote-sensing data sources is used to produce an updated wall-to-wall Top of Canopy Height (TCH) map. This monitoring of forest growth using remote sensing imagery is conducted in combination with remeasuring of field plots. It is important to note that while the forest growth monitoring process utilises both remote sensing and field measurements, it is very much supported with the field plot measurements, and it is possible to accurately model the regrowth without measuring the field plots every monitoring period.

As part of the workflow, annual composites of Landsat 8 (L8) imagery were created for the project area using Google earth engine. For the SAR data, imagery from Sentinel 1 (S1) was used where all S1 images, for a given year, that intersected the area of interest, were collected. Each image was preprocessed using

the steps described in Mullissa et al (2021).[39] All S1 preprocessing was carried out using google earth engine and the {rgee} package. The Copernics GLO 30 m global digital elevation model (DEM)[40] was used to derive terrain data for the area of interest including: slope, aspect, minimal curvature, mean curvature. All the bands from the imagery discussed above were combined into a data cube, comprising a total of 41 bands. In order to harmonize the data between yearly composites, it was necessary to apply temporal smoothing across each band of the data cube for all years in the period 2015:2022.[41]

The data cube was aligned with the tree Canopy Height Model (CHM) that was generated to produce figure 13. The coverage of the CHM is not complete due to some areas where LiDAR point clouds where not directly available to the project as a result of clouds or areas not flown. All regions that intersected the CHM were used to create a data frame comprising the measured canopy height values from the CHM and all of the environmental/ earth observation data contained within the data cube. Machine learning was applied to analyse the information in the data cube and develop a Canopy Height Model using the combination of environmental metrics that could produce a model with the lowest RMSE value. Spatial resampling was undertaken to evaluate the performance of the ensemble model as shown in figure 14. The model was then used to predict canopy height. The resulting predictions stored as spatial raster data.

[39] https://doi.org/10.3390/rs13101954

[40] https://portal.opentopography.org/raster?opentopoID=OTSDEM.032021.4326.3

[41] Although this Monitoring report focuses on the years 2016:2021, including years 2015 and 2022 improves the temporal smoothing estimation for those non-endpoint years.

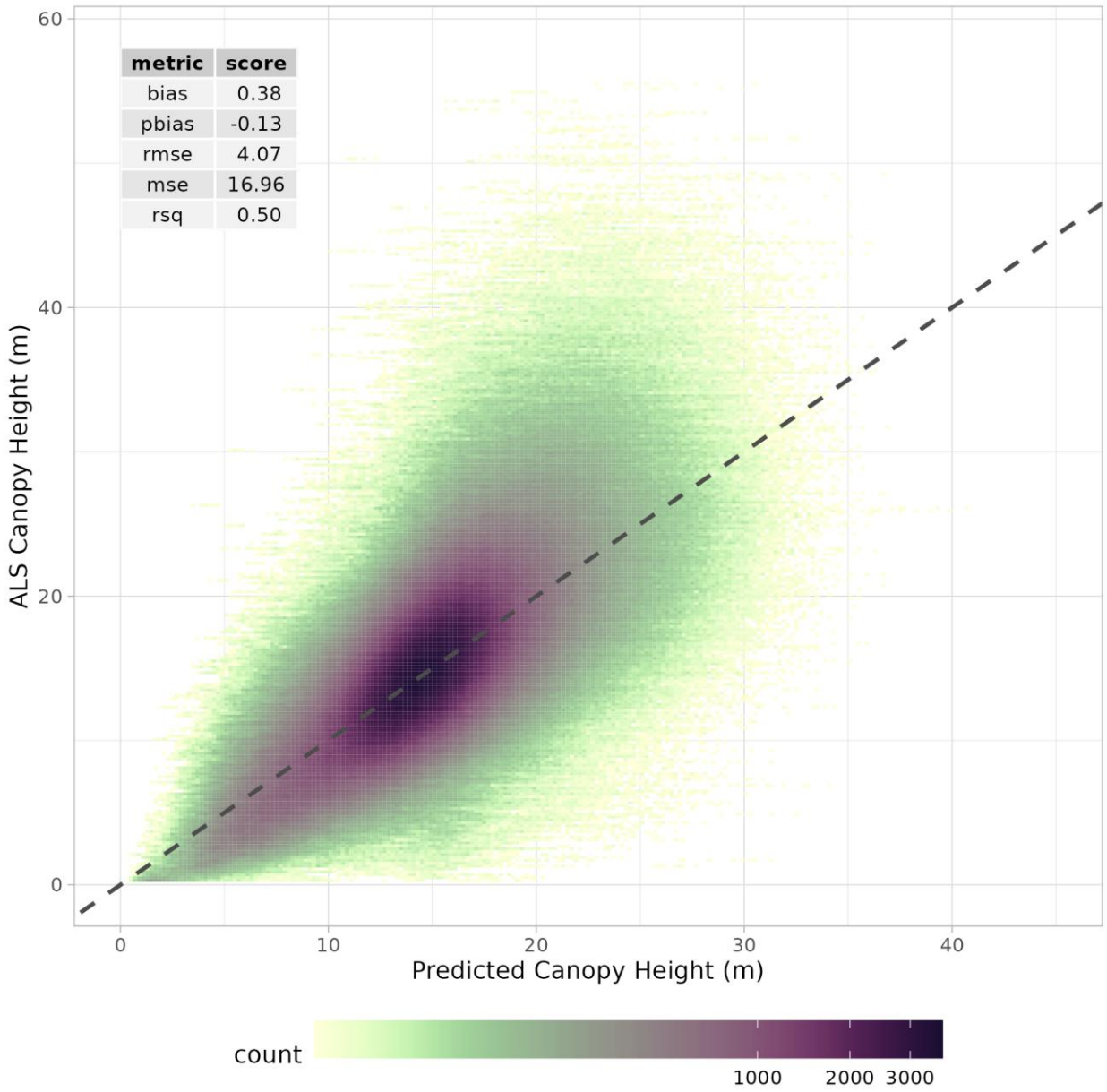



*Figure 14: Evaluation of the performance of the developed Canopy Height Model against the Lidar generated canopy height data*

To determine the Above Ground Biomass, the canopy height model predictions for all years were appended to their respective year's data cube as an additional band to form the input data cube for biomass model development. This was combined with the data from the field measurements that were undertaken in 2016 and 2020 in the Kuamut project area. Data cubes for the corresponding years were used to extract the earth observation data that intersected each plot area for each year it was surveyed. The total Above Ground Carbon (AGC) in the plot was converted to Aboveground Carbon density (ACD) by dividing the AGC by the planimetric area of the plot. The derived dataframe was used to train a model to predict ACD. All variable combinations were tested that included between 6-10 control features, two of which were required

to be modelled: canopy height and mean curvature[42] (because of their importance). The best performing model was selected. The model was trained on the full forest plot inventory and validated using spatial resampling (see figure 15).

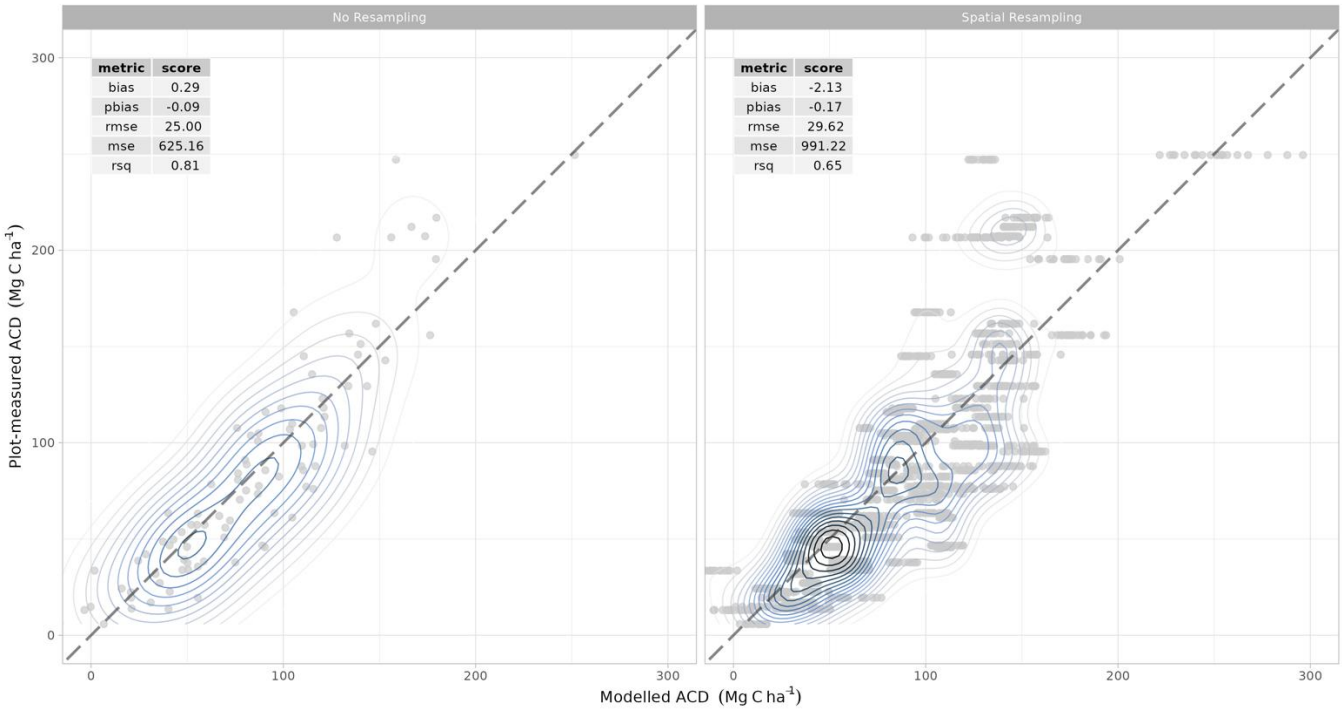



*Figure 15: Model validation comparing plot-measured ACD against modelled ACD values, indicating extremely low bias and good model performance.*

The best model was used to predict ACD across the entire Kuamut area. All steps related to the model were repeated for Merchantable Volume with cutting limits of 10 cm, 31 cm, and 40 cm. The combination of data sources was used to produce volume maps for 2016, as per the methodology.

**Growth Rate calculation:**

Growth rate was calculated across multiple years for the entire Kuamut project area to a derive the most robust estimate possible. Predicted ACD maps for years 2016-2021 were used because the project commenced in 2016 and 2022 predictions require an additional annual prediction in 2023 to be confident in the stability of the time series. A linear mixed effects model, with fixed effect for strata, was fit across the entire dataset providing a distribution of predicted growth rates, and the fixed effect slopes are therefore the growth rates for each of the strata in the project area (as described in the monitoring part of this report above).

[42] Mean curvature identifies upland areas and ridgelines, which in the Kuamut project area are typically less effected by historical logging activity, due to their inaccessibility

Baseline Emissions

Calculation of carbon stocks in commercial timber volumes (section 8.1.1 of the methodology)

Section 3.1.4 above, in the step titled 'modelling of the baseline scenario' describes how the merchantable volume of timber per unit area ($V_{j,i|BSL}$) that is potentially available for harvest was estimated through an approach where a detailed forest inventory using field plots was combined with airborne LiDAR data.

In summary, a total of 46 circular 30-meter radius (each 0.28 ha) permanent sample plots (PSPs) plots were set up within the Kuamut area. We recorded taxonomic information, taking leaf samples wherever possible. More than 75% of the individuals were identified to Genus, and more than 50% of the individuals have been identified to Species level. Average wood density values were estimated for each genus using the Global Wood Density Database (Chave et al. 2009). Using these values, we then calculated a plot-level basal area weighted average and assigned it to any individuals lacking botanical information.

Biomass was calculated according to equation 4 from Chave et al. (2014) utilising the measured diameter and heights, and the estimated wood density. This means that the taxonomic information is incorporated via the wood density, so while one equation is used – the estimated biomass will be quite different for different species of the same dimensions. The equations of Chave et al. (2014) are widely regarded as more accurate than species specific allometric (which also do not exist for the majority of species diverse tropical regions). We estimated timber volume from the calculated biomass using a BCEF-R of 1.89. The plot level timber volume was derived by removing the species conservation factors from the total timber volume of all trees above the defined cutting limit (40 cm DBH for the NFM areas, and 31 cm DBH for the Mosaic Planting Approach areas). By estimating species conservation factors using our full plot data set, using these factors to reduce the timber volume of the trees above the cutting limit, we conservatively account for any species that would not be harvested without being reliant on perfect botanical information in each individual plot. See additional information describing how conservative this approach is in appendix 8, 'APPENDIX 8. Species conservation factor details.

