FOREST RESEARCH CENTRE (FRC)

RESEARCH PROGRAMMES & ACTIVITIES

2026–2030

SABAH FORESTRY DEPARTMENT

Contents

Compiled by Reuben Nilus
Cover designed by Sarah J Mianus

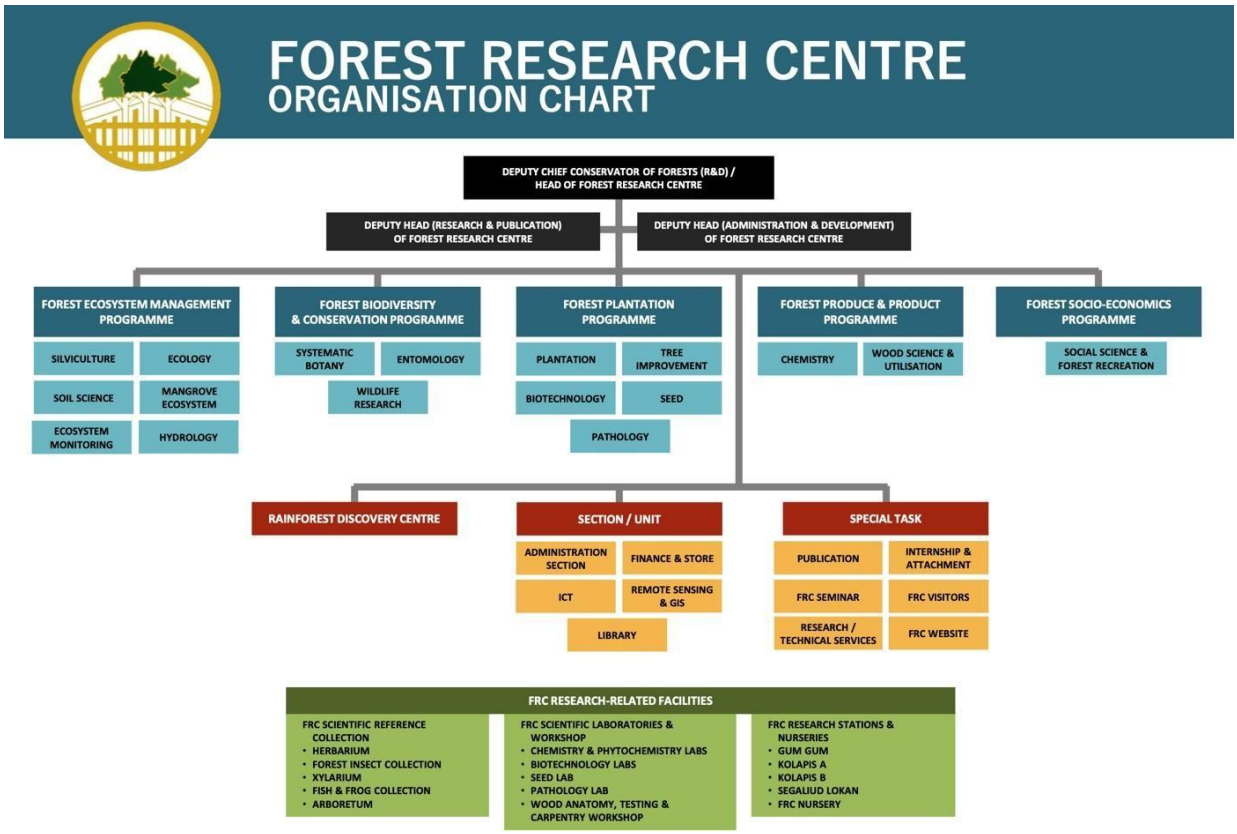
Forest Research Centre (FRC),
Sabah Forestry Department

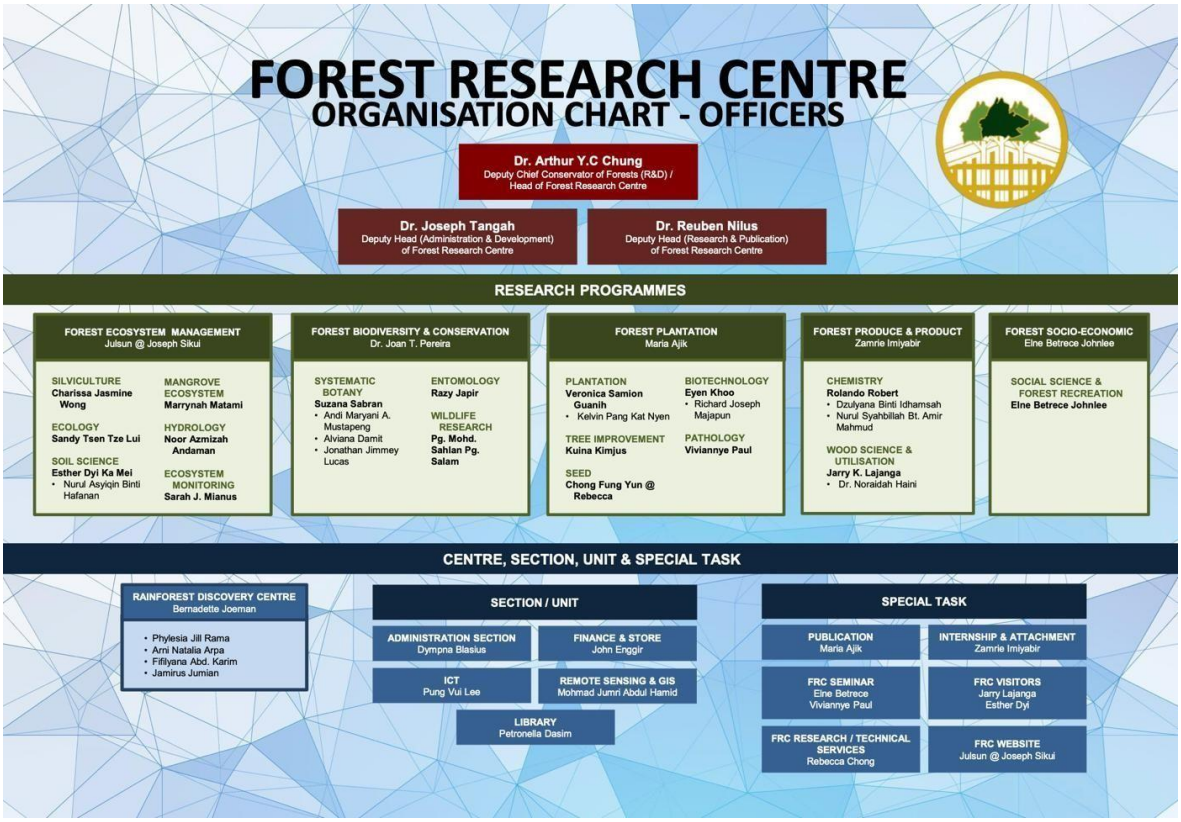
Vision

To be a centre of excellence in forestry research, providing the best service to its clients

Mission

To generate knowledge and technology that support the conservation, management, development and sustainable utilisation of the forest resources of Sabah through scientific research


FOREST RESEARCH CENTRE
ORGANISATION CHART
DEPUTY CHIEF CONSERVATOR OF FORESTS (R&D) / HEAD OF FOREST RESEARCH CENTRE
DEPUTY HEAD (RESEARCH & PUBLICATION) OF FOREST RESEARCH CENTRE
DEPUTY HEAD (ADMINISTRATION & DEVELOPMENT) OF FOREST RESEARCH CENTRE
FOREST ECOSYSTEM MANAGEMENT PROGRAMME
SILVICULTURE
ECOLOGY
SOIL SCIENCE
MANGROVE ECOSYSTEM
ECOSYSTEM MONITORING
HYDROLOGY
FOREST BIODIVERSITY & CONSERVATION PROGRAMME
SYSTEMATIC BOTANY
ENTOMOLOGY
WILDLIFE RESEARCH
FOREST PLANTATION PROGRAMME
PLANTATION
TREE IMPROVEMENT
BIOTECHNOLOGY
SEED
PATHOLOGY
FOREST PRODUCE & PRODUCT PROGRAMME
CHEMISTRY
WOOD SCIENCE & UTILISATION
FOREST SOCIO-ECONOMICS PROGRAMME
SOCIAL SCIENCE & FOREST RECREATION
RAINFOREST DISCOVERY CENTRE
SECTION / UNIT
ADMINISTRATION SECTION
FINANCE & STORE
ICT
REMOTE SENSING & GIS
LIBRARY
SPECIAL TASK
PUBLICATION
INTERNSHIP & ATTACHMENT
FRC SEMINAR
FRC VISITORS
RESEARCH / TECHNICAL SERVICES
FRC WEBSITE
FRC RESEARCH-RELATED FACILITIES
FRC SCIENTIFIC REFERENCE COLLECTION
• HERBARIUM
• FOREST INSECT COLLECTION
• XYLARIUM
• FISH & FROG COLLECTION
• ARBORETUM
FRC SCIENTIFIC LABORATORIES & WORKSHOP
• CHEMISTRY & PHYTOCHEMISTRY LABS
• BIOTECHNOLOGY LABS
• SEED LAB
• PATHOLOGY LAB
• WOOD ANATOMY, TESTING & CARPENTRY WORKSHOP
FRC RESEARCH STATIONS & NURSERIES
• GUM GUM
• KOLAPIS A
• KOLAPIS B
• SEGALIUD LOKAN
• FRC NURSERY


FOREST RESEARCH CENTRE
ORGANISATION CHART - OFFICERS
Dr. Arthur Y.C Chung
Deputy Chief Conservator of Forests (R&D) / Head of Forest Research Centre
Dr. Joseph Tangah
Deputy Head (Administration & Development) of Forest Research Centre
Dr. Reuben Nilus
Deputy Head (Research & Publication) of Forest Research Centre
RESEARCH PROGRAMMES
FOREST ECOSYSTEM MANAGEMENT
Julsun @ Joseph Sikui
SILVICULTURE
Charissa Jasmine Wong
ECOLOGY
Sandy Tsen Tze Lui
SOIL SCIENCE
Esther Dyi Ka Mei
• Nurul Asyiqin Binti Hafanan
MANGROVE ECOSYSTEM
Marrynah Matami
HYDROLOGY
Noor Azmizah Andaman
ECOSYSTEM MONITORING
Sarah J. Mianus
FOREST BIODIVERSITY & CONSERVATION
Dr. Joan T. Pereira
SYSTEMATIC BOTANY
Suzana Sabran
• Andi Maryani A. Mustapeng
• Alviana Damit
• Jonathan Jimmey Lucas
ENTOMOLOGY
Razy Japir
WILDLIFE RESEARCH
Pg. Mohd. Sahlan Pg. Salam
FOREST PLANTATION
Maria Ajik
PLANTATION
Veronica Samion Guanih
• Kelvin Pang Kat Nyen
TREE IMPROVEMENT
Kuina Kimjus
SEED
Chong Fung Yun @ Rebecca
BIOTECHNOLOGY
Eyen Khoo
• Richard Joseph Majapun
PATHOLOGY
Viviannye Paul
FOREST PRODUCE & PRODUCT
Zamrie Imiyabir
CHEMISTRY
Rolando Robert
• Dzulyana Binti Idhamsah
• Nurul Syahbillah Bt. Amir Mahmud
WOOD SCIENCE & UTILISATION
Jarry K. Lajanga
• Dr. Noraidah Haini
FOREST SOCIO-ECONOMIC
Elne Betrece Johnlee
SOCIAL SCIENCE & FOREST RECREATION
Elne Betrece Johnlee
CENTRE, SECTION, UNIT & SPECIAL TASK
RAINFOREST DISCOVERY CENTRE
Bernadette Joeman
• Phylesia Jill Rama
• Arni Natalia Arpa
• Fifilyana Abd. Karim
• Jamirus Jumian
SECTION / UNIT
ADMINISTRATION SECTION
Dympna Blasius
FINANCE & STORE
John Enggir
ICT
Pung Vui Lee
REMOTE SENSING & GIS
Mohmad Jumri Abdul Hamid
LIBRARY
Petronella Dasim
SPECIAL TASK
PUBLICATION
Maria Ajik
INTERNSHIP & ATTACHMENT
Zamrie Imiyabir
FRC SEMINAR
Elne Betrece
Viviannye Paul
FRC VISITORS
Jarry Lajanga
Esther Dyi
FRC RESEARCH / TECHNICAL SERVICES
Rebecca Chong
FRC WEBSITE
Julsun @ Joseph Sikui

The Forest Research Centre's Strategic Plan

The Forest Research Centre's programme for strategic research employs an integrated, science-based approach to sustainable forest management in Sabah (Table 1). It utilises robust monitoring systems, including field inventories, remote sensing, and digital platforms, to generate reliable data for decision-making in sustainable forest management and climate reporting.

The programme promotes biodiversity conservation, ecosystem restoration, and landscape connectivity while supporting sustainable natural-forest and planted-timber production systems. By integrating ecosystem services, climate resilience, and innovative technologies, it enhances Sabah's capacity to address emerging environmental challenges.

Importantly, this approach is grounded in socio-economic considerations, ensuring that forest management supports community livelihoods, stakeholder engagement, and green economic growth. Together, these efforts help position Sabah as a leader in sustainable forest management and nature-based solutions for a green economy.

Table 1. Strategic Research Themes and Scopes Supporting Sustainable Forest Management and Green Economy

Theme	Key Research Scopes
Biodiversity Conservation	Flora, fauna, soil, ecosystem services
Climate & Carbon	Forest Reference Level (FRL) support, biomass/carbon, climate resilience
Monitoring & Data Systems	Permanent sample slot (PSP), remote sensing, conservation monitoring system, biodiversity inventories
Restoration & Connectivity	Mangroves, corridors, degraded forests
Sustainable Production	Timber, plantations, non-timber forest produce
Digitalisation & Decision Support	Conservation monitoring system, geographical information system, modelling
Socio-economic Integration	Livelihoods, social impact assessment, ecotourism

Table 2 presents a comprehensive framework for forest research in Sabah, structured into five core programmes: Forest Ecosystem Management, Biodiversity and Conservation, Plantation, Forest Produce and Products, and Forest Socio-Economics. Each programme is further organised into targeted sub-programmes with clearly defined objectives and implementation scopes. The framework integrates long-term ecological monitoring, remote sensing, and digital systems such

as the Conservation Monitoring System to support data-driven decision-making. It also addresses climate resilience, carbon assessment, biodiversity conservation, restoration, and sustainable production. Importantly, the framework incorporates socio-economic dimensions, including livelihoods and nature-based tourism, ensuring that forest management contributes to inclusive, climate-resilient, and sustainable development.

Table 2. Forest Research and Development Framework: Programme, Objectives and Scope Alignment

Programme	Sub-Programme	Key Objectives	Key Scopes
1. Forest Ecosystem Management **Head:** **Julsun Sikui**	**1.1 Terrestrial Ecosystems**	• Monitor forest structure, biomass & dynamics • Assess land-use change & timber resources • Evaluate soil biodiversity under disturbance	• Long-term PSP monitoring & forest health • LULC mapping (10.2 km & 5.1 km grids) • Remote sensing for timber & biomass • Soil biodiversity under land-use & climate stress
	1.2 Tidal Ecosystems	• Assess mangrove composition, dynamics & biomass	• Mangrove LTER monitoring • Blue carbon assessment • Coastal ecosystem condition tracking
	1.3 Physical Environment & Climate	• Understand soil–rainfall–water interactions • Monitor climate variability & risks	• Soil productivity & hydrology monitoring • Rainfall & climate datasets • Climate risk mapping & resilience analysis
	1.4 Ecosystem Services	• Map ecosystem services • Support restoration & rehabilitation • Enhance biodiversity & connectivity	• Carbon, water, soil & biodiversity mapping • Mangrove/coastal rehabilitation • Forest restoration (site/species matching) • Wildlife food resources & nesting • Wildlife corridors

Programme	Sub-Programme	Key Objectives	Key Scopes
	1.5 Conservation Monitoring System (Digital Monitoring)	• Integrate datasets into central system • Develop decision-support tools	• CMS platform & dashboards "***Sabah Ecosystem Hub"*** • Data standardisation & interoperability • Real-time ecosystem monitoring
2. Forest Biodiversity & Conservation **Head:** **Dr Joan T Pereira**	**2.1 Plant & Fungal Diversity**	• Document plant & fungal diversity • Conserve threatened/ endemic species	• Flora inventories (trees, ferns, bryophytes, Ficus) • Conservation action plans (RTE species) • Fagaceae ecology & conservation • Fungal diversity & utilisation
	2.2 Wildlife Diversity	• Inventory wildlife diversity • Assess conservation status & threats	• Mammals, birds, fish, anurans surveys • Mangrove fauna ecology • Insect diversity & bioindicators • Species distribution modelling (SDM) • Nature tourism (birds, insects)
3. Forest Plantation **Head:** **Maria Ajik**	**3.1 Plantations**	• Improve plantation productivity • Evaluate species performance • Support sustainable timber supply	• Fast-growing species trials • Smallholder plantation monitoring • Growth, spacing, fertiliser & mulching trials • Pest/disease monitoring • Soil fertility assessment • Harvest productivity
	3.2 Tree Breeding	• Improve genetic quality of planting materials • Enhance climate resilience	• CPT evaluation & selection • Clonal material testing • Phenology & climate response Seed technology & germination optimisation
	3.3 Biotechnology	• Advance tree improvement technologies • Enhance propagation & breeding efficiency	• CPT selection using EFA • Clonal propagation & MRT comparison • Seed/propagation innovation