A multi-temporal modelling approach was used to estimate the spatial variability and distribution of aboveground biomass. Different remote sensing imagery was combined into a data cube, comprising a total of 41 bands. Machine learning was applied to analyse the information in the data cube and develop a Canopy Height Model using the combination of environmental metrics that could produce a model with the lowest RMSE value. The model was then used to produce a high-resolution merchantable timber volume map that provides the merchantable timber volume at a 30-meter pixel resolution,

From this high resolution map, the mean volume of extracted merchantable timber per hectare (VEX,j,i|BSL) was estimated as indicated in Table 13.

*Table 13: Mean volume of extracted merchantable timber per hectare for each year (years in bold indicate the years included in the first baseline period)*

| Year that logging would occur according to the timber harvesting plan | Mean volume of extracted merchantable timber per hectare in stratum *i* ($m^3$ $ha^{-1}$) | | |
|---|---|---|---|
| | Stratum 2 (Natural Forest Management) | Stratum 3 (selective | Stratum 4 (planting |

| | | logging within Mosaic Planting) | areas within Mosaic Planting |
|---|---|---|---|
| 2016 | | 74.3 | 55.5 |
| 2017 | | 62 | 45.1 |
| 2018 | | 65.8 | 50.8 |
| 2019 | | 74.3 | 53.6 |
| 2020 | | 79.9 | 62 |
| 2021 | | 80.8 | 76.1 |
| 2022 | | | |
| 2023 | | | |
| 2024 | 33.4 | | |
| 2025 | 40.3 | | |
| 2026 | 38.8 | | |
| 2027 | 41.8 | | |
| 2028 | 44.8 | | |
| 2029 | | | |
| 2030 | | | |
| 2031 | | | |
| 2032 | | | 89.3 |
| 2033 | | | 89.3 |
| 2034 | | | 89.3 |
| 2035 | | | 89.3 |
| 2036 | | | 89.3 |
| 2037 | | | 89.3 |
| 2038 | | | 89.3 |
| 2039 | 33.4 | | 89.3 |
| 2040 | 40.3 | | 89.3 |
| 2041 | 38.8 | | 89.3 |
| 2042 | 41.8 | | 89.3 |
| 2043 | 44.8 | | 89.3 |
| 2044 | | | 89.3 |
| 2045 | | | 89.3 |

The carbon stock of timber harvested per hectare was then calculated as:

$$C_{HB,j,i|BSL} = (V_{EX,j,i|BSL} + V_{EX,INF,j,i|BSL}) * BCEF_R * CF_j$$ (equation 3 from VM0010)

Where:

| | |
|---|---|
| $C_{HB,j,i\|BSL}$ | Mean carbon stock of harvested biomass per unit area for species j in stratum *i*, tC·ha$^{-1}$ |
| $V_{EX,j,i\|BSL}$ | Mean volume of extracted timber per unit area for species *j* in stratum i, m$^3$·ha$^{-1}$ |
| $V_{EX,INF,j,i\|BSL}$ | Mean volume of extracted timber for forestry infrastructure per unit area for species *j* in stratum *i*, m$^3$·ha$^{-1}$; |
| $BCEF_R$ | Biomass conversion and expansion factor applicable to wood removals in the project area, t.d.m m$^{-3}$ |
| $CF_j$ | Carbon fraction of biomass for species *j*, tC t d.m$^{-1}$ |
| *i* | 1,2,3 …*M* strata |
| *j* | 1,2,3 …*J* tree species. |

The model described in section 3.1.4 establishes the relationship between field plot merchantable timber volume ($V_{EX,j,i|BSL}$ ) and the Canopy Height Model. The model does not estimate the mean volume of extracted timber for forestry infrastructure ($V_{EX,INF,j,i|BSL}$). This parameter was therefore considered to be zero in the calculations. This is a conservative assumption since it underestimates the timber extracted, and therefore the carbon removed, in the baseline.

To estimate the carbon stock of timber harvested, a $BCEF_R$ of 1.89 was used which is the IPCC default value for natural forests in the humid tropics (table 4.5 of the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 4). For the carbon fraction, the value of 0.47 tC·td.m$^{-1}$ was used (Martin and Thomas 2011)[43]. The resulting values for the mean carbon stock of harvested biomass per hectare ($C_{HB,j,i|BSL}$) is provided in **¡Error! No se encuentra el origen de la referencia.**.

*Table 16. Mean carbon stock of harvested biomass per hectare per year (years in bold indicate the years included in the first baseline period)*

| Year that logging would occur according to the timber harvesting plan | Mean carbon stock of harvested biomass in stratum *i* (tC ha$^{-1}$) | | |
|---|---|---|---|
| | Stratum 2 (Natural Forest Management) | Stratum 3 (selective logging within Mosaic Planting) | Stratum 4 (planting areas within Mosaic Planting |
| 2016 | | 66 | 49.3 |

[43] Martin, Adam & Thomas, Sean. (2011). A Reassessment of Carbon Content in Tropical Trees. PloS one. 6. e23533. 10.1371/journal.pone.0023533.

| | | | |
|---|---|---|---|
| 2017 | | 55.07 | 40.06 |
| 2018 | | 58.45 | 45.13 |
| 2019 | | 66 | 47.61 |
| 2020 | | 70.98 | 55.07 |
| 2021 | | 71.77 | 67.6 |
| 2022 | | | |
| 2023 | | | |
| 2024 | 29.67 | | |
| 2025 | 35.8 | | |
| 2026 | 34.47 | | |
| 2027 | 37.13 | | |
| 2028 | 39.8 | | |
| 2029 | | | |
| 2030 | | | |
| 2031 | | | |
| 2032 | | | 79.33 |
| 2033 | | | 79.33 |
| 2034 | | | 79.33 |

| | | | |
|---|---|---|---|
| 2035 | | | 79.33 |
| 2036 | | | 79.33 |
| 2037 | | | 79.33 |
| 2038 | | | 79.33 |
| 2039 | 29.67 | | 79.33 |
| 2040 | 35.8 | | 79.33 |
| 2041 | 34.47 | | 79.33 |
| 2042 | 37.13 | | 79.33 |
| 2043 | 39.8 | | 79.33 |
| 2044 | | | 79.33 |
| 2045 | | | 79.33 |

Following the methodology, it is assumed that not all of the harvested biomass leaves the forest and the timber harvested as divided in two components: 1) wood removed to market (extracted timber) and 2) wood remaining in the forest as a result of harvest.

The mean carbon stock of the wood removed to markets (extracted timber), is calculated as:

$$C_{EX,j,i|BSL} = (V_{EX,j,i|BSL} + V_{EX,INF,j,i|BSL}) * D_j * CF_j$$ *(equation 4 from VM0010)*

Where:

| | |
|---|---|
| $C_{EX,j,i\|BSL}$ | Mean carbon stock of extracted timber per unit area for species *j* in stratum i; $tC \cdot ha^{-1}$ |
| $V_{EX,j,i\|BSL}$ | Mean volume of extracted timber per unit area for species *j* in stratum i, $m^3 \cdot ha^{-1}$ |
| $V_{EX,INF,j,i\|BSL}$ | Mean volume of extracted timber for forestry infrastructure per unit area for species *j* in stratum *i*, $m^3 \cdot ha^{-1}$; |

| | |
|---|---|
| *Dj* | Basic wood density of species *j*; t d.m. $m^{-3}$ |
| $CF_j$ | Carbon fraction of biomass for species *j*, tC t $d.m^{-1}$ |
| *i* | 1,2,3 …*M* strata |
| *j* | 1,2,3 …*J* tree species. |

For $D_j$ the value of 0.51 was used which is the average value of the species found in the field plots. For the carbon fraction, the value of 0.47 tC-td.$m.^{-1}$ was used. The resulting values for the mean carbon stock of extracted timber per hectare is provided in Table 14.

*Table 14: Mean carbon stock of extracted timber per hectare for each year (years in bold indicate the years included in the first baseline period)*

| Year that logging would occur according to the timber harvesting plan | Mean carbon stock of harvested biomass in stratum *i* (tC $ha^{-1}$) | | |
|---|---|---|---|
| | Stratum 2 (Natural Forest Management) | Stratum 3 (selective logging within Mosaic Planting) | Stratum 4 (planting areas within Mosaic Planting |
| 2016 | | 17.71 | 13.23 |
| 2017 | | 14.78 | 10.75 |
| 2018 | | 15.68 | 12.11 |
| 2019 | | 17.71 | 12.77 |
| 2020 | | 19.04 | 14.78 |
| 2021 | | 19.26 | 18.14 |
| 2022 | | | |
| 2023 | | | |
| 2024 | 7.96 | | |

| | | | |
|---|---|---|---|
| 2025 | 9.6 | | |
| 2026 | 9.25 | | |
| 2027 | 9.96 | | |
| 2028 | 10.68 | | |
| 2029 | | | |
| 2030 | | | |
| 2031 | | | |
| 2032 | | | 21.28 |
| 2033 | | | 21.28 |
| 2034 | | | 21.28 |
| 2035 | | | 21.28 |
| 2036 | | | 21.28 |
| 2037 | | | 21.28 |
| 2038 | | | 21.28 |
| 2039 | 7.96 | | 21.28 |
| 2040 | 9.6 | | 21.28 |
| 2041 | 9.25 | | 21.28 |
| 2042 | 9.96 | | 21.28 |

| | | | |
|---|---|---|---|
| 2043 | 10.68 | | 21.28 |
| 2044 | | | 21.28 |
| 2045 | | | 21.28 |

Calculation of dead wood (logging slash) generated in the process of timber harvest (section 8.1.2 of the methodology)

The change in carbon stock in the dead wood pool in stratum i has been calculated as the difference between the total carbon stock of the harvested biomass and the carbon stock of the extracted timber, plus the residual stand damage and biomass of trees left to decay as a result forestry infrastructure establishment:

$$\Delta C_{DWSLASH,i,p|BSL} = \left[\sum_{j=1}^{J}[(C_{HB,j,i|BSL} - C_{EX,j,i|BSL}) + C_{RSD,j,i|BSL} + C_{notHB,inf,j,i|BSL}\right]$$

*(equation 5 from VM0010)*

Where:

| | |
|---|---|
| $\Delta C_{DWSLASH,i,p\|BSL}$ | Change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum *i* in land parcel *p*, in tC ha$^{-1}$ |
| $C_{HB,j,i\|BSL}$ | Mean carbon stock of harvested biomass per unit area for species *j* in stratum *i*, tC·ha$^{-1}$ |
| $C_{EX,j,i\|BSL}$ | Mean carbon stock of extracted timber per unit area for species *j* in stratum *i*, tC·ha$^{-1}$; |
| $C_{RSD,j,i\|BSL}$ | Mean carbon stock in timber from residual stand damage per unit area for species j in stratum i, tC·ha$^{-1}$ |
| $C_{notHB,inf,lj,i\|BSL}$ | Mean carbon stock of biomass that is not harvested during the establishment of forestry infrastructure per unit area for species j in stratum i, tC·ha$^{-1}$ |
| *i* | 1,2,3 …*M* strata |
| *j* | 1,2,3 …*J* tree species. |
| *P* | *1, 2, 3 …P* land parcels |

The mean carbon stock in timber from residual stand damage was calculated as follows:

$$C_{RSD,j,i|BSL} = C_{EX,j,i|BSL} * F_{RSD|BSL}$$ *(equation 6 from VM0010)*

Where:

| | |
|---|---|
| $C_{RSD,j,i\|BSL}$ | Mean carbon stock in timber from residual stand damage per unit area for species *j* in stratum *i,* tC·ha$^{-1}$ |

| | |
|---|---|
| $C_{Ex,j,i\|BSL}$ | Mean carbon stock of extracted timber per unit area for species *j* in stratum *i*, tC·ha$^{-1}$ |
| $F_{RSD\|BSL}$ | Factor for residual stand damage, dimensionless |
| *i* | 1,2,3 …*M* strata |
| *j* | 1,2,3 …*J* tree species. |

For $F_{RSD|BSL}$ the methodology suggests a value of 2.3 based on Pinard and Putz (1996)[44] who found unharvested trees where severely damaged (uprooted and crushed) in conventional logging within the Ulu Segama area. We have used a more conservative value of 1.8. The $F_{RSD}$ value of 1.8 was used for both NFM and Mosaic stratum.