Programme	Sub-Programme	Key Objectives	Key Scopes
			Field validation of improved planting materials
4. Forest Produce & Products **Head:** **Zamrie Imiyabir**	**4.1 Wood & Biomass**	• Characterise wood properties & utilisation	• Wood density, strength & anatomy • Timber utilisation potential • Medicinal wood identification
	4.2 Non-Timber Forest Products (NTFP)	• Assess economic & medicinal value of forest products	• Resin & latex utilisation • Wild fruits nutrition & phytochemicals • Mangrove medicinal plants • Bioprospecting (exosomes, microbes)
	4.3 Method Development	• Develop analytical & compliance tools	• Formaldehyde testing • DNA fingerprinting & chemotaxonomy • Soil/biomass analytical methods
5. Forest Socio-Economics **Head:** **Elne Betrece Johnlee**	**5.1 Socio-Economics & Governance**	• Strengthen socio-economic data systems • Support participatory forest management	• Community & stakeholder databases • Social Impact Assessment (SIA) • Livelihood & enterprise studies • Traditional knowledge & ecosystem services valuation
	5.2 Nature Tourism	• Enhance sustainable forest-based tourism • Strengthen conservation financing	• Tourism asset mapping & readiness • Visitor behaviour & economic valuation • Community participation & livelihood impacts • Conservation financing models

1. FOREST ECOSYSTEM MANAGEMENT

Overall objectives:

- Enhance ecosystem health through management of terrestrial and tidal ecosystems.
- Monitor forest conservation status and ecosystem services.
- Promote climate-resilient forestry and overall ecosystem health.

Key Subjects & Topics:

- Land use management, forest ecosystem services, mangrove conservation, and ecological health monitoring.
- Forest inventory & monitoring systems; growth and yield modelling.
- Biodiversity assessment; landscape-level biodiversity management.
- Forest rehabilitation & restoration.
- Carbon sequestration and climate resilience and science-policy integration.
- Remote sensing & GIS applications in forestry research.
- Capacity building & partnership development.
- Curation of soil collections

SUB-PROGRAMME 1.1 — TERRESTRIAL ECOSYSTEMS

Project 1.1.1: Long-Term Forest Ecosystem Monitoring

Investigators: Dr Reuben Nilus, Julsun Sikui, Sandy Tsen Tze Lui, Charissa J Wong, Esther Dyi Ka Mei, Nurul Asyiqin Hafanan & Sarah J Mianus

Rationale: Sabah's terrestrial forests need ongoing, long-term monitoring to track changes in species composition, biomass, and overall ecosystem resilience. This monitoring is essential to understand how forests respond to climate variability, disturbances, and management actions. Keeping consistent datasets over time enables the identification of trends, evaluation of forest health, and assessment of the success of conservation and sustainable management. Long-term monitoring also supports informed decision-making, improves climate reporting, and enhances the ability to predict and mitigate future ecological shifts, ensuring the survival of Sabah's rich forest biodiversity and ecosystem services.

Objectives:

1. Document forest structure and composition across Sabah.
2. Monitor forest dynamics and biomass change.

3. Support adaptive forest management decisions.

Study 1. Permanent Sample Plot Re-census (PI: Dr Reuben Nilus, Julsun Sikui, Sandy Tsen Tze Lui, Charissa J Wong)

Study 2. Forest Health & Climate Response Monitoring (PI: Dr Reuben Nilus, Sandy Tsen Tze Lui, Julsun Sikui)

Study 3. Landscape Ecological Integrity Assessment (PI: Dr Reuben Nilus, Esther Dyi Ka Mei, Sandy Tsen Tze Lui, Julsun Sikui, Sarah J Mianus, Charissa J Wong, Nurul Asyiqin Hafanan)

Output:

- Comprehensive long-term datasets on forest composition, structure, biomass, and ecosystem dynamics
- Established and maintained a network of Permanent Sample Plots (PSPs) with standardised monitoring protocols
- Technical reports and peer-reviewed scientific publications on forest ecosystem trends and resilience
- Updated species inventories and ecological baseline data for key forest types
- High-resolution geospatial products, including forest condition, change detection, and biomass, carbon maps
- Decision-support tools and GIS layers for forest management, conservation planning, and land-use policy

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.1.2: Forest Ecosystem conservation, and Forest Cover and Land Use Monitoring (10.2 km & 5.1 km grid)

Investigators: Sarah J Mianus, Sandy Tsen Tze Lui, Charissa J Wong & Nurul Asyiqin Hafanan

Rationale: Continuous monitoring of forest cover and land use is essential to accurately assess changes in ecosystem condition and conservation status in Sabah. Rapid land-use transitions, including deforestation, degradation, and agricultural expansion, require up-to-date information to support effective forest planning and policy decisions. Reliable monitoring enables early detection of

environmental change, evaluation of management interventions, and identification of high conservation value areas. It also strengthens evidence-based decision-making for sustainable forest management and climate mitigation efforts. By maintaining consistent and updated data, the project supports national reporting requirements, enhances resource governance, and ensures long-term protection of biodiversity and ecosystem services.

Objectives:

1. Assess forest land use and land cover change using geospatial technologies.
2. Maintain statewide inventory monitoring grids.
3. Update and rectify the Sabah forest ecosystem spatial information

Study 1. Statewide Land Use and Land Cover Monitoring (PI: Sarah J Mianus, Sandy Tsen Tze Lui, Charissa J Wong)

Study 2. Remote Sensing Analysis of Forest Change (PI: Sarah J Mianus)

Study 3. Revision of forest ecosystem extent (PI: Nurul Asyiqin Hafanan, Sandy Tsen Tze Lui, Sarah J Mianus)

Output:

- Spatial datasets and maps of forest cover and land-use/land-cover (LULC) change derived from geospatial analyses
- Time-series analysis reports on forest change trends (deforestation, degradation, regeneration)
- Updated and validated Sabah forest ecosystem spatial database (GIS layers)
- Technical reports and documentation on methodologies and findings
- Decision-support maps and tools for forest planning and conservation policy
- Standardised protocols for geospatial monitoring and data management

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.1.3: Advancing Timber Resource Assessment through Remote Sensing for Sustainable Forest Management

Investigators: Julsun Sikui, Charissa J Wong & Dr Reuben Nilus

Rationale: Developing an assessment and monitoring system for timber resources in natural forests and industrial tree plantations using remote sensing is essential for sustainable forest management. Traditional inventory methods are time-consuming and spatially limited, while remote sensing enables efficient, large-scale, and repeatable monitoring of forest structure, growth, and harvesting activities. This approach improves accuracy in estimating timber volume, detecting degradation, and tracking plantation performance. It supports evidence-based decision-making, enhances transparency, and strengthens compliance with regulatory frameworks. Ultimately, integrating remote sensing into timber resource management ensures optimal utilisation of resources, reduces environmental impacts, and supports long-term economic and ecological sustainability.

Objectives:

1. To develop a remote sensing–based framework for assessing timber resources (e.g., volume, biomass, stand structure) in natural forests and industrial tree plantations
2. To monitor spatial and temporal changes in timber stocks, forest condition, harvesting activities, and plantation growth dynamics
3. To support decision-making and policy development by generating accurate, scalable, and timely information for sustainable forest management and resource planning

Study 1. Natural forest management

Study 2. Industrial tree plantation

Output:

- High-resolution spatial maps of timber resources (e.g., volume, biomass, stand structure) for natural forests and industrial plantations
- Time-series datasets and reports on timber stock changes, harvesting patterns, and plantation growth dynamics
- Remote sensing–based monitoring system and analytical framework for timber resource assessment
- Geospatial database integrating field inventory and remote sensing data
- Decision-support tools and technical reports to guide sustainable forest management, planning, and policy development

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.1.4: Investigating the Impacts of Intensifying Land-Use and Extreme Weather Events on Soil Biodiversity and Functioning

Investigators: Rolando Robert & Tom Khoo Meng Chorng

Collaborators

- Dr. Michael O'Brien (Estación Experimental de Zonas Áridas, Spain)

Rationale: Intensifying land-use change and the rising frequency of extreme weather events threaten soil biodiversity and its essential ecological functions. Understanding these impacts is crucial for assessing ecosystem resilience, nutrient cycling, and soil health. This research offers evidence to inform sustainable land management, climate adaptation strategies, and the conservation of soil ecosystems amidst changing environmental conditions.

Objectives:

- To determine the impacts of intensifying land-use and extreme weather events on soil biodiversity and soil functioning in Sabah.

Study 1. Comparative assessment of soil biodiversity and functional attributes across land-use intensification gradients.

Study 2. Evaluation of soil biological and functional responses to extreme weather events (e.g. droughts and heat stress).

Study 3. Integration of biodiversity, soil physicochemical, and climatic data to identify key vulnerability and resilience indicators.

Output:

- Peer-reviewed publications on land-use and climate impacts on tropical soil biodiversity and functioning.

Timeline: 2025–2030

Remarks:

- Supports Thrust 3 (Objectives 1 & 2) of Sabah Forest Policy 2018, and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.
- The soil biome is increasingly recognised as an ecosystem at risk of degradation globally (see 'Global Land Outlook 2' report by UNCCD), and we foresee soil biodiversity and functioning as another key research area in forestry in the coming years.

SUB-PROGRAMME 1.2 — TIDAL ECOSYSTEMS

Project 1.2.1: Mangrove Ecosystem Monitoring

Investigators: Dr Joseph Tangah, Marrynah Matami

Rationale: Mangroves and the adjacent intertidal vegetation are important fishery areas as nursing and harvesting grounds for fish, prawns and shellfish. Mangrove systems are essential in abating shoreline erosion and are sites of land expansion. However, exploitative extraction of its timber and other non-wood products has altered these forests' composition and underlying dynamics. These changes have been poorly described and studied. The long-term monitoring of the forest condition shall provide valuable insights into the appropriate management requirements of these forests, whilst periodic assessments on the conservation status of these forests will support the government's long-term goals in conserving and promoting the sustainable utilisation of this valuable biological resource.

Objectives:

1. To determine mangrove forest composition and structure
2. To determine mangrove forest changes in species, turnover and growth
3. To determine mangrove forest biomass changes

Study 1. Mangrove LTER Monitoring

Study 2. Blue Carbon Assessment

Output:

- Periodic reports on trends in forest health turnover to key stakeholders.
- Reports on the conservation status of the tidal ecosystem in Sabah.

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 2.1, 3.1, 3.2 and 4.1.

SUB-PROGRAMME 1.3 — PHYSICAL ENVIRONMENT & CLIMATE

Project 1.3.1: Soil, rainfall and water quality in forest land use

Investigators: Esther Dyi Ka Mei, Nurul Asyiqin Hafanan, Julsun Sikui, Sarah J Mianus & Noor Azmizah Andaman

Rationale: Understanding the interactions between soil, rainfall, and water quality in forest land use is essential for sustainable ecosystem management. Soil properties influence water infiltration, storage, and nutrient cycling, while rainfall patterns drive hydrological processes affecting runoff and erosion. These interactions directly impact water quality in forested catchments, including sediment load and nutrient transport. Changes in land use, forest degradation, and climate variability can alter these dynamics, potentially compromising ecosystem services such as clean water supply and soil stability. Research in this area provides critical insights to support watershed management, forest conservation, and climate-resilient land-use planning.

Objectives:

1. To assess the relationships between soil properties, rainfall patterns, and hydrological processes influencing water quality in forested landscapes
2. To evaluate the impacts of forest land-use changes and management practices on soil stability, runoff, erosion, and water quality
3. To develop evidence-based guidelines and decision-support tools for sustainable watershed management, forest conservation, and climate-resilient land-use planning

Study 1. Soil Productivity Monitoring (PI: Esther Dyi Ka Mei, Nurul Asyiqin Hafanan)

Study 2. Rainfall Monitoring (PI: Noor Azmizah Andaman, Sarah J Mianus)

Output:

- Comprehensive datasets on soil properties (e.g., fertility, texture, organic carbon)
- Technical reports and guidelines for soil management, restoration practices, and sustainable land-use planning
- Decision-support tools and policy briefs to inform ecosystem restoration, watershed management, and climate adaptation strategies

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.3.2: Monitoring Climate Resilience in forest land use

Investigators: Sarah J Mianus, Dr Reuben Nilus, Sandy Tsen Tze Lui & Julsun Sikui

Rationale: Climate monitoring is essential for adaptive forest management and meeting carbon reporting obligations. Continuous data on temperature, rainfall, and climate variability enable a better understanding of forest responses to climate change. This supports timely management interventions, improves the accuracy of carbon accounting and reporting frameworks, and strengthens compliance with national and international commitments. Ultimately, climate monitoring enhances forest resilience, informs policy decisions, and ensures sustainable management of forest ecosystems under changing climatic conditions.

Objectives:

1. Procure continuous data on temperature, rainfall, and climate variability
2. Produce a climate risk map

Output:

- Continuous climate datasets (temperature, rainfall, variability) from established monitoring systems and stations
- Maps of spatial climate risks identifying vulnerable forest regions under various climate scenarios.
- Technical reports and decision-support tools that connect climate data with forest resilience, management strategies, and carbon aspects.

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2, 4.1 and 4.2.

SUB-PROGRAMME 1.4 — ECOSYSTEM SERVICES

Project 1.4.1: Mapping Ecosystem Services in forest land use

Investigators: Julsun Sikui, Esther Dyi Ka Mei, Sarah J Mianus, Charissa J Wong, Sandy Tsen Tze Lui, Nurul Asyiqin Hafanan & Dr Reuben Nilus

Rationale: Mapping ecosystem services is vital for understanding and managing benefits such as carbon storage, water regulation, soil protection, and biodiversity support. In Sabah, rapid land-use change and forest degradation threaten these services, yet their distribution and value remain poorly documented. Mapping enables identification of high-value areas, trade-offs, and priority zones for conservation and restoration. It supports evidence-based decision-making by integrating ecological and socio-economic data, improving land-use planning and forest management. Additionally, it strengthens climate mitigation and adaptation efforts, including carbon accounting and watershed protection, while enhancing stakeholder coordination for balanced and sustainable development.

Objectives:

- To map and quantify key ecosystem services (e.g., carbon storage, water regulation, soil protection, biodiversity) across Sabah's forest landscapes
- To identify priority areas and trade-offs for conservation, restoration, and sustainable land-use planning based on ecosystem service values
- To support policy and decision-making by integrating ecosystem service maps into forest management, climate strategies, and spatial planning frameworks

Output:

- Spatial maps of key ecosystem services, including carbon storage, water regulation, soil protection, and biodiversity value
- Integrated geospatial database linking ecosystem services with land-use, forest condition, and socio-economic data

- Technical reports and policy briefs to support sustainable forest management, climate mitigation, and land-use planning

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2, 4.1 and 4.2.

Project 1.4.2: Rehabilitation of mangrove and coastal beach ecosystems

Investigators: Dr Joseph Tangah & Marrynah Matami

Rationale: About 60% of Malaysia's mangrove vegetation is located along the coast of Sabah, representing approximately 4.5% of the State of Sabah's total forest cover. Covering about 365,000 hectares, these mangrove forests are increasingly under pressure from socio-economic development, such as conversion of mangrove areas to aquaculture, agriculture, and urban areas. Nonetheless, the mangrove systems in the State remain an important resource, contributing to its fisheries and tourism industry. However, an estimated 1% of Sabah's mangrove vegetation is highly degraded and needs rehabilitation. Through a collaborative project with the International Society for Mangrove Ecosystems (ISME), and supported by Federal and State funds, an annual planting target of 40-50 hectares is set in Sabah.

Objectives:

1. To select suitable species (site-specific) for the mangrove/coastal beach rehabilitation project in Sabah
2. To improve rehabilitation techniques and cost-effective methods for mangrove restoration in Sabah
3. To establish rehabilitation demo plots for mangroves and associate mangrove species
4. To enhance capacity building on mangrove rehabilitation and related activities

Study 1. Notes Long-term mangrove and coastal beach ecosystem rehabilitation site in Sabah
Monitoring of 428 ha: Beaufort District - Pulau ISME (Islet 2) & Weston FR (Ext.) Class I; Semporna District - Opposite Timbun Mata island, (Tinggol-Tinggol & Gading-Gading) Semporna FR Class V; Kota Kinabalu District - Sulaman Lake FR (Class V), Sulaman Wetlands, Tuaran; Kota Belud District - Abai FR (Ext.) Class V;

Sandakan District– Labuk Bay Proboscis Monkey Sanctuary; Beluran District – Sg Matanggar at Kuala Bonggaya & Kuala Labuk (Class V)

Output:

- Established rehabilitation and demonstration plots with site-specific mangrove and coastal species, including survival and growth performance data
- Improved and standardised restoration protocols, including species-site matching guidelines and cost-effective rehabilitation techniques
- Capacity-building outputs, including training programmes, technical manuals, and stakeholder engagement reports on mangrove restoration practices

Timeline: Long-term (25 years)

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.4.3: Integrated Approach to Forest Restoration: Site Selection, Species Matching, and Project Compilation

Investigators: Dr Reuben Nilus, Julsun Sikui, Esther Dyi Ka Mei, Charissa J Wong, Sandy Tsen Tze Lui & Sarah J Mianus

Rationale: Restoration research is vital for enhancing ecosystem services, rehabilitating degraded landscapes, and improving biodiversity connectivity. Scientific knowledge of restoration techniques, species selection, and site conditions enables more effective recovery of forest ecosystems. This research supports ecological functions such as carbon sequestration, soil stability, and water regulation. It also promotes landscape-level connectivity, facilitating species movement and resilience. Ultimately, restoration research guides sustainable management practices and contributes to long-term environmental health and conservation objectives.