Applying this value leads to the values for mean carbon stock in timber from residual stand damage in each stratum as provide in Table 15.

*Table 15: Mean carbon stock in timber from residual stand damage in each stratum (years in bold indicate the years included in the first baseline period)*

| Year that logging would occur according to the timber harvesting plan | Mean carbon stock in timber from residual stand damage in stratum *i* (tC ha$^{-1}$) | | |
|---|---|---|---|
| | Stratum 2 (Natural Forest Management) | Stratum 3 (selective logging within Mosaic Planting) | Stratum 4 (planting areas within Mosaic Planting |
| 2016 | | 31.87 | 23.81 |
| 2017 | | 26.6 | 19.35 |
| 2018 | | 28.23 | 21.79 |
| 2019 | | 31.87 | 22.99 |
| 2020 | | 34.28 | 26.6 |
| 2021 | | 34.66 | 32.65 |

[44] Pinard, M., & Putz, F. (1996). Retaining Forest Biomass by Reducing Logging Damage. Biotropica, 28(3), 278-295. doi:10.2307/2389193

| | | | |
|---|---|---|---|
| 2022 | | | |
| 2023 | | | |
| 2024 | 14.33 | | |
| 2025 | 17.29 | | |
| 2026 | 16.64 | | |
| 2027 | 17.93 | | |
| 2028 | 19.22 | | |
| 2029 | | | |
| 2030 | | | |
| 2031 | | | |
| 2032 | | | 38.31 |
| 2033 | | | 38.31 |
| 2034 | | | 38.31 |
| 2035 | | | 38.31 |
| 2036 | | | 38.31 |
| 2037 | | | 38.31 |
| 2038 | | | 38.31 |
| 2039 | 14.33 | | 38.31 |

| | | | |
|---|---|---|---|
| 2040 | 17.29 | | 38.31 |
| 2041 | 16.64 | | 38.31 |
| 2042 | 17.93 | | 38.31 |
| 2043 | 19.22 | | 38.31 |
| 2044 | | | 38.31 |
| 2045 | | | 38.31 |

As indicated earlier, the calculations have conservatively assumed that the mean volume of extracted timber for forestry infrastructure ($V_{EX,INF,j,i|BSL}$) is zero. Based on that, it is also assumed that the mean carbon stock of biomass that is not harvested during the establishment of forestry infrastructure ($C_{notHB,inf,lj,i|BSL}$ in equation 5 of the methodology) is also zero.

The resulting total change in carbon stock of dead wood remaining in the forest as a result of harvest under the baseline ($\Delta C_{DWSLASH,i,p|BSL}$) is estimated in Table 16.

*Table 16: Total change in carbon stock of dead wood remaining in the forest as a result of harvest under the baseline in each stratum (years in bold indicate the years included in the first baseline period)*

| **Year that logging would occur according to the timber harvesting plan** | **Change in carbon stock of dead wood remaining in the forest as a result of harvest in stratum *i* (tC ha$^{-1}$)** | | |
|---|---|---|---|
| | **Stratum 2 (Natural Forest Management)** | **Stratum 3 (selective logging within Mosaic Planting)** | **Stratum 4 (planting areas within Mosaic Planting** |
| 2016 | | 80.17 | 59.88 |
| 2017 | | 66.9 | 48.66 |
| 2018 | | 71 | 54.81 |
| 2019 | | 80.17 | 57.83 |

| | | | |
|---|---|---|---|
| 2020 | | 86.21 | 66.9 |
| 2021 | | 87.18 | 82.11 |
| 2022 | | | |
| 2023 | | | |
| 2024 | 36.04 | | |
| 2025 | 43.48 | | |
| 2026 | 41.86 | | |
| 2027 | 45.1 | | |
| 2028 | 48.34 | | |
| 2029 | | | |
| 2030 | | | |
| 2031 | | | |
| 2032 | | | 96.35 |
| 2033 | | | 96.35 |
| 2034 | | | 96.35 |
| 2035 | | | 96.35 |
| 2036 | | | 96.35 |
| 2037 | | | 96.35 |

| | | | |
|---|---|---|---|
| 2038 | | | 96.35 |
| 2039 | 36.04 | | 96.35 |
| 2040 | 43.48 | | 96.35 |
| 2041 | 41.86 | | 96.35 |
| 2042 | 45.1 | | 96.35 |
| 2043 | 48.34 | | 96.35 |
| 2044 | | | 96.35 |
| 2045 | | | 96.35 |

Calculation of baseline carbon sequestered in wood products (section 8.1.3 of the methodology)

Under the baseline, the harvested wood would have been harvested for conversion to wood products. Therefore, the carbon stock in the wood products pool have been included in the baseline.

The methodology makes the distinction between (i) wood products that would decay within 3 years after harvest (ie, the Wood Waste (WW) and the Short-Lived Fraction (SLF)), (ii) wood products that are retired between 3 and 100 years after harvest and (iii) other wood products that are considered to permanently store carbon.

The Sabah Forestry Department provided on the production of major wood products in Sabah for the period 2015-2020. Based on this data the shares of likely wood products to be produced from the harvested wood have been determined as shown in Table 17.

*Table 17: Share of wood product k in the total wood products produced from the harvested*

| Wood product *k* | Share of wood product *k* in the total wood products produced from the harvested wood |
|---|---|
| **Sawn Wood** | 0.19 |
| **Woodbase Panels** | 0.56 |
| **Other Industrial Roundwood** | 0.25 |

These fractions were applied to the mean carbon stock of harvested biomass in stratum *i* as estimated earlier in Table 14.

The carbon stock of extracted timber that is immediately emitted to the atmosphere at the time of harvest is calculated as:

$$C_{WP0,i|BSL} = \sum_k C_{EX,i,k|BSL} * (WW_k + SLF_k)$$ *(equation 9 from VM0010)*

Where:

| | |
|---|---|
| $C_{WP0,i\|BSL}$ | Carbon stock of extracted timber from stratum *i* that is assumed to be emitted immediately at the time of harvest, in t C·ha$^{-1}$ |
| $C_{EX,i\|BSL}$ | Mean carbon stock of extracted timber per unit area in stratum *i*, for wood product type *k*, tC·ha$^{-1}$ |
| *WWk* | Fraction of biomass carbon from wood waste that is assumed to be emitted to the atmosphere immediately at the time of harvest for wood product *k*, dimensionless; |
| $SLF_k$ | Fraction of biomass carbon from the shortlived wood product pool that is assumed to be emitted to the atmosphere immediately at the time of harvest for wood product k, dimensionless |
| *i* | 1,2,3 …*M* strata |
| *k* | Wood products |

For WW and SLF, the default values given in the methodology were used which in turn are taken from Winjum *et al* (1998). This means that for WW, a value of 24% (suitable for developing countries) was used for all types of wood products. For SLF the following values were used

- Sawn wood: 0.12
- Woodbase panels: 0.06
- Other industrial roundwood: 0.18

The resulting carbon stock of extracted timber from each stratum that is assumed to be emitted immediately at the time of harvest is provided in Table 18.

*Table 18: Carbon stock of extracted timber from each stratum that is assumed to be emitted immediately at the time of harvest (years in bold indicate the years included in the first baseline period)*

| Year that logging would occur according to the timber harvesting plan | Stratum 2 (Natural Forest Management) | | | | Stratum 3 (selective logging within Mosaic Planting) | | | | Stratum 4 (planting areas within Mosaic Planting | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Sawn. Wood* | *Panels* | *Other Industrial. Round-wood* | **total** | *Sawn. Wood* | *Panels* | *Other Industrial. Round-wood* | **total** | *Sawn.Wood* | *Panels* | *Other Industrial. Round- wood* | **total** |
| 2016 | | | | | 1.21 | 2.97 | 1.86 | 6.05 | 0.90 | 2.22 | 1.39 | 4.52 |
| 2017 | | | | | 1.01 | 2.48 | 1.55 | 5.04 | 0.74 | 1.81 | 1.13 | 3.67 |
| 2018 | | | | | 1.07 | 2.63 | 1.65 | 5.35 | 0.83 | 2.03 | 1.27 | 4.13 |
| 2019 | | | | | 1.21 | 2.97 | 1.86 | 6.05 | 0.87 | 2.15 | 1.34 | 4.36 |
| 2020 | | | | | 1.30 | 3.20 | 2.00 | 6.50 | 1.01 | 2.48 | 1.55 | 5.04 |
| 2021 | | | | | 1.32 | 3.24 | 2.02 | 6.57 | 1.24 | 3.05 | 1.90 | 6.19 |
| 2022 | | | | | | | | | | | | |
| 2023 | | | | | | | | | | | | |
| 2024 | 0.54 | 1.34 | 0.84 | 2.72 | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2025 | 0.66 | 1.61 | 1.01 | 3.28 | | | | | | | | |
| 2026 | 0.63 | 1.55 | 0.97 | 3.16 | | | | | | | | |
| 2027 | 0.68 | 1.67 | 1.05 | 3.40 | | | | | | | | |
| 2028 | 0.73 | 1.79 | 1.12 | 3.65 | | | | | | | | |
| 2029 | | | | | | | | | | | | |
| 2030 | | | | | | | | | | | | |
| 2031 | | | | | | | | | | | | |
| 2032 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2033 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2034 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2035 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2036 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2037 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2038 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2039 | 0.54 | 1.34 | 0.84 | 2.72 | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2040 | 0.66 | 1.61 | 1.01 | 3.28 | | | | | 1.46 | 3.58 | 2.23 | 7.27 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2041 | 0.63 | 1.55 | 0.97 | 3.16 | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2042 | 0.68 | 1.67 | 1.05 | 3.40 | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2043 | 0.73 | 1.79 | 1.12 | 3.65 | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2044 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |
| 2045 | | | | | | | | | 1.46 | 3.58 | 2.23 | 7.27 |

The amount of extracted carbon stock that is assumed to enter the wood products pool that is not immediately emitted at harvest was calculated as:

$$C_{WP,i|BSL} = \sum_k C_{EX,i,k|BSL} - C_{WP0,i|BSL}$$ *(equation 10 from VM0010)*

Where:

| | |
|---|---|
| $C_{WP\|BSL}$ | Carbon stock of extracted timber that is assumed to enter the wood products pool that is not immediately emitted at the time of harvest, in t C ha$^{-1}$; |
| $C_{EX,\|BSL}$ | Mean carbon stock of extracted timber per unit area for wood product type *k*, tC ha$^{-1}$ |
| $C_{WP0,BSL}$ | Carbon stock of extracted timber that is assumed to be emitted immediately at the time of harvest, in t C ha$^{-1}$ |
| *k* | Wood products |

Of this amount, the carbon stock of wood products assumed to be retired between 3-100 years following harvest was calculated as:

$$C_{WP100|BSL} = C_{WP|BSL} * OF_K$$ *(equation 11 from VM0010)*

Where:

| | |
|---|---|
| $C_{WP100,i,p\|BSL}$ | Carbon stored in wood products that are assumed to be retired between 3 - 100 years after harvest, t C ha$^{-1}$ |
| $C_{WP\|BSL}$ | Carbon stock of extracted timber that is assumed to enter the wood products pool that is not immediately emitted at the time of harvest, in t C ha$^{-1}$ |
| *OFk* | Fraction of biomass carbon for wood product type *k* that is assumed to be emitted to the atmosphere between 3 and 100 years of timber harvest, dimensionless |
| *i* | 1,2,3 ...*M* strata |

For the fraction of biomass carbon for wood product that is assumed to be emitted to the atmosphere between 3 and 100 years of timber harvest, the default values for OF provided in the methodology were used, with the default values for the tropical forest region. These values for OF were estimated in the methodology using values from Winjum *et al* 1998 split by forest region.