Objectives:

1. Identify priority restoration sites.
2. Develop species-site matching guidelines.
3. Collate information on forest restoration projects conducted in forest land-use areas

Study 1. Restoration Site Prioritisation (PI: Dr Reuben Nilus, Julsun Sikui, Sarah J Mianus)

Study 2. Species-Site Matching Research (PI: Dr Reuben Nilus, Sandy Tsen Tze Lui, Julsun Sikui)

Study 3. Evaluating Carbon Sequestration of Planted Species in Ecosystem Rehabilitation Projects (Charissa J Wong, Esther Dyi Ka Mei, Sandy Tsen Tze Lui, Julsun Sikui, Dr Reuben Nilus)

Output:

- Periodic reports to key stakeholders.
- Spatial data on the efforts of restoration sites in Sabah
- Development of Sabah Forest Restoration one-stop portal

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2, 4.1 and 4.2.

Project 1.4.4: Wildlife research on enhancing food resources in the forest area

Investigator: Pg Mohd Sahlan bin Salam

Rationale: Anthropogenic activities have caused forest fragmentation and degradation across Sabah, threatening key wildlife habitats. Remaining forests serve as refuges, underscoring the need for effective restoration. Forest rehabilitation improves ecological function and connectivity. Fig species, as keystone resources, provide essential food for frugivores and can boost carrying capacity. However, gaps remain in knowledge regarding their distribution, phenology, and management. This study aims to develop practical guidelines for integrating figs into restoration programmes to enhance biodiversity conservation.

Objective:

1. To identify forest fruit plants eaten by wildlife (frugivores)
2. To determine the best propagation techniques for selected forest fruit plants
3. To determine appropriate field planting techniques for selected forest fruit plants

Study 1. Documenting feeding habits of wildlife on selected forest fruit plants.

Study 2. Propagation of selected Ficus species.

Study 3. Re-introduction of selected Ficus species in degraded forest.

Study 4. Development of the fig garden in Rainforest Discovery Park.

Output:

- Periodic reports on the feeding habits of wildlife on selected forest fruit plants.
- Periodic reports on the propagation of selected Ficus species.
- Periodic reports on the reintroduction of selected Ficus species in degraded forests.

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.4.5: Wildlife research on providing alternative nesting sites for selected arboreal wildlife

Investigator: Pg Mohd Sahlan bin Salam

Rationale: Natural tree cavities are critical habitats for many bird and mammal species but are more abundant in natural than managed forests. Forest management alters decay processes and forest structure, reducing cavity availability and limiting nesting sites for cavity-dependent wildlife, potentially affecting biodiversity. Artificial nest boxes offer an alternative conservation tool, but knowledge gaps remain regarding suitable materials, design, and placement. This study aims to address these gaps to support effective conservation of cavity-dwelling species.

Objectives:

1. To design customised artificial nest boxes suited to selected arboreal wildlife.
2. To determine the appropriate placement of artificial nest boxes in the field.
3. To observe the impact of artificial nest boxes on wildlife behaviour

Study 1. The efficacy of using artificial nest box to in providing alternative nesting sites for selected arboreal wildlife

Output

- Customised artificial nest box prototypes and design guidelines for selected arboreal wildlife species
- Field-based recommendations on optimal nest box placement, including suitable tree characteristics, height, and habitat conditions
- Monitoring data and technical assessment reports on nest box use and their effects on wildlife occupancy and behaviour

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

Project 1.4.6: Wildlife corridor

Investigator: Mick Jerrald Stephen & Jandy Veldy Kim Ann

Rationale: Infrastructure development and human expansion have caused habitat fragmentation that restricts wildlife mobility. Wide-ranging wildlife struggle to move between habitat patches, which can lead to inbreeding and a loss of genetic diversity. If this happens, the long-term health of a population will be significantly reduced, making it susceptible and vulnerable to disease, and increasing the risk of extinction. One ecological measure to lessen the impact of fragmentation is to enhance connectivity or create corridors linking nearby habitats through restoration, ultimately forming a network of protected areas. This will allow wildlife to disperse among these areas to find food and shelter and facilitate cross-breeding with other populations.

Objectives:

1. To identify and select ecologically appropriate species based on site conditions, habitat requirements, and target wildlife needs to enhance corridor functionality and biodiversity
2. To implement and maintain restoration plantings through systematic silvicultural practices, including monitoring, tending, and adaptive management to ensure high survival, growth performance, and long-term corridor effectiveness

Study 1. Tabin-Kulamba wildlife corridor

Study 2. Silabukan-Tabin wildlife corridor

Study 3. Silvicultural treatment in Bukit Piton (Compartment 103 & 104)

Output:

- Species-site matching guidelines and planting schemes for corridor rehabilitation
- Established and maintained restoration plots with documented growth performance and survival rates
- Monitoring datasets and reports on vegetation recovery and wildlife movement/use of corridors
- Technical guidelines and policy recommendations for corridor design, restoration, and long-term management

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

SUB-PROGRAMME 1.5 — CONSERVATION MONITORING SYSTEM (CMS)

Project 1.5.1: Forest Ecosystem Intelligence & Data Integration

Investigators: Sarah J Mianus, Sandy Tsen Tze Lui, Dr Reuben Nilus & Julsun Sikui

Rationale: An integrated monitoring platform is crucial for centralising ecological, biodiversity, and ecosystem services data across Sabah's forest landscapes. Currently, data is scattered among various institutions and formats, which hampers its usefulness for analysis and decision-making. A unified platform would standardise data, provide real-time access, and enhance interoperability—leading to more accurate assessments of ecosystem conditions and trends. This supports evidence-based policymaking, improves forest management and conservation strategies, and fulfils national and international reporting needs. Overall, such a platform would foster better coordination among stakeholders, boost efficiency, and ensure data-driven decisions promote sustainable forest management and long-term environmental resilience.

Objectives:

1. Integrate landscape ecosystem research datasets into CMS.
2. Develop decision-support dashboards.

Study 1. CMS Data Integration (PI: Sarah J Mianus, Sandy Tsen Tze Lui, Dr Reuben Nilus, Julsun Sikui)

Study 2. Geospatial Decision Dashboard Development (PI: Sarah J Mianus, Sandy Tsen Tze Lui)

Output:

- Maintenance of the Conservation Areas Monitoring System portal
- Centralised and standardised forest ecosystem database integrating ecological, biodiversity, and ecosystem services datasets into a unified CMS
- Operational digital platform with real-time data access, storage, and interoperability across agencies
- Interactive decision-support dashboards for forest monitoring, planning, and policy analysis
- Harmonised data standards, metadata protocols, and data governance framework
- Analytical reports and visualisations supporting forest condition assessment, conservation planning, and national/international reporting

Timeline: 2026–2030

Remarks: This project aligns with Sabah Forest Policy Thrust 2 (Objective 3) & Thrust 3 (Objective 1 & 2); and 20th Malaysian Forestry Conference Resolutions 3.1, 3.2 and 4.1.

2. FOREST BIODIVERSITY & CONSERVATION PROGRAMME

Overall Objectives:

- To maintain and enhance documentation on biodiversity, including flora, fauna, and fungi.
- To safeguard and conserve rare, threatened, and endemic species through research, assessment and strategic conservation actions
- To support biodiversity-related policy

Key Subjects & Topics:

- Plant & fungal diversity, wildlife diversity (mammals, reptiles, insects, fish, herpetofauna, birds).
- Biodiversity documentation, assessment and monitoring.
- Target species conservation action
- Contribute towards policy review, e.g. CITES; science-policy integration.
- Capacity building & partnerships.
- Curation of biodiversity collection facilities and database (Herbarium, Fungi, Insects, Fish, Anurans)

SUB-PROGRAMME 2.1 – PLANT AND FUNGAL DIVERSITY CONSERVATION

Project 2.1.1: Plant diversity

Investigators: Dr Joan T. Pereira, Suzana Sabran, Andi Maryani, Jonathan J. Lucas & Alviana Damit

Rationale: Plant names are obtained through taxonomy and expert revision, and they are continuously updated. This provides the foundation for forestry-related research. Studying specific plant groups, such as lower plant flora and Ficus, which have limited information but are vital for wildlife and hold economic value, is essential.