*Table 19: Fraction of biomass carbon for wood product type that is assumed to be emitted to the atmosphere between 3 and 100 years of timber (from Winjum et al 1998)*

| Wood Product Class | *OF* | | |
|---|---|---|---|
| | Boreal | Temperate | Tropical |
| Sawnwood | 0.39 | 0.62 | 0.86 |
| Woodbase panels | 0.62 | 0.86 | 0.98 |
| Other industrial roundwood | 0.86 | 0.98 | 0.99 |
| Paper and paperboard | 0.39 | 0.62 | 0.99 |

The resulting values for the carbon stored in wood products that are assumed to be retired between 3 - 100 years after harvest are provide in Table 20.

*Table 20: Carbon stored in wood products that are assumed to be retired between 3 - 100 years after harvest*

| Year that logging would occur according to the timber harvesting plan | Stratum 2 (Natural Forest Management) | | | | Stratum 3 (selective logging within Mosaic Planting) | | | | Stratum 4 (planting areas within Mosaic Planting | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Sawn. Wood* | *Panels* | *Other Industrial. Round-wood* | **total** | *Sawn. Wood* | *Panels* | *Other Industrial. Round-wood* | **total** | *Sawn. Wood* | *Panels* | *Other Industrial Round-wood* | **total** |
| 2016 | | | | | 1.91 | 6.40 | 2.89 | 11.19 | 1.42 | 4.78 | 2.16 | 8.36 |
| 2017 | | | | | 1.59 | 5.34 | 2.41 | 9.34 | 1.16 | 3.88 | 1.75 | 6.79 |
| 2018 | | | | | 1.69 | 5.67 | 2.56 | 9.91 | 1.30 | 4.38 | 1.97 | 7.65 |
| 2019 | | | | | 1.91 | 6.40 | 2.89 | 11.19 | 1.37 | 4.62 | 2.08 | 8.07 |
| 2020 | | | | | 2.05 | 6.88 | 3.10 | 12.04 | 1.59 | 5.34 | 2.41 | 9.34 |
| 2021 | | | | | 2.07 | 6.96 | 3.14 | 12.17 | 1.95 | 6.56 | 2.96 | 11.46 |
| 2022 | | | | | | | | | | | | |
| 2023 | | | | | | | | | | | | |
| 2024 | 0.86 | 2.88 | 1.30 | 5.03 | | | | | | | | |
| 2025 | 1.03 | 3.47 | 1.57 | 6.07 | | | | | | | | |
| 2026 | 1.00 | 3.34 | 1.51 | 5.84 | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2027 | 1.07 | 3.60 | 1.62 | 6.30 | | | | | | | | |
| 2028 | 1.15 | 3.86 | 1.74 | 6.75 | | | | | | | | |
| 2029 | | | | | | | | | | | | |
| 2030 | | | | | | | | | | | | |
| 2031 | | | | | | | | | | | | |
| 2032 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2033 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2034 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2035 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2036 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2037 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2038 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2039 | 0.86 | 2.88 | 1.30 | 5.03 | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2040 | 1.03 | 3.47 | 1.57 | 6.07 | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2041 | 1.00 | 3.34 | 1.51 | 5.84 | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2042 | 1.07 | 3.60 | 1.62 | 6.30 | | | | | 2.29 | 7.69 | 3.47 | 13.45 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2043 | 1.15 | 3.86 | 1.74 | 6.75 | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2044 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |
| 2045 | | | | | | | | | 2.29 | 7.69 | 3.47 | 13.45 |

Change in carbon stocks due to forest regrowth after harvest (section 8.1.4 of the methodology)

In accordance with the methodology, the carbon sequestration in the baseline scenario resulting from forest regrowth after timber harvest up to year t is considered equal to the estimated baseline forest regrowth rate of each stratum.

Therefore, carbon sequestration resulting from forest regrowth after timber harvest is calculated as:

$$C_{RG,i,p|BSL} = \sum_i RGR_i \qquad \textit{(equation 12 from VM0010)}$$

Where:

| | |
|---|---|
| $C_{RG,i,p\|BSL}$ | Carbon sequestration resulting from forest regrowth after timber harvest and establishment of forestry infrastructure in stratum *i* in land parcel *p*, t C $ha^{-1}yr^{-1}$ |
| *RGRi* | Regrowth rate of forest post timber harvest post forestry infrastructure establishment for stratum *i*, t C $ha^{-1}yr^{-1}$; |
| *i* | 1,2,3 ...*M* strata |

For stratum 2 and 3, $RGR_i$ is assumed to be 1.6 t C $ha^{-1}yr^{-1}$ based on table 1 of Suarez (2019)[45] (which would be an average growth rate of 3.4 Mg d.m. $ha^{-1}$ $year^{-1}$ for tropical rainforest in Asia and a carbon fraction of 0.47). For stratum 4, $RGR_i$ is estimated as 3.0 t C $ha^{-1}yr^{-1}$. For this estimation, data from Yahya and Ikau (2016)[46] on DBH, height, age, and planting density were used. In addition, we used 0.2955 Mg $M^{-3}$ as the mean wood density for Paraserianthes from the global wood density database (Chave 2009, Zanne 2009[47]). To our knowledge Neolamarckia was not in the database and we used a value of 0.362 from Mahmud *et al*. (2017)[48]. Using these values, Tree-level Above-Ground Biomass (in Mg) was calculated using Eq. 4 in Chave *et al*. (2014), and assuming an average age of planted individuals of 6.25 years.

The average regrowth rate was estimated from the tree-level above-ground biomass based on a feasible planting rate and harvesting 15 years after planting. For the planting rate it was assumed that the entire area would take 30 years to plant, or 1261 hectares per year. Based on the planting density in Yahya and

[45] Suarez *et all*, 2019. Estimating aboveground net biomass change for tropical and subtropical forests: Refinement of IPCC default rates using forest plot data

[46] Ahmad Zuhaidi Yahya & Albert Ikau A.G. (2016) Reforestation with naturally regenerated trees and selected forest plantation species based on mosaic planting approach. International Journal of Agriculture, Forestry and Plantation, Vol. 1 (Dec 2015)

[47] Zanne, A., Lopez-Gonzalez, G., Coomes, D., Ilic, J., Jansen, S., Lewis, S., Miller, R., Swenson, N., Wiemann, M. & Chave, J. 2009. Global Wood Density Database. Dryad Digital Repository

[48] Mahmud, Siti Zalifah & Hashim, Rokiah & Saleh, Abdul & Sulaiman, Othman & Saharudin, Nur & Lokmal, N. & Masseat, Khairul & Husain, Hamdan. (2017). Physical and mechanical properties of juvenile wood from Neolamarckia cadamba planted in West Malaysia. Maderas. Ciencia y tecnología. 19. 10.4067/S0718-221X2017005000020.

Ikau (2016), this planting rate would require nursery facilities for almost a million seedlings per year. This is an ambitious planting rate and results in a conservative overall *RGR* for the planted areas. We will further analyse the reference areas in the coming years to see if this planting rate has been achieved.

In estimating the forest regrowth in stratum 4, it was further assumed that there would be no growth between the salvage logging and the planting within the mosaic areas due to the damaging nature of salvage logging. If there was any regrowth during this interlude, not only would it be negligible, but there would also be additional site preparation clearing immediately before planting. When we average the growth rate based on this planting rate, we estimate the overall average growth rate mentioned above for the area to be 3.0 t C $ha^{-1}yr^{-1}$.

Calculation of baseline emissions from the combustion of fossil fuels in forestry and wood processing machinery (section 8.1.5 of the methodology)

The implementation of the baseline activity (selective logging and/or clearcutting) entails the use of forestry and wood processing machinery, which leads to GHG emissions from fossil fuel combustion. In accordance with the methodology, the omission of any or all of the associated GHG emission sources is considered conservative. These emissions have therefore been excluded from the calculations and CFuel is considered zero in the baseline.

Calculation of baseline scenario greenhouse gas emissions from change in carbon stocks (section 8.1.6 of the methodology)

The net greenhouse gas emissions in the baseline scenario are estimated from the carbon stock change as a result of timber harvest plus the carbon stock change resulting from conversion and retirement of wood products minus carbon sequestration from forest regrowth after harvest.

In accordance with the methodology, annualized calculations have been performed that vary between years 1, 2-10; 11-20 using the following equations:

$$\Delta C_{NET|BSL1} = \sum_{i,p} A_{1,i,p} * \sum_{i=1}^{M} (C_{DWslash,i,p|BSL}/10) + C_{WP0,i,p|BSL} + (C_{WP100,i,p|BSL}/20)$$

*(equation 23 from VM0010)*

$$\Delta C_{NET|BSL(2-10)} = \sum_{i,p} A_{2-10,i,p} * \sum_{i=1}^{M} ((\Delta C_{DWslash,i,p|BSL}/10) + (\Delta C_{WP100,i,p|BSL}/20))$$

*(equation 24 from VM0010)*

$$\Delta C_{NET|BSL(11-20)} = \sum_{i,p} A_{11-20,i,p} * \sum_{i=1}^{M} (C_{WP100,i,p|BSL}/20)$$

*(equation 25 from VM0010)*

Where:

| | |
|---|---|
| $\Delta C_{NET\|BSL(1)}$ | Net change in carbon stock across all parcels in the baseline scenario in the first year since harvest in the baseline scenario, in t C |
| $\Delta C_{NET\|BSL(2\text{-}10)}$ | Net change in carbon stock across all parcels in the baseline scenario in years 2 - 10 since harvest in the baseline scenario, in t C |
| $\Delta C_{NET\|BSL(11\text{-}20)}$ | Net change in carbon stock across all parcels in the baseline scenario in years 11 - 20 since the start of the project activity, in t C; |
| $\Delta C_{Slash,i,p\|BSL}$ | Change in carbon stock of dead wood as logging slash resulting from timber harvest per unit area in stratum *i* in land parcel *p*, in t C $ha^{-1}$ |
| $\Delta C_{WP0,i,p\|BSL}$ | Change in carbon stock resulting from wood product conversion and retirement from stratum *i* in land parcel *p*, that is assumed to be emitted in the first year of harvest in the baseline t C $ha^{-1}$ |
| $\Delta C_{WP100,i,p\|BSL}$ | Carbon stored in wood products that is assumed to be retired between 3 - 100 years after harvest from stratum *i* in land parcel *p*, t C $ha^{-1}$; |
| $A_{1,i,p\|BSL}$ | Area of stratum *i* in land parcel *p* that was harvested 1 year ago, ha |
| $A_{2\text{-}10,i,p\|BSL}$ | Area of stratum *i* in land parcel *p* that was harvested between 2 and 10 year ago, ha |
| $A_{11\text{-}20,i,p\|BSL}$ | Area of stratum *i* in land parcel *p* that was harvested between 11 and 20 year ago, ha |
| *i* | 1,2,3 …*M* strata |
| *p* | *1, 2, 3 …P* land parcels harvested within the project crediting period |

The net change (sequestration) in carbon stock due to forest regrowth across all parcels in all years since harvest in the baseline scenario are calculated as follows:

$$\Delta C_{NET|BSL(1+)} = \sum_{i,p} A_{t*} * \sum_{i=1}^{M}(-\Delta C_{RG,i,p|BSL}) \qquad \textit{(equation 26 from VM0010)}$$

Where:

| | |
|---|---|
| $\Delta C_{NET\|BSL(1+)}$ | Net change in carbon stock due to forest regrowth in all parcels that have been harvested in the baseline scenario, in t C; |
| $\Delta C_{RG,I,p\|BSL}$ | Carbon sequestration resulting from forest regrowth after timber harvest in stratum *i* in land parcel *p*, t C $ha^{-1}$ |
| $A_{t*}$ | Cumulative area harvested until time t*, ha; |
| *t** | 1, 2,….10, time elapsed since the start of the project, in years |
| *i* | 1,2,3 …*M* strata |
| *p* | *1, 2, 3 …P* land parcels harvested within the project crediting period |

Since the baseline emissions from the combustion of fossil fuels have been conservatively omitted, the net change in carbon stock over each year of the project crediting period in the baseline scenario since the start of the project activity is calculated as:

$$\Delta C_{NET|BSL,t*} = \sum_{p=1}^{P}[\Delta C_{Net,p|BSL(1)} + \Delta C_{Net,p|BSL(2-10)} + \Delta C_{Net,p|BSL(11-20)} + \Delta C_{Net,p|BSL(+1)}]$$
*(equation 27 from VM0010)*

Where:

| | |
|---|---|
| $\Delta C_{NET\|BSL,t}$ | Net change in carbon stock across all parcels in the baseline scenario in the year t* since the start of the project activity, in tC; |
| $\Delta C_{NET\|BSL\ (1)}$ | Net change in carbon stock in the baseline scenario for all parcels *p* that are within 1 year of harvest in the baseline scenario, in tC; |
| $\Delta C_{NET\|BSL\ (2\text{-}10)}$ | Net change in carbon stock in the baseline scenario for all parcels p, that were harvested between 2 – 10 years ago in the baseline scenario, in tC; |
| $\Delta C_{NET\|BSL\ (11\text{-}20)}$ | Net change in carbon stock in the baseline scenario for all parcels *p*, that were harvested between 11 – 20 years ago in the baseline scenario, in tC |
| $\Delta C_{NET\|BSL(1+)}$ | Net change in carbon stock due to forest regrowth in all parcels that have been harvested in the baseline scenario, in t C; |
| *t** | 1, 2,….10, time elapsed since the start of the project, in years |
| *p* | *1, 2, 3 …P* land parcels harvested within the project crediting period |

The net carbon stock change in the baseline scenario has been converted to net greenhouse gas emissions resulting in **¡Error! No se encuentra el origen de la referencia.**.

*Table 21: Net carbon stock change in the baseline scenario.*

| Year that logging would occur according to the timber harvesting plan | Net change in carbon stock across all parcels in the baseline scenario in year t* (tC) | Net greenhouse gas emissions in the baseline scenario in year t* ($tCO_2e$) | Cumulative net greenhouse gas emissions in the baseline scenario in year t* since the start of the project activity |
|---|---|---|---|
| 2016 | 62744.85 | 230064.47 | 230064.5 |
| 2017 | 89309.57 | 327468.44 | 557532.9 |
| 2018 | 103619.40 | 379937.79 | 937470.7 |
| 2019 | 160404.16 | 588148.59 | 1525619.3 |
| 2020 | 189483.06 | 694771.21 | 2220390.5 |
| 2021 | 187617.75 | 687931.75 | 2908322.2 |
| 2022 | 168602.81 | 618210.31 | 3526532.6 |
| 2023 | 168602.81 | 618210.31 | 4144742.9 |
| 2024 | 195705.26 | 717585.94 | 4862328.8 |
| 2025 | 241360.11 | 884987.07 | 5747315.9 |
| 2026 | 203960.51 | 747855.22 | 6495171.1 |
| 2027 | 175997.84 | 645325.42 | 7140496.5 |
| 2028 | 167161.55 | 612925.67 | 7753422.2 |
| 2029 | 79559.97 | 291719.89 | 8045142.1 |

| | | | |
|---|---|---|---|
| 2030 | 26617.45 | 97597.33 | 8142739.4 |
| 2031 | 1401.60 | 5139.20 | 8147878.6 |
| 2032 | 19299.20 | 70763.73 | 8218642.3 |
| 2033 | 28273.77 | 103670.49 | 8322312.8 |
| 2034 | 17607.54 | 64560.97 | 8386873.8 |
| 2035 | -14948.75 | -54812.09 | 8332061.7 |
| 2036 | -36486.55 | -133784.02 | 8198277.7 |
| 2037 | -58208.38 | -213430.73 | 7984847.0 |
| 2038 | -84923.86 | -311387.47 | 7673459.5 |
| 2039 | -53221.18 | -195144.32 | 7478315.2 |
| 2040 | -2287.39 | -8387.10 | 7469928.1 |
| 2041 | 13020.42 | 47741.55 | 7517669.6 |
| 2042 | 29766.63 | 109144.31 | 7626813.9 |
| 2043 | 55631.45 | 203981.98 | 7830795.9 |
| 2044 | 26465.80 | 97041.27 | 7927837.2 |
| 2045 | 20708.43 | 75930.90 | 8003768.1 |

**>>> end of updated section 3.2.1<<<<**

**>>>start of updated section 3.2.3 of the PD<<<<<**

### 3.2.3 Leakage

**Analysis for leakage due to market effects (section 8.3.2 of the methodology)**

When it comes to leakage due to market effects, this was estimated as the net emissions from planned timber harvest activities in the baseline scenario multiplied by an appropriate leakage factor:

$$GHG_{LK|LtPF,t*} = LF_{ME} * GHG_{NET|BSL,t*}$$ *(equation 40 from VM0010)*

Where:

| | |
|---|---|
| $GHG_{LK\|LtPF,t}*$ | Total market leakage as a result of IFM LtPF activities, in the year t* since the start of the project activity, $tCO_2e$ |

| | |
|---|---|
| $LF_{ME}$ | Leakage factor for market-effects calculations; dimensionless |
| $GHG_{NET\|BS,t^*L}$ | Net greenhouse gas emissions in the baseline scenario in the year $t^*$ since the start of the project activity, $tCO_2e$ |

The leakage factor was determined by considering where logging will be increased as a result of the decreased supply of the timber caused by the project. This analysis assumes that the forest estate where harvesting would likely be displaced to, are all the known forest areas in Sabah where harvesting legally took place during the years 2016-2019 (the base year until the year of last archived data by SFD).

All harvested merchantable volume from the year 2016 (project baseline base year) until 2019 was collated by SFD for all active logging concessions within the State of Sabah. All SFD data was recorded as either 'NFM', 'Salvage logging' or 'Plantation Timber'. Data for Plantation Timber was not included in our analysis as it does not apply to our baseline scenario. We calculated the Volume per hectare (Harvest Volume / Harvest Area), for every individual record within the database. We then calculated the mean volume extracted per hectare (2016-2019), for each Forest Reserve and Logging Type ('NFM' or 'Salvage logging'). Using the mean volume extracted per hectare we estimate the biomass within the timber volume using the BCEFR of 1.89. We consider these records of timber that was harvested from the base year, the best estimate of merchantable timber biomass available.

For all of these active Forest Reserves the total biomass per hectare in the analysed forest estate was calculated a published carbon map for the base year of 2016 (Asner et al. 2017, & 2021). The carbon of all pixels was summed for each forest reserve using outlines provided by SFD (see Figure 16).

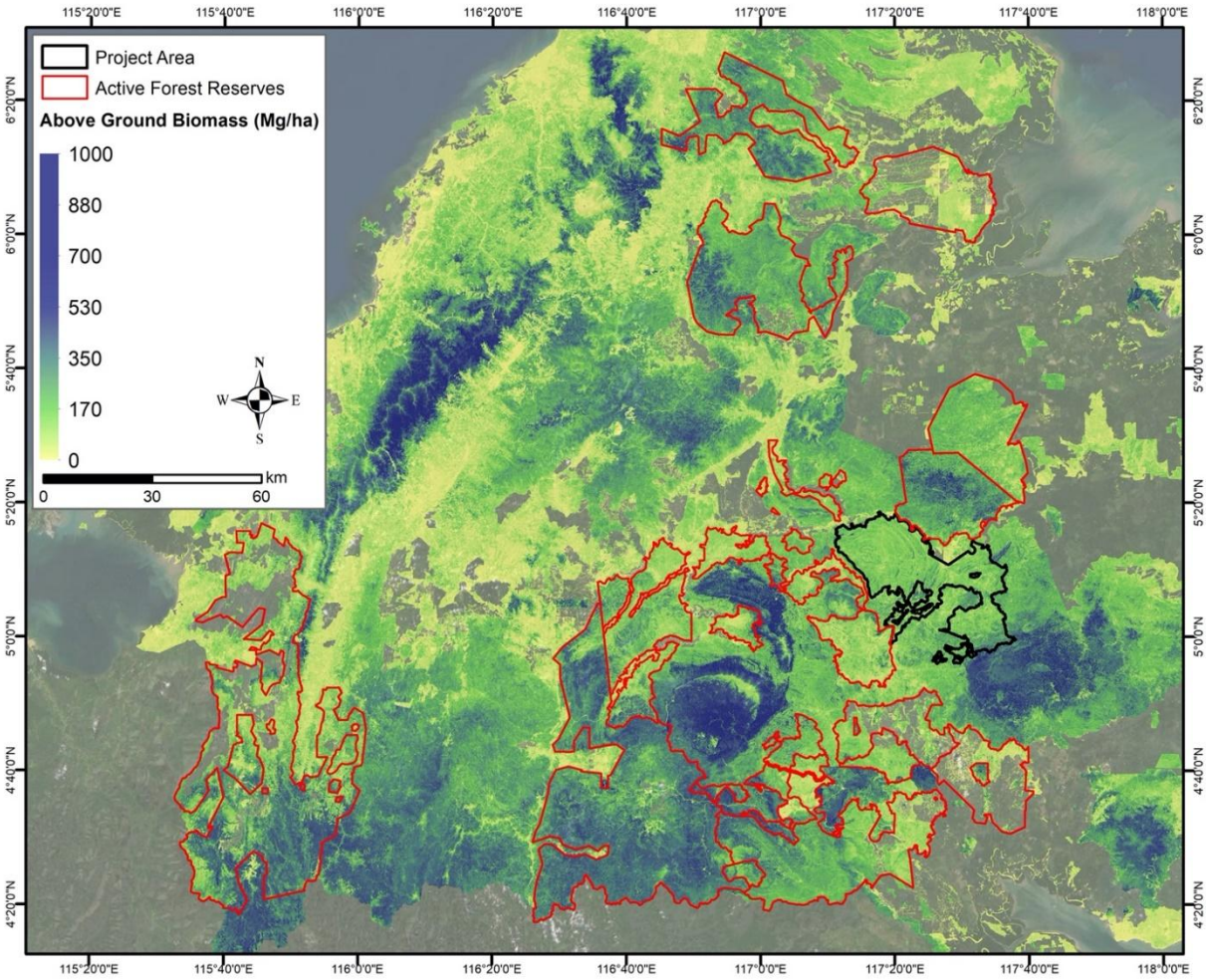



*Figure 16. Active concessions in the state from 2010 to 2019, overlaid on Above Ground Biomass (in Mg ha-1). AGB was calculated from a published Carbon map from the state and dividing by a carbon fraction of 0.47 (Asner 2017).*

The carbon per hectare was calculated based on the total carbon for the forest reserve and the total area based on the SFD Forest Reserve boundaries. One forest reserve (Bengkoka FR.), had no remaining biomass per hectare, we therefore applied the ACD value of the lowest FR. Biomass data is summarised from data in 2016 Asner et al. (2017, & 2021), and merchantable biomass was collated from all records of timber that was harvested (merchant-ED) during 2016-2019. The biomass per hectare was calculated from the carbon per hectare using the $BCEF_R$ of 1.89 and a Carbon fraction of 0.47 (see Table 22). Here PML is calculated individually for each Forest Reserve Logging Type combination.

*Table 22: Above Ground Biomass and Merchanted biomass for all active logging concessions from the years 2016-2019 within the SFD Estate.*

| *Forest Reserve* | *AGB (mg/ha)* | *Logging Type* | *Merchantable Biomass* |
|---|---|---|---|
| BENGKOKA FR. | 37.44681 | SalvageLogging | 124.52561 |

| | | | |
|---|---|---|---|
| BONGGAYA FR. | 37.4468 | SalvageLogging | 11.8043 |
| DERAMAKOT FR. | 286.8085 | NFM | 92.2929 |
| GN. RARA FR. | 141.4894 | NFM | 106.1330 |
| GN. RARA FR. | 141.4894 | SalvageLogging | 134.1513 |
| KALABAKAN FR. | 139.3617 | SalvageLogging | 30.8830 |
| LINGKABAU FR. | 262.5532 | NFM | 50.1192 |
| LINGKABAU FR. | 262.5532 | SalvageLogging | 108.5909 |
| SAPULUT FR. | 339.1489 | NFM | 65.1720 |
| SAPULUT FR. | 339.1489 | SalvageLogging | 99.4819 |
| SEGALIUD LOKAN FR. | 156.8085 | NFM | 15.7768 |
| SEGALIUD LOKAN FR. | 156.8085 | SalvageLogging | 105.0819 |
| SG. PINANGAH FR. | 158.7234 | NFM | 22.9497 |
| SG. PINANGAH FR. | 158.7234 | SalvageLogging | 163.5833 |
| SIPITANG FR. | 185.9574 | NFM | 263.0616 |
| SIPITANG FR. | 185.9574 | SalvageLogging | 271.4405 |
| ULU TUNGUD FR. | 234.4681 | NFM | 19.0139 |

In order to obtain comparable values of total biomass per hectare for the project area, we summarised the biomass data from Asner et al. (2018, & 2021) in the same way as for the active forest reserves above. We estimated the total biomass per hectare for the main boundary of NFM and Mosaics within the project area (i.e not subtracting stratum 1, or separating mosaic strata) as this is the most comparable to the process for the other forest reserves.