Objectives:

1. To document and provide comprehensive, up-to-date botanical and ecological information on the tree flora of Sabah & Sarawak with a dbh > 10 cm, serving as a key reference for foresters, botanists, and all those involved in the timber and wood-based industries.
2. To document and provide detailed and up-to-date botanical information of the ferns, lycophytes, and bryophytes of Malaysian Borneo.

Study 1. Tree Flora of Sabah and Sarawak

Study 2. Lower Plant Flora: ferns, lycophytes and bryophytes

Study 3. Ficus of Sabah (Moraceae)

Output:

- Accounts of selected plant groups to support projects (e.g. Tree Flora of Sabah and Sarawak).
- An updated checklist and current status of Ferns and Lycophytes in Sabah and Borneo.
- New addition of bryophytes for Sabah and Borneo (via herbarium specimens and collaboration studies).
- An updated revision/checklist for Ficus in Sabah.
- A checklist of plant species in Sabah.
- An updated checklist of tree species in Sabah.
- A checklist of endemic plant species in Sabah.
- Dissemination of information in publications, reports & and presentations.
- Plant specimens are deposited in the reference collection for researchers and students.

Timeline: 2026-2030

Remarks: This project supports MFC-20 Resolutions 1.1, 1.3, 4.1 and 4.3

Project 2.1.2: The Conservation and Recovery of The Rare, Threatened and Endemic Plants in Sabah

Investigators: Alviana Damit, Dr Joan T. Pereira & Suzana Sabran

Rationale: Malaysia is the fifth country with greatest number of endemic Rhododendron taxa (54 species), of which 22 are threatened by extinction. Along with MFC Resolution 3.5: Conservation status of rare, threatened and endangered flora and fauna be continuously monitored and updated.

Objectives:

1. To carry out conservation programme for the threatened plant species

Study 1. Conserving Critically Endangered *Adonidia dransfieldii* and *Saurauia sammanniana* in Sabah" (Technical and financial assistance from Botanic Gardens Conservation International (BGCI) and funding from Fondation Franklinia).

Study 2. Preparation of the Conservation Action Plan for Malaysia's threatened trees 2025 – 2035 document.

Output:

- Conservation/Recovery Plan for target species.
- A Conservation Action Plan for Malaysia.

Timeline: 2025-2027

Remarks:

- MFC-20 Resolutions 1: 1.2 Conservation initiatives outside permanent reserved forests and forest estates be further strengthened.
- MFC-20 Resolutions 4: 4.1 Collaborations and innovative technologies in research and monitoring ecological integrity of critical biodiversity areas be enhanced.

Project 2.1.4: Fagaceae conservation assessment and diversity study in Sabah

Investigators: Eyen Khoo

Rationale: For Borneo island, Sabah to date holds the highest recorded species for the family, such as phenology, germination, plant animal interaction (food source), distribution and regeneration. The project aims to address the mentioned gaps.

Objectives:

1. To document and update the distribution and ecological range.
2. To conduct conservation assessment (State and Global).
3. To document wildlife and plant interaction.

Output:

- Generation of species information and recommendations for dissemination/use in Forest Management Plans (FMPs), High Conservation Value Reports (HCVs), IUCN Red Listing (Global and State), publications and presentations.
- Short listing of potential species for conservation, reintroduction, and ex situ conservation at selected sites.

Timeline: 2026-2030

Remarks: In line with Sabah Forestry Policy 2018 Thrust 2 & 3, and also MFC-20 Resolution 4.1

Project 2.1.7: Fungal Diversity in Selected Forest Reserves in Sabah

Investigator: Viviannye Paul

Rationale: Fungi are studied under a separate branch of Botany called Mycology. This is one of the main thrusts in the Sabah Forest Policy. Research on fungi in Borneo is still scarce and relatively unknown. One of the reasons to conduct a study of fungi is to document the diversity of species in a particular area.

Objectives:

1. To identify areas of particular fungal interest (For example, detect the potential fungi that we can exploit fungi industrially/commercial value).
2. To make recommendations to conserve and promote further fungal interest, for consideration within the management plan of the site.
3. To promote awareness of the ecological requirements of fungi.

Output:

- Publications, presentations, and technical reports on conspicuous fungal diversity in Sabah.
- Enhancement of nature-based tourism and public interest through fungal diversity documentation.

Timeline: 2026-2030

Remarks: This project supports MFC-20 Resolutions 1.3, 3.1 and 4.1 and remains aligned with Sabah Forestry Policy 2018 Thrusts 2 & 3.

SUB-PROGRAMME 2.2 – WILDLIFE DIVERSITY AND CONSERVATION

Project 2.2.1: Diversity of mammals in selected forest reserves and conservation areas in Sabah

Investigators: Sandy Tsen Tze Lui, Jabanus Miun & Dr Reuben Nilus

Rationale: Borneo's island hosts at least 247 terrestrial mammal species. However, their numbers are dynamic, influenced by natural changes and human activities. Therefore, long-term research on these species in Sabah is essential. These studies

aid in tracking Sabah's rare, threatened, and endemic mammals. Mammal data can also be combined with other fields, such as plant diversity, forest ecology, and social sciences, to develop a comprehensive management strategy. This approach will also enhance the research capacity of the Forest Research Centre.

Objectives:

1. To inventory terrestrial mammal species
2. To assess the species richness of mammals and their conservation status
3. To assess the issues and threats detrimentally affecting the terrestrial mammals
4. To provide recommendations for conservation from the mammal perspective

Output:

- Species richness of terrestrial mammals (preliminary checklist of terrestrial mammals)
- Data on rare, threatened, endemic and outstanding conservation value species for FMP and HCV reports
- Dissemination of information in publications, reports & presentations
- Photographic data deposited in database for researchers & students

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 2, MFC-20 Resolutions 4.1.

Project 2.2.2: Diversity of birds in selected forest reserves and conservation areas in Sabah

Investigators: Bernadette Joeman & Loraiti Lolin

Rationale: Borneo's island is home to at least 673 bird species, but these numbers can vary because of natural changes and human impact. Consequently, long-term research on these birds in Sabah is crucial. Such studies help track rare, threatened, and endemic species, providing vital data. Bird information can be integrated with research on plant diversity, forest ecosystems, and social sciences to create a holistic management strategy. This approach will also bolster the Forest Research Centre's research capabilities.

Objectives:

1. To inventory bird species
2. To assess species richness of birds, and their conservation status
3. To assess the issues and threats detrimentally affecting the terrestrial birds

4. To provide recommendations for conservation from the bird perspective
5. To train lay people in conducting bird survey from the perspective of bird ecology
6. To come up with a standardised methodology for rapid bird assessment
7. To promote birdwatching in Sabah

Output:

- Species richness of birds
- Data on rare, threatened, endemic and outstanding conservation value species for FMP and HCV reports
- Dissemination of information in publications, reports & presentations
- More people trained in conducting bird surveys

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 2 and also MFC-20 Resolutions 4.1, 4.3 and 6.3

Project 2.2.3: Mangrove fauna

Investigators: Dr Joseph Tangah, Dr Arthur Y.C. Chung, Razy Japir, Dauni Seligi, Dr Henry Bernard & Dr Tohru Naruse

Rationale: Mangrove is a unique ecosystem situated between the sea and inland forests. They serve as breeding grounds for marine species and provide refuge for certain terrestrial animals. Understanding the ecology, distribution, and behaviour of animals in mangrove forests is crucial, especially in relation to the livelihoods of local communities living within and near these areas.

Objectives:

1. To survey mangrove wildlife of Sabah
2. To investigate their behavioural traits and ecological aspect
3. To study ways of promoting selected fauna (e.g. proboscis monkey, crocodile, etc) for nature eco-tourism in Sabah

Study 1. Study on selected and iconic groups of mangrove fauna

Output:

- Data procured will be used for general information and talks

- Publications, reports & presentations in conferences

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrusts 2 & 4 and also MFC-20 Resolution 4.1

Project 2.2.4: The inland freshwater fish research of selected forest reserves in Sabah

Investigator: Pg. Mohd Sahlan bin Salam

Rationale: Inland freshwater fishes are declining mainly due to habitat destruction caused by logging activities, pollution from extensive agricultural plantations, overfishing, and illegal fishing. Among all vertebrates, freshwater fishes have the highest extinction rate. In Sabah, the conservation and taxonomy of freshwater fishes are still very much in the discovery phase. Therefore, understanding the factors influencing freshwater fish can aid in forest management and the conservation of freshwater fish diversity.