To estimate the leakage factor, the ratio of merchantable biomass to total biomass was estimated for the NFM stratum (stratum 2) and the combined Mosaic strata (stratum 3 and 4) in the project area ($PMP_i$). Using the Merchantable Biomass and total biomass values in the above Table 22 (for each forest reserve), we calculated the mean merchantable and total biomass, and then the PML for each of the comparable forest types in the analysed forest estate (PMLFT). The results are shown in the tables below.

*Table 23: Ratio of merchantable biomass to total biomass for each forest type (PMLFT)*

| *Logging Type* | *PMP_FT* | *Merchantable Biomass* | *AGB (mg/ha)* |
|---|---|---|---|
| Salvage Logging | 0.964 | 116.62 | 162.10 |
| NFM | 0.399 | 79.31 | 220.74 |

*Table 24: Ratio of merchantable biomass to total biomass (PMPi)*

| Stratum | PMP_I | Merchantable Biomass | AGB (mg/ha) | Area (ha) |
|---|---|---|---|---|
| Mosaic | 0.7117 | 112.74 | 158.4134 | 44635.62 |
| NFM | 0.4454 | 75.26 | 168.9854 | 35028.57 |

The difference between these two ratios (expressed as a percentage) was used to estimate the leakage factor (LFME). The minor change in this value is a result of the slightly improved DEM input data since the PD. The results of the calculations are provided in the table below.

*Table 25: Calculated deduction factors (LFME)*

| **Stratum in the project area** | **Corresponding forest type in the analysed forest estate** | **% difference between $PMP_I$ and $PML_{FT}$** | **$LF_{ME}$** |
|---|---|---|---|
| **Stratum 2** | Natural Forest Management | 10.30% | 0.4 |
| **Stratum 3 and Stratum 4** | Salvage logging | 35.48% | 0.2 |

Based on the area of the NFM Strata (35,241.45 ha), and the Mosaic Strata (44,808.52 ha), we estimated an area weighted leakage for the entire project as 0.288.

Applying this value to equation 20- and using activity leakage of zero, this leads to the following results for the leakage calculation as shown in Table 29.

*Table 26: Emission as a result of leakage.*

| Year that logging would occur according to the timber harvesting plan | Leakage due to activity shifting ($tCO_2e$) | Market leakage as a result of IFM LtPF activities in year t* ($tCO_2e$) | Total cumulative leakage in year t* since the start of the project activity |
|---|---|---|---|
| 2016 | 0 | 66258.57 | 66258.57 |
| 2017 | 0 | 94310.91 | 160569.48 |
| 2018 | 0 | 109422.08 | 269991.56 |
| 2019 | 0 | 169386.80 | 439378.36 |
| 2020 | 0 | 200094.11 | 639472.47 |
| 2021 | 0 | 198124.34 | 837596.81 |
| 2022 | 0 | 178044.57 | 1015641.38 |
| 2023 | 0 | 178044.57 | 1193685.95 |
| 2024 | 0 | 206664.75 | 1400350.70 |
| 2025 | 0 | 254876.28 | 1655226.97 |
| 2026 | 0 | 215382.30 | 1870609.28 |
| 2027 | 0 | 185853.72 | 2056463.00 |
| 2028 | 0 | 176522.59 | 2232985.59 |
| 2029 | 0 | 84015.33 | 2317000.92 |
| 2030 | 0 | 28108.03 | 2345108.95 |
| 2031 | 0 | 1480.09 | 2346589.04 |
| 2032 | 0 | 20379.95 | 2366968.99 |
| 2033 | 0 | 29857.10 | 2396826.10 |
| 2034 | 0 | 18593.56 | 2415419.66 |
| 2035 | 0 | -15785.88 | 2399633.77 |
| 2036 | 0 | -38529.80 | 2361103.97 |
| 2037 | 0 | -61468.05 | 2299635.92 |
| 2038 | 0 | -89679.59 | 2209956.33 |
| 2039 | 0 | -56201.56 | 2153754.77 |
| 2040 | 0 | -2415.49 | 2151339.28 |
| 2041 | 0 | 13749.57 | 2165088.85 |
| 2042 | 0 | 31433.56 | 2196522.41 |

| | | | |
|---|---|---|---|
| 2043 | 0 | 58746.81 | 2255269.22 |
| 2044 | 0 | 27947.89 | 2283217.10 |
| 2045 | 0 | 21868.10 | 2305085.20 |

# APPENDIX 2: PROJECT RISKS TABLE

| | Identified risk(s) | Potential impact of risk on stakeholders, ecosystem health, and biodiversity | Mitigation or preventative measure(s) taken |
|---|---|---|---|
| Natural and human induced risks to stakeholders' wellbeing | Over-reliance on project benefits without long-term sustainability | Economic instability once project funding ends. The project will provide cash support in addition to other financial and non-financial support (see benefit sharing plan) | Fostering economic self-sufficiency, supporting sustainable community alternative livelihoods based on the decisions made by the community themselves |
| | Increased human-wildlife conflicts due to forest conservation | Damage to crops/livelihoods, negative perception of conservation, particularly by elephants | The project is in close coordination with the Sabah Wildlife Department and specialized NGOs to develop an integrated monitoring and prevention system against damaged caused by elephants. |
| Risks to stakeholder participation | Exclusion of marginalized groups Reduced social equity, ineffective community engagement (women, youth, Indigenous Peoples) from decision-making | Reduced social equity, ineffective community engagement | Ensuring Free, Prior, and Informed Consent (FPIC), establishing inclusive governance structures. Through our partner PACOS and with the establishment of AJK in each community, the project aims to ensure broad stakeholder participation. |
| | Lack of capacity or knowledge to participate in project activities | Reduced local involvement, weak implementation of conservation efforts | Capacity building program design |

| | | | |
|---|---|---|---|
| **Working conditions** | Unsafe working conditions in remote areas | Increased risk of accidents, isolation of workers in emergencies | Establishing emergency response mechanisms, ensuring safe transport (boat ambulance), safety trainings, staff insurance, safety protocols |
| **Safety of women and girls** | Lack of gender-sensitive policies and risks to women and girls | Increased vulnerability, reduced participation of women | Implementing gender-sensitive policies and activities ensuring women participation in decision making, project activities, and others. This is described in section 4.4.3 |
| **Safety of minority and marginalized groups, including children** | Marginalization of minority and vulnerable groups, including children | Limited access to project benefits, exclusion from decision-making | Inclusive benefit-sharing mechanisms, targeted outreach programs. This is implemented through the continuous community engagement (evidence provided) |
| **Pollutants (air, noise, discharges to water, generation of waste, and release of hazardous materials and chemical pesticides and fertilizers)** | No risk identified | The project will not generate significant pollutants, including air and noise pollution, water discharges, hazardous waste, or the release of chemical pesticides and fertilizers, because it is designed with strict environmental safeguards. The project prioritizes eco-friendly conservation and restoration practices, sustainable water management, and non-toxic, nature-based solutions. | N/A |

| | | | |
|---|---|---|---|
| **Discrimination** | Unequal distribution of project benefits | Social tensions, decreased trust in the project, exclusion of vulnerable groups | Transparent benefit-sharing mechanisms, participatory governance |
| **Sexual harassment** | Risk of sexual harassment in project areas | Unsafe work and community environments | Implementing anti-harassment policies, clear reporting/grievance mechanisms. Permian Global, Permian Malaysia, PACOS, SEARRP and RBJ have policies in place to prevent any kind of harassment |
| **Equal pay for equal work** | Wage disparities among workers within the project | Economic disparity, reduced worker motivation | Ensuring compliance with equal pay regulations and labor laws |
| **Gender equity in labor and work** | Gender inequality in conservation and forest management work | Underrepresentation of women, reduced social equity | Promoting women's leadership, capacity-building programs. Please find the number of women participating in table 1.2 and section 4.4.3 |
| **Forced labor**[1] | No risk identified | The project will not generate risks related to forced labor, child labor, or human trafficking, including among staff and contracted workers employed by third parties, because it upholds strict labor policies aligned with international human rights and labor standards. All project activities comply with national labor laws and International Labour Organization (ILO) conventions, ensuring fair and | N/A |

| | | | |
|---|---|---|---|
| | | ethical working conditions. Robust due diligence measures, including worker verification processes, contractual obligations for third-party employers, regular audits, and grievance mechanisms, are in place to prevent exploitation. The project also prioritizes awareness training and community engagement to reinforce ethical labor practices across all levels. | |
| **Child labor** | *No risk identified* | *The project will not generate risks related to forced labor, child labor, or human trafficking, including among staff and contracted workers employed by third parties, because it upholds strict labor policies aligned with international human rights and labor standards. All project activities comply with national labor laws and International Labour Organization (ILO) conventions, ensuring fair and ethical working conditions. Robust due diligence measures, including worker verification processes, contractual obligations for third-party employers, regular audits, and grievance mechanisms, are in place to prevent exploitation. The project also prioritizes awareness training and community engagement to* | N/A |

| | | | |
|---|---|---|---|
| | | *reinforce ethical labor practices across all levels.* | |
| **Human trafficking** | *No risk identified* | *The project will not generate risks related to forced labor, child labor, or human trafficking, including among staff and contracted workers employed by third parties, because it upholds strict labor policies aligned with international human rights and labor standards. All project activities comply with national labor laws and International Labour Organization (ILO) conventions, ensuring fair and ethical working conditions. Robust due diligence measures, including worker verification processes, contractual obligations for third-party employers, regular audits, and grievance mechanisms, are in place to prevent exploitation. The project also prioritizes awareness training and community engagement to reinforce ethical labor practices across all levels.* | N/A |
| **Recognition of, respect of, and promotion of the rights to IPs, LCs and customary rights holders** | Conflicts over land tenure and resource rights | Disputes among stakeholders, delay in project implementation | The project abides by the current legislation in Sabah in relation to the establishment of Class 1 Protection Forest. This includes the recognition of the boundaries with project zone communities. |

| | | | |
|---|---|---|---|
| **Preserving and protecting cultural heritage** | Failure to integrate traditional and Indigenous knowledge into conservation strategies | Loss of valuable ecological practices, reduced community support | Recognition and inclusion of traditional knowledge in project design. This knowledge was collected when developing the Community Development Plan and continuous adjustment to the project design. |
| | Potential restrictions on cultural sites or spiritual practices | Loss of cultural heritage, resistance to project activities | Mapping and protecting culturally significant sites (see HCV), engaging communities in conservation planning |
| **Protecting and preserving property rights, customary rights, or protecting legal or customary tenure/access rights to territories, property, and resources, including collective and/or conflicting rights** | No risk has been identified | The project will not generate risks related to the violation of property rights, customary rights, or legal tenure/access rights to territories, property, and resources, including collective and potentially conflicting rights, because it is committed to respecting and strengthening land tenure security. The project follows Free, Prior, and Informed Consent (FPIC) principles, ensuring that Indigenous Peoples, local communities, and customary rights holders are fully engaged in decision-making. Legal assessments and participatory land-use planning are integrated into the project design to recognize and formalize customary and legal rights. Additionally, conflict resolution mechanisms are in place to address any disputes fairly and transparently. Furthermore, the | N/A |