Objectives:

1. To document the freshwater fish fauna.
2. To survey and assess the diversity and its conservation status.
3. To provide up-to-date information on inland freshwater fish diversity in Sabah.
4. To identify the issues and threats adversely affecting the inland fish fauna.
5. To expand the Forest Research Centre's inland fish collection.

Study 1. The quantitative and qualitative of inland freshwater fish in Sabah

Output:

- Technical reports, presentations, publications
- Establishment of inland freshwater fish voucher specimens for future reference

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forestry Policy Thrust 2 and also MFC-20 Resolution 4.1

Project 2.2.5: Anuran diversity and conservation of selected forest reserves in Sabah

Investigator: Pg. Mohd Sahlan bin Salam

Rationale: The widespread decline of amphibians worldwide is well documented, with up to 40% of species at risk of extinction. While tropical regions like Southeast Asia boast high anuran diversity, they also host some of the most threatened habitats. Tropical anurans are particularly vulnerable to environmental changes due to their physiological and ecological constraints, making them highly sensitive to habitat loss and degradation. For example, Borneo has over 180 anuran species but faces threats from deforestation and habitat destruction. Additionally, the absence of comprehensive baseline data on amphibian diversity hampers conservation efforts for Southeast Asia's endangered species. Assessing the diversity of anurans in small forest patches is crucial for conserving these habitats, especially since they may not support large mammals but can be vital refuges for amphibians in disturbed environments.

Objectives:

1. To document Anuran diversity (frogs and toads)
2. To provide up-to-date information on anuran diversity in forest reserves in Sabah.
3. To expand the anuran collection in FRC.
4. To promote selected anurans in nature tourism.

Study 1. Anuran diversity and conservation of various forest reserves under the HoB Initiative

Output:

- Established anuran scientific collection in FRC
- Scientific publications, reports and presentations

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 2 & 4 and also MFC-20 Resolution 4.1

Project 2.2.6: Insect diversity and conservation of selected forest reserves in Sabah

Investigators: Dr Arthur Y.C. Chung & Razy Japir

Rationale: Due to their high diversity and abundance, insects are utmost important in the functioning of the ecosystem, but much is still not known about the rainforest insects. Click this link for a comprehensive justification of this project: https://www.youtube.com/watch?v=TI0_8Pxx_5g

Objectives:

1. To document the insect fauna
2. To evaluate the diversity of insects and its status
3. To investigate the issues and threats adversely affecting the insect fauna
4. To provide recommendations for conservation from the insect perspective
5. To expand the FRC Insect Collection

Study 1. Nocturnal insect diversity (via light-trapping)

Study 2. Butterfly diversity (via sweep-netting & fruit-baiting)

Study 3. Dragonfly diversity (via sweep-netting)

Study 4. Beetle diversity (via light-trapping & manual collecting)

Study 5. Ant diversity (via manual collecting)

Study 6. Grasshopper & cricket diversity (via manual collecting – day & night)

Study 7. Stick insect diversity (via manual collecting – day & night)

Study 8. Praying mantis diversity (via manual collecting & light-trapping)

Output:

- Data on endemic species and other species of conservation interest for FMP & HCV reports
- Dissemination of information in publications, reports & presentations
- Insect specimens deposited in reference collection for researches and student

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 2; MFC-20 Resolutions 4.1

Project 2.2.7: Insect diversity in promoting nature tourism

Investigators: Dr Arthur Y.C. Chung & Razy Japir

Rationale: The rationale is that insect watching, particularly butterflies and dragonflies, is becoming increasingly popular, similar to bird watching. Promoting these nature tourism activities could boost revenue for the state government and enhance local communities' livelihoods. This aligns with one of the key goals in the Sabah Forest Policy. Currently, research on insects within the context of nature tourism remains limited and underexplored. Thus, it is appropriate to undertake studies to assess its potential in Sabah and to document insects that attract interest from tourists.

Objectives:

1. To document insects that contribute towards nature tourism
2. To investigate the life cycle, behavioural and ecological aspect of selected insects
3. To study ways of promoting selected insects in nature tourism

Study 1. The study will focus on selected groups, which include butterflies, beetles & dragonflies

Output:

- Data procured will be used for talks for students, tourist guides and the public in general
- Scientific publications, reports & presentations in conferences
- Layman publications for the general public

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrusts 2 & 4, MFC-20 Resolution 6.3

Project 2.2.8: Insect diversity as a tool to monitor the ecological succession of selected mangrove sites in Sabah

Investigators: Dr Arthur Y.C. Chung, Dr Joseph Tangah, Razy Japir & Dr Maria Lourdes (UMS)

Rationale: Insects are often used in environmental studies as bioindicators due their diversity, abundance and close relationship with the biotic and abiotic factors in the environment. They can indicate the effects of habitat changes and fragmentation, and the effectiveness of management schemes designed to preserve or change individual species- or community-level patterns. Insect diversity has been used as a tool to indicate the status of the surveyed area, and to compare with other forested sites in Sabah. Mangrove insects, however, have remained a neglected

field although Sabah accounts for about 60% of the mangroves in Malaysia. Hence, this project is being conducted.

Objectives:

1. To document the insect fauna in selected mangrove site in Sabah
2. To investigate the status of mangroves based on insect diversity

Study 1. The study will focus on two sites, namely Sg. ISME in Sg Manila and LTER site in Sepilok Laut

Output:

- Scientific publications, reports & presentations in conferences
- Layman publications for the general public on insect fauna of mangroves
- Enhance collaboration among ISME, UMS and SFD in research cooperation
- Capacity building for interns and final year student projects from UMS

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrusts 2 & 7, MFC-20 Resolution 4.2

Project 2.2.9: Distribution Modelling on Insects in Sabah, Malaysia

Investigators: Razy Japir, Dr Arthur Chung, Dg Fazrinah Awg Damit, Cyril Ann Daniel, John Lee Yukang & Herwin Andrian Monis Noni

Rationale: Sabah is among the most biodiverse regions in Southeast Asia, yet insect distributions remain poorly documented despite their dominance in biodiversity and essential ecological roles. Significant knowledge gaps persist, with many species under-sampled, particularly in remote forest reserves, and existing data fragmented across sources. Insects are vital for ecosystem functioning, contributing to pollination, nutrient cycling, and sustaining food webs; changes in their distribution may disrupt ecosystem stability. Increasing pressures from deforestation, forest degradation, plantation expansion, and climate variability further threaten insect habitats, but their impacts remain poorly quantified. There is therefore a critical need for predictive tools such as Species Distribution Models (SDMs) to map current and future species ranges, identify conservation priorities, and support forest monitoring frameworks such as Forest Reference Levels (FRL). This approach aligns with Sabah's commitment to Sustainable Forest Management, climate reporting mechanisms such as REDD+, and global goals, including SDG 13 (Climate Action) and SDG 15 (Life on Land).

Objective: To develop spatially explicit models of insect distribution in Sabah to support biodiversity conservation, forest management, and climate-resilient land-use planning.

Study 1. The study will focus on selected groups, which include butterflies, beetles & dragonflies

- Species Distribution Modelling of Troides andromache in Sabah
- SDM of CRE species of Odonata in Sabah

Output:

- Scientific publications/ poster
- Capacity building for interns and final year student projects from UMS

Timeline: 2026-2030

Remarks: This project is in line with MFC-20 Resolution 4.1

Outreach & extension

- Capacity building (courses & lectures) on plant and insect identification for rangers, students and the general public
- Plant and insect identification services to FMU holders, other forestry stakeholders and related agencies
- Internship programme for local university students, such as UMS, UPM, USM and UNIMAS.

Other related activities & technical services

- ***Biodiversity Exploration/Expedition***
  The Forest Biodiversity & Conservation Programme conducts exploration to collect plants and animals (insect, fish & frog) specimens around Sabah. Since the initiation of the Heart of Borneo (HoB) project in 2008, scientific expeditions were focused on selected areas for inventories, including identification of related corridor/buffer for conservation targets within the HoB area. This effort is to assess the flora & fauna diversity and their conservation status and also determine the vegetation and fauna quality (e.g. richness, endemism, etc.) in the selected forest reserves.

- ***Botanical Research & Herbarium Management System (BRAHMS)***

The specimens stored at the Sandakan Herbarium are curated and the information are input into a database, i.e., BRAHMS to produce a networkable information system designed to assist botanists and others working with botanical data with the assembly, storage, processing and publication of data associated with their work. These data have been used for producing Checklist of plants, producing conservation assessments of plants and many more outputs.

- ***Maintenance and curation of Scientific Reference Collections***
  Sandakan Herbarium, Insect Museum, Fish & Frog Collection (see sub-heading on FRC Scientific Reference Collections)

3. FOREST PLANTATION

Objectives:

- Develop sustainable plantations and improve tree breeding techniques.
- Support forest plantation development in the state.

Key Subjects & Topics:

- Plantation silviculture, seed procurement, and biotech improvements.
- Provenance trials, growth performance, and best practice manuals.
- Carbon stock modelling and productivity assessment.

SUB-PROGRAMME 3.1 – PLANTATIONS

Project 3.1.1: Trial of fast-growing selected potential plantation species

Investigators: Veronica S. Guanih & Pang Kat Nyen Kelvin

Rationale: This project aims to evaluate fast-growing, carefully selected plantation species with high potential for sustainable timber production. By conducting systematic field trials, the study will assess growth performance, adaptability to local site conditions, and early yield characteristics. The outcomes will support evidence-based species selection, reduce investment risks, and improve plantation productivity.

Objectives:

1. To quantify the growth and yield of the selected potential species in plantation conditions
2. To evaluate the physical form of the species for solid wood utilisation
3. To document the species performance and make recommendations on the species suitability for forest plantation development

Species:

1. Laran putih (*Neolamarckia cadamba*)
2. Talisai Paya (*Terminalia copelandii*)
3. Binuang (*Octomeles sumatrana*)

4. *Eucalyptus pellita*
5. Mahogany (*Swietenia macrophylla*)
6. *Acacia crassicarpa*
7. Batai (*Falcataria moluccana*)
8. Laran Merah (*Neolamarckia macrophylla*)*

(Note * is indicated to be undertaken when seeds and seedlings are available)

Output:

- Data of growth and yield of the selected forest plantation species
- Information on the physical form of the selected species for various utilizations
- Dissemination of information in publications, reports & presentations
- Advice and recommendations on potential species for forestry stakeholders

Timeline: Long-term project with a minimum timeline of 10-15 years from planted date, with the assumption that a full rotation is 10-15 years, or when the DBH of the planted tree is above 45cm average.

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.2: RMK13: Continue monitor the smallholder plot-RMK12 (Promoting Tree Planting by Smallholders and Local Communities as an Important Source of Wood for the Timber Industry)

Investigators: Pang Kat Nyen Kelvin & Veronica S. Guanih

Rationale: This project focuses on continued monitoring of RMK12 smallholder plots to evaluate tree growth, survival, and management practices. The findings will support improved productivity, strengthen smallholder participation, and ensure a sustainable wood supply for the timber industry while promoting community-based forestry development.

Objectives:

1. To evaluate the growth performance; and
2. To disseminate information on tree plantation through publication, outreach programme, seminar, workshop, conference, etc.

Timeline: 10 years from 2022-2031 (cycle of fast-growing species).

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.3: FRIM Project Potential of *Antoshorea roxburghii*@ Meranti Temak Nipis as a forest plantation species.

Investigators: Veronica S. Guanih & Pang Kat Nyen Kelvin

Rationale: This project evaluates the plantation potential of *Antoshorea roxburghii* (Meranti Temak Nipis) which is an exotic species by assessing its growth performance, adaptability, and early stand development. The study aims to determine its suitability as an alternative forest plantation species to enhance species diversity and long-term sustainability**.**

Objectives :

1. To assess the survival rate and evaluate the growth performance of Antoshorea roxburghii planted in monoculture plot,
2. To examine the adaptability of the species across different ecological environments (Peninsular Malaysia, Sarawak and Sabah).
3. To conduct a preliminary cost–benefit analysis to determine the economic viability of Antoshorea roxburghii plantations.
4. To provide recommendations on the suitability of Antoshorea roxburghii for large-scale plantation establishment in Sabah.

Timeline: 5–15 years from 2026-2040 (studies FRIM at Selangor, Perak, Terengganu, Kelantan and Johor).

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.4: Occurrence of diseases in forest plantations

Investigators: Viviannye Paul, Dr Arthur Y.C. Chung, Razy Japir & Pang Kat Nyen Kelvin

Rationale: Forest pathology is the study of diseases affecting trees and forest ecosystems. This study focuses on selected tree species in forest plantations in Sabah, where disease outbreaks can pose significant risks to plantation productivity and forest health. Plant diseases, if not detected and managed at an early stage, can spread rapidly due to the vulnerability of plantation systems, resulting in increased damage and economic losses. Therefore, systematic documentation and investigation of forest diseases are essential to support timely intervention and sustainable forest plantation management.

Objectives:

1. To document diseases causing damage to forest plantation trees in Sabah.
2. To investigate the extent of infestation and ecological aspects of major forest diseases.
3. To provide science-based recommendations for effective plant disease management in forest plantations.

Outputs:

- Scientific data to be disseminated through publications, technical reports & conferences presentations.
- Practical recommendations for plant disease management to support Forest Management Units (FMUs) and other forestry stakeholders.

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrusts 4 & MFC 20 Resolution 4.1

Project 3.1.5: Impacts of Forest Plantations on Soil Health and Fertility in Sabah for the Development of a Soil Monitoring Programme

Investigators: Rolando Robert, Tom Khoo Meng Chorng, Richard J. Majapun & Kelvin Pang Kat Nyen

Collaborator: Prof. Vijay Kumar (Universiti Malaysia Sabah)

Objectives:

1. To determine the impacts of forest plantation establishment and management on soil fertility and soil health in Sabah.

2. To develop and optimise rapid, low-cost methods for assessing soil fertility and health in forest plantation systems.

Study 1. Assessment of soil fertility and health across forest plantation types, ages, and management regimes.

Study 2. Development and validation of rapid soil testing tools for selected soil health and fertility indicators relevant to forest plantations.

Output:

- Peer-reviewed publications on soil fertility and health dynamics in forest plantation systems.
- A standardised soil monitoring framework and indicator set for forest plantations in Sabah.
- Technical reports for stakeholders in forest plantations.

Duration: 2026–2030

Remarks:

- Supports Thrust 3 (Objectives 1 & 2) of Sabah Forest Policy 2018
- Designed in collaboration with forest plantation resource managers to translate scientific soil health concepts into operational monitoring and management tools.

Project 3.1.6: Growth and Performance Evaluation of *Terminalia copelandii* (Talisai Paya) Under Varying Spacing Treatments

Investigators: Richard Majapun & Pang Kat Nyen Kelvin

Collaborator:

- Maxi Self (Jawala Plantation Industries Sdn. Bhd)

Rationale: *Terminalia copelandii* (Talisai Paya) is a promising plantation species in Sabah, yet scientifically validated spacing recommendations remain limited, particularly across varying site conditions. Planting spacing strongly influences stand structure, competition, growth dynamics and long-term productivity, making empirical evaluation essential for silvicultural optimisation. This study evaluates the growth and performance of *T. copelandii* under four spacing regimes across contrasting terrain conditions, providing evidence-based insights into stand development over time. The results will support informed spacing guidelines, improve plantation planning and management, and contribute to technical knowledge dissemination through reports and peer-reviewed publication, thereby strengthening silvicultural

decision-making for Talisai plantations in Sabah.

Objectives:

- To evaluate the growth responses of *Terminalia copelandii* to varying planting spacings and environmental conditions, thereby supporting long-term silvicultural planning for the species

Output:

These findings highlight the dynamic nature of stand development over time and underscore the need for longitudinal monitoring to refine spacing recommendations for Talisai plantations.

Timeline: April 2025 to 2029

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.7: Assessment of Growth Performance of Laran (*Neolamarckia cadamba*) Progeny Trial Plot.

Investigators: Kuina Kimjus & Richard Majapun

Collaborator:

- Maxi Self (Jawala Plantation Industries Sdn. Bhd)

Rationale: Progeny trials are essential for evaluating the genetic potential and field performance of Laran (*Neolamarckia cadamba*) derived from Candidate Plus Trees (CPTs). This assessment enables the identification of superior CPTs based on growth and survival traits, providing a scientific basis for species improvement, reforestation, and sustainable forest plantation development programmes.

Objectives :

1. To evaluate the growth performance of Laran (*Neolamarckia cadamba*) progenies derived from selected Candidate Plus Trees (CPTs) based on height, diameter, and survival rate.
2. To identify superior CPTs and provide scientifically based recommendations for species improvement, reforestation, and forest plantation development programmes.

Output:

- To identify superior Laran Candidate Plus Trees (CPTs) with high growth performance.
- To