| | | | |
|---|---|---|---|
| | | project area has been classified as Class 1 Protection Forest under Sabah legislation, meaning it is legally designated for conservation and cannot be used for development or commercial activities. As a result, the project does not put any property rights at risk and ensures the long-term protection of land and resources. | |
| Impacts on biodiversity and ecosystems | No risk identified | The project will not generate risks of negative impacts on biodiversity and ecosystems because it is specifically designed to restore and conserve forest landscapes, enhance ecosystem connectivity, and protect endangered species. All activities align with Class 1 Protection Forest status under Sabah legislation, ensuring that the area remains legally protected from deforestation, land conversion, and harmful development. The project prioritizes nature-based solutions, sustainable land management, and ecological restoration to improve habitat quality and biodiversity resilience. Additionally, strict environmental monitoring, biodiversity assessments, and community-based conservation efforts ensure that the project enhances rather than degrades local | N/A |

| | | | |
|---|---|---|---|
| | | ecosystems, safeguarding both wildlife and ecosystem services for long-term sustainability. | |
| **Soil degradation and soil erosion** | No risk identified | The project will not generate risks related to soil degradation and soil erosion because it is actively engaged in forest restoration, sustainable land management, and watershed conservation, which help stabilize soils, prevent erosion, and maintain soil fertility. | N/A |
| **Water consumption and stress** | No risk identified | The project will not generate risks related to water consumption and stress because it is actively improving water access for local communities through a gravity-fed water system, ensuring a sustainable and equitable water supply without over-extracting local resources. Additionally, the project focuses on watershed conservation and forest restoration, which enhances natural water retention, regulates water flow, and reduces erosion, contributing to long-term water security for both people and ecosystems. | N/A |
| **Habitats (and areas needed for habitat connectivity) for rare,** | No risk identified | The project will not generate risks to habitats or habitat connectivity for rare, threatened, and endangered species because it is specifically | N/A |

| | | | |
|---|---|---|---|
| threatened, and endangered species | | designed to restore and protect forest ecosystems, ensuring the conservation of critical wildlife corridors. The project area has been classified as Class 1 Protection Forest under Sabah legislation, meaning it is legally designated for conservation, prohibiting deforestation and habitat destruction. | |
| Areas needed for habitat connectivity | No risk identified | The project will not generate risks to areas needed for habitat connectivity because it is designed to restore and maintain ecological corridors, ensuring the free movement of wildlife and the long-term viability of ecosystems | N/A |
| Invasive species | No risk identified | The project will not generate risks related to invasive species because, while scientific studies have documented the presence of invasive species in Sabah, no such species have been recorded within the project area. The project operates in a Class 1 Protection Forest under Sabah legislation, ensuring strict conservation measures that prevent habitat disturbances that could facilitate the introduction or spread of invasive species. | N/A |

| | | | |
|---|---|---|---|
| Ecosystem conversion | Unintended effects of conservation areas restricting community access to resources | Loss of local economic opportunities, social tensions | Developing alternative livelihood programs, promoting sustainable forest-based enterprises in future project phases. |

[1] The identified risks and commensurate mitigation or preventative measure(s) for forced labor, child labor, and human trafficking, must be inclusive of staff and contracted workers employed by third parties.

# APPENDIX 3: COMMERCIALLY SENSITIVE INFORMATION

| Section | Information | Justification |
|---|---|---|
| 2.4.6 | All agreements between project proponents and other implementing partners governing the implementation of project activities | These agreements contain specific terms, conditions, and intellectual property considerations that are confidential to the parties involved. Disclosure could compromise contractual negotiations, proprietary methodologies, and the strategic interests of the project partners. |
| 2.4.6 | Detailed 30-year financial projections for the project, including all project-related costs and ex-ante carbon estimates | This information is commercially sensitive as it contains proprietary financial data that could impact the project's competitive position and market dynamics if disclosed. It includes cost structures, anticipated revenues, and investment returns that are crucial for maintaining strategic and financial confidentiality. |
| 2.4.6 | Detail Workplan and Budgets | The workplans and budgets include sensitive operational strategies and financial allocations that are critical to the project's execution. Public disclosure of this information could undermine the project's competitive advantage and operational integrity. |
| NPRT | Financial Viability Analysis | This document includes details about the cost of the project and revenues which are commercially sensitive. |

# APPENDIX 4: RESPONSES TO FORWARD ACTION REQUEST FROM PRR

1. GRIEVANCE REDRESS MECHANISM

The **Kuamut Rainforest Conservation Project (KRCP)** has implemented a robust **Grievance Mechanism** to provide a transparent, accessible, and effective channel for addressing concerns raised by individuals and communities affected by the project. This mechanism is designed to uphold human rights, ensure equitable resolutions, and align with national and international frameworks such as **REDD+ safeguards, Malaysian human rights regulations, and the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).**

**1.1. Objectives and Principles**

The grievance mechanism is structured around the following key objectives:

- **Accessibility:** Ensure that all affected stakeholders, including indigenous communities, field workers, and conservation partners, have multiple ways to submit grievances.
- **Transparency:** Maintain a clear, traceable, and publicly available grievance resolution process.
- **Fairness and Impartiality:** Investigate grievances objectively, ensuring no conflict of interest in decision-making.
- **Timeliness:** Provide a well-defined timeline for acknowledging, investigating, and resolving complaints.
- **Confidentiality:** Protect complainants from retaliation or negative repercussions.
- **Compliance:** Align with **REDD+ grievance procedures, international labor standards, and local human rights laws**.

**1.2. Scope of the Grievance Mechanism**

The grievance mechanism covers:

- **Project Activities:** Any grievances related to **biodiversity conservation, climate initiatives, land use, or community impact**.
- **Local Communities:** Concerns from communities residing near or within the project area, including those related to **land tenure, employment, or resource access**.
- **Field Staff and Workers:** Issues related to **workplace safety, rights violations, discrimination, or mistreatment**.
- **Stakeholder Disputes:** Conflicts between project entities, **local government representatives, or partner organizations**.

**1.3. Channels for Submission**

Stakeholders can submit grievances through multiple channels to ensure accessibility:

- **Village Grievance Boxes:** Secure boxes placed in **key community locations**, monitored biweekly by field staff.
- **WhatsApp and Phone Line:** A dedicated contact for **immediate reporting** of grievances, especially for urgent matters.
- **In-Person Meetings:** Community members can submit grievances during **village meetings, stakeholder forums, or direct consultations with PACOS Trust representatives**.

- **Alternative External Avenues:** In cases where a complainant **prefers external intervention**, grievances may be raised with:
    - **SUHAKAM (Malaysian Human Rights Commission)** – Investigates potential human rights violations and indigenous rights concerns.
    - **Indigenous Peoples Network of Malaysia (JOAS)** – Provides **community-driven advocacy and representation** for indigenous land and rights issues.

**1.4. Grievance Resolution Process**

Each grievance follows a **structured six-step process**:

**Step 1: Submission and Acknowledgment (2 days)**

- Complaints are received through any of the designated channels.
- The grievance is logged and assigned a unique reference number.
- An acknowledgment notice is provided to the complainant.

**Step 2: Initial Review and Categorization (3 days)**

- The grievance is reviewed to determine **its nature, severity, and relevant jurisdiction**.
- If it involves potential **human rights violations, indigenous rights disputes, or legal matters**, external bodies like **SUHAKAM** may be engaged.
- The grievance is classified into:
    - **Minor Issues:** Resolved at the local level through direct community engagement.
    - **Moderate Concerns:** Require panel investigation and intervention.
    - **Severe Cases:** May involve third-party mediation or legal intervention.

**Step 3: Investigation and Stakeholder Consultation (7 days)**

- A grievance panel—including Permian Malaysia, PACOS Trust, SEARRP, Sabah Forestry Department, and community representatives—convenes to investigate the case.
- Field assessments and stakeholder interviews are conducted.
- A proposed resolution is drafted and shared with the complainant.

**Step 4: Resolution Agreement and Implementation (7 days)**

- If the complainant accepts the resolution, **actions are implemented immediately**.
- If further intervention is required, additional resources (e.g., legal consultation, mediation) are provided.

**Step 5: Appeal Process (7 days)**

- If the complainant rejects the resolution, they may appeal within one week.
- The grievance panel reassesses the complaint and issues a revised resolution.

**Step 6: Monitoring, Follow-up, and Case Closure (2 weeks)**

- Actions taken are monitored for effectiveness, and a final report is logged.
- A post-resolution follow-up ensures that the issue remains resolved.
- If necessary, recommendations are made to improve policies or procedures.

**1.5. Role of External Entities in Grievance Redress**

In cases where **internal grievance resolution is insufficient**, independent organizations may intervene:

- **SUHAKAM:** Provides **human rights-based investigations, public inquiries, and legal support**.
- **JOAS:** Engages in **indigenous rights advocacy** to **protect native land and cultural autonomy**.
- **Malaysian Judiciary and Legal Aid Services:** If a grievance escalates to **legal proceedings**, KRCP facilitates complainants' access to legal resources.

**1.6. Capacity-Building and Awareness Programs**

To ensure effective implementation:

- Community Training: Regular training workshops educate local communities on grievance procedures, their rights, and reporting mechanisms.
- Staff Sensitization: Field officers undergo training on grievance handling, conflict resolution, and human rights frameworks.
- Public Information Campaigns: Outreach activities distribute educational materials and conduct awareness roadshows, ensuring communities understand how to file complaints.

**1.7. Monitoring and Evaluation of the Grievance System**

- **Annual Grievance Reports:** A **comprehensive annual review** is prepared, documenting:
    - Number of grievances received and resolved.
    - Categories of complaints and resolution effectiveness.
    - Improvements made based on lessons learned.
- **Community Feedback Surveys:** Regular feedback sessions ensure **continuous improvement** and maintain community trust.

**1.9. Alignment with International Human Rights Standards**

The grievance mechanism adheres to:

- UNDRIP (Article 26): Recognizes indigenous land rights and traditional territories.
- ILO Indigenous and Tribal Peoples Convention 169: Ensures indigenous peoples' participation in decision-making.
- CCB Standards (GL2): Requires projects to demonstrate positive social impacts.

**Conclusion**

The Kuamut Rainforest Conservation Project's Grievance Mechanism is a comprehensive, multi-tiered system designed to empower communities, promote accountability, and uphold human rights. By ensuring accessible, fair, and independent redress options, KRCP strengthens its commitment to social inclusion, conservation ethics, and equitable project implementation.



**2. Agreements with PACOS Trust and Other Entities**

**2.1. Agreement Between Permian Malaysia and PACOS Trust (2024)**

- PACOS Trust is engaged in providing services for the Kuamut Rainforest Conservation Project (KRC Project).
- The contract is effective from 1st January 2024.
- The total contract value is MYR 1,338,600, with payments made progressively.
- The work includes community engagement, benefit-sharing mechanism design, livelihood development, biodiversity monitoring, and outreach activities.
- The "Workplan 24" attached to the agreement outlines the specific deliverables.

PACOS is not explicitly stated as a direct financial beneficiary, but it provides services crucial to project implementation

**2.2. Agreement Between Permian Malaysia and SEARRP (2024-2029)**

- SEARRP is contracted for carbon and biodiversity monitoring in the Kuamut Rainforest Conservation Project.
- The contract runs from 1st January 2024 to 31st July 2029.
- SEARRP's responsibilities include:
    - Maintaining and monitoring carbon plots.
    - Conducting biodiversity assessments (camera trapping, bio-acoustic recordings, dung beetle monitoring).
    - Orangutan population surveys.
    - Data management and reporting.
    - Logistic and administrative support.
    - SEARRP is also engaged in community outreach in collaboration with PACOS.

Monthly payments are made in MYR, based on an agreed exchange rate with USD

2.3. **Agreement between Permian Malaysia and RBJ (2022-2024)**

RBJ's services

- Helicopter Surveillance

Conduct aerial monitoring of the project area.

- Ground and River Patrolling

Conduct surveillance during the last 10 days of every month.

- Monitoring teams are responsible for patrolling critical areas.

Engagement with Authorities

- Attend meetings with Sabah Forestry Department (SFD) and other relevant agencies regarding monitoring and protection activities.

Payment Structure (2022-2023)

- A one-time payment of MYR 171,000.
- Provision of a motor vehicle (MYR 160,000).

Equipment:

- GPS Unit: MYR 5,000.
- Desktop Computer: MYR 6,000.

Payment Structure (2023-2024)
RBJ receives MYR 44,427 per month for ongoing surveillance and monitoring activities.



**3. Community Gold-Level Benefits**

The Social and Economic Impact Plan (SEIP) explicitly defines eligible stakeholders, benefit-sharing criteria, and the distribution mechanisms (See SEIP: "Eligibility Criteria" and "Benefits Distribution Mechanism")
Below are the key community groups benefiting from KRCP:

| Community Group | Impact | Type of Benefit | Change in Well-being |
|---|---|---|---|
| **Local Communities** | Increased employment, access to clean water, improved health services, enhanced decision-making participation | Livelihood benefits, inclusive governance | Sustained livelihood improvements, better health, enhanced food security |
| **Women and Girls** | Increased employment, training, healthcare access, clean water | Economic empowerment, health improvements | Enhanced well-being, gender equity, increased financial independence |

| | | | |
|---|---|---|---|
| **Youth and Adults (Training Participants)** | Vocational training for sustainable employment | Skill development, career opportunities | Improved income, job security, economic stability |
| **Casual Workers (Surveyors, Data Collectors, etc.)** | Temporary employment through conservation work | Income generation, capacity-building | Increased economic opportunities, financial security |
| **Households in Kg Kuamut, Kg Tangkuyang, Karamuak Cluster** | Improved access to water, healthcare services | Infrastructure support (clean water, health facilities) | Long-term health benefits, resilience to climate change |

**Key Socio-Economic Impacts of KRCP**
**Improved Economic Opportunities (Jobs & Livelihoods)**
Without-Project Scenario:

- Limited employment opportunities, leading to financial instability.
- Heavy dependence on unsustainable forest use for income.
- Lack of investment in alternative livelihoods.

With-Project Scenario:

- 167 community members improved their livelihoods, including 41 women *(SEIP)*.
- 40 full-time jobs created, including 4 for women *(SEIP)*.
- Promotion of small-scale businesses, including agriculture, eco-tourism, and cocoa processing.
- Training in sustainable agriculture to increase crop yields and market access.
- Financial empowerment for women, enhancing household well-being and gender equity.

Net Well-being Impact: Increased economic stability, reduced poverty, and improved financial security.

**Strengthened Community Governance & Participation**
Without-Project Scenario:

- Limited community involvement in decision-making.
- Development projects often failed due to lack of community ownership.

With-Project Scenario:

- Establishment of community-led project committees *(SEIP: "Benefits Distribution Mechanism")*.
- Committees include women and youth, ensuring inclusive participation.
- Free, Prior, and Informed Consent (FPIC) process conducted to integrate community input into decision-making.

Net Well-being Impact: Enhanced local governance, long-term sustainability, and increased empowerment.

**Improved Health & Clean Water Access**
Without-Project Scenario:

- Poor healthcare services and high disease prevalence.

- Water shortages during droughts, leading to health issues.

With-Project Scenario:

- Installation of clean water systems benefiting 189 people (49 households, 37 houses) in Kuamut Village *(SEIP: "Distribution Process (2023)")*.
- Provision of a water ambulance to improve medical access for 486 people (243 women).
- Future electricity infrastructure development for Desa Parmal & Desa Tulang Tulang (July 2024).

Net Well-being Impact: Sustained access to clean water and improved healthcare services.

**Improved Training & Education**

Without-Project Scenario:

- Limited access to education in rural areas.
- Low vocational training rates, restricting employment options.

With-Project Scenario:

- 167 community members trained in technical and vocational skills *(SEIP)*.
- 40 women trained, enhancing economic inclusion.
- Microfinance program for sustainable businesses *(post-2024 implementation)*.

Net Well-being Impact: Increased employment opportunities and economic mobility.

**Protection of High Conservation Values (HCV)**

Legal Protection & Sustainable Management

- The Project Area is a Class I Forest Reserve, ensuring full legal protection *(Forest Enactment, 1968)*.
- Protection of indigenous settlements and cultural heritage sites.
- No activities harm HCVs, and all sustainable agriculture follows low-impact environmental practices.

Net Well-being Impact: Biodiversity conservation ensures long-term ecological and cultural protection.

**Stakeholder Engagement & Mitigation of Negative Impacts**

Engagement & Compensation for Government Agencies

- Sabah Forestry Department & Yayasan Sabah:
    - Engaged in project design and implementation.
    - Compensated for foregone revenues from logging through alternative funding mechanisms.

Capacity-Building for Stakeholders

- Training for local government officials and conservation workers.
- Support for sustainable development practices, ensuring economic benefits without environmental trade-offs.

Net Well-being Impact: Sustainable economic alternatives reduce reliance on deforestation.

**Conclusion: Meeting CCB Gold-Level Criteria**

The KRCP has demonstrably improved community well-being, aligning with CCB Standards GL2 indicators by:

- Enhancing livelihoods and financial security (Employment, Training, Microfinance).

- Strengthening governance and participation (Community-led committees, FPIC implementation).
- Improving health and clean water access (Medical access boat, clean water systems).
- Protecting HCVs and biodiversity (Class I Forest Reserve, legal safeguards).
- Engaging stakeholders and mitigating opportunity costs (Collaboration with Sabah Forestry & Yayasan Sabah).

*Note: For more information review section 4 of the Monitoring Report*



**4. Biodiversity Monitoring & Gold-Level Benefits**

**4.1. Biodiversity Monitoring Plan**

The Kuamut Rainforest Conservation Project (KRCP) has established a comprehensive **Biodiversity Monitoring Plan** to assess and track changes in ecosystem health, species populations, and forest regeneration. This plan aligns with **CCB Standards (B4.1, B4.2, GL1.4, GL3.4)** and is extensively documented in the supporting evidence folder under *"Kuamut Biodiversity Monitoring Plan 20220708 (submitted for validation).pdf"*.

The key objectives of the **Biodiversity Monitoring Plan** are:

- **Securing critical orangutan habitats and populations.**
- **Filling knowledge gaps** on the presence and habitat use of **Rare, Threatened, and Endangered (RTE) and High Conservation Value (HCV) species** (such as elephants, gibbons, hornbills, and endemic plant species).
- **Enhancing connectivity** between existing conservation areas, such as serving as a buffer to the western flank of the Danum Valley Conservation Area, one of the last remaining lowland primary forests in Sabah.

To measure biodiversity indicators, the project evaluates **pressure, state, and response variables**, including:

1. **Vegetation quality** (canopy height, aboveground biomass).
2. **Presence of HCV 1 species** (orangutans, pangolins, hornbills, elephants, and others).
3. **Signs of anthropogenic disturbance** (e.g., illegal logging, hunting, encroachment).
4. **Status of hunting activities** (evidence from security patrols and camera traps).

The **biodiversity monitoring efforts are conducted by SEARRP and Permian field teams**, with **security patrols managed by RBJ** to monitor threats and ensure forest protection.

### 4.2. Biodiversity Monitoring Methods and Findings

#### 4.2.1. Biodiversity Monitoring Sites

During the **2022 monitoring period**, biodiversity data was collected from **49 monitoring sites** (camera trap stations), primarily in **riparian areas along the Kuamut and Melian Rivers** for accessibility (Figure 5.1a). In **2023, 31 monitoring sites** were established further into the reserve, covering a broader **elevation range, forest types, and biomass variations** (Figure 5.1b). Future monitoring efforts will expand into the **eastern region of the project area following road repairs** *(For full methodology, see "Scriven 202303 Representative Points for BioD Sampling.pdf" in the supporting evidence folder).*

### 4.3. Key Biodiversity Indicators

#### 4.3.1. Vegetation Quality

- **Aboveground biomass and canopy height data** were collected by the Permian technical team *(see Climate section 3.1)*.
- **Findings:**
    - Since the start of the project, **58.5% of the forest area has been regenerating**, with an **annual canopy height growth rate of 0.18 m (SD ±0.25 m)** *(see Table 5.1)*.
    - Only **2.7% of the project area has experienced degradation**, primarily in **Kuamut Valley**, an area historically affected by illegal logging (pre-2022).
    - These regrowth patterns **benefit forest-dependent species**, including the **Great Argus, Sun Bear, and hornbills** *(see Nakamura et al., 2017)*.

#### 4.3.2. Presence of HCV 1 Species

**Orangutan Population Monitoring**

Orangutan nest surveys were conducted between **November 2-3, 2023**, covering **6% of the project area (83,381 ha)** via aerial surveys *(see "Final_Methodology_Kuamut_OU_2024_Oram.pdf")*.

- **Results:**
    - **Estimated orangutan population: 868 individuals (95% CI = 468–1610)**.
    - These results are **consistent with the 2014-2017 statewide survey** *(Simon et al., 2019)*, confirming a **stable orangutan population**.
    - The **absence of further habitat fragmentation** has allowed for **continued natural recovery**, ensuring the long-term survival of the species.

**Camera Trapping**

Camera trap monitoring conducted in **2022-2023** at **49 sites (2022) and 31 sites (2023)** recorded:

- **61 species, including 36 RTE species.**
- **Key findings:**
    - **Two critically endangered (CR) species detected: Bornean Orangutan, Sunda Pangolin**.
    - **Six endangered (EN) species detected:** Asian Elephant, Banteng, Borneo Bay Cat, Long-tailed Macaque, Otter Civet, Southern Pig-tailed Macaque.
    - **13 vulnerable (VU) species detected**, including Sun Bear, Sunda Clouded Leopard, and Great Argus *(See "Kuamut Project MR2 - Camera Trapping Report.docx")*.
    - **No evidence of hunting was captured in 2022 or 2023** *(see Section 5.3)*.

**Bioacoustic Monitoring**

Bioacoustic surveys were conducted at the **same 49 sites (2022) and 31 sites (2023) as camera traps**, using **Wildlife Acoustics Song Meter Micro devices**.

- The monitoring focused on **20 focal species, including critically endangered Helmeted Hornbills**.
- **Machine-learning classifiers** (BirdNET, Google Perch) were tested to **automatically identify species through vocalizations** *(see "D021-04-01R1 Kuamut report_draft.pdf")*.
- **Findings:**
    - The AI model successfully classified **six species with >95% confidence**, including **Wrinkled Hornbill, Rhinoceros Hornbill, and Black Hornbill**.
    - Future work will focus on **refining classification accuracy** and **training models for unclassified species**.

**Dung Beetle Surveys**

Dung beetles were monitored at **49 sites (2022)** using **pitfall traps**.

- **42 species detected**, including **17 forest-associated species and 12 Borneo endemics**.
- **High abundance of forest indicator species** suggests that the **Project Area maintains strong ecological integrity** *(See "Kuamut Project MR2 - Dung Beetle Report.docx")*.

**Rare, Threatened, and Endangered (RTE) Plant Species**

- **34 threatened tree species identified**, including **6 CR, 5 EN, and 23 VU species** *(see Table 5.2)*.
- **Project protection has prevented further logging**, allowing for **species recovery and natural regeneration** *(See Climate section 3.1.1)*.

### 4.4. Signs of Anthropogenic Disturbance

#### 4.4.1. Satellite Monitoring

- **Satellite-based analysis (2022-2023) found no major deforestation (>2.5 ha) within the Project Area**.

- **One small-scale disturbance was recorded due to flooding** *(see "2023 flooding event.pdf")*.

#### 4.4.2. Security Patrols

- **RBJ security teams conducted monthly patrols**.
- **Findings:**
    - **One minor land encroachment (80x80m) outside the project area in 2022**, resolved by **Sabah Forestry Department**.
    - **Limited evidence of hunting** (one suspected incident in early 2022).
    - **Frequent wildlife sightings, including orangutans, elephants, and hornbills**.

### 4.5. Gold-Level Biodiversity Distinction

The **KRCP has achieved the Gold Level under CCB Standards (GL3 indicators)** by demonstrating significant conservation outcomes:

- **Population stability of key species**, including orangutans and hornbills.
- **Habitat regeneration leading to increased biodiversity**.
- **Successful mitigation of threats such as deforestation and hunting**.

Future biodiversity monitoring will continue to:

- Expand into **previously unmonitored regions**.
- Integrate **AI-driven species classification** for bioacoustics.
- Assess **long-term biodiversity recovery trends**.

This commitment ensures that KRCP continues to **protect biodiversity, mitigate threats, and enhance ecosystem resilience for future generations**.

***Note: For more information, please review section 5.3.1 in the Second Monitoring Report.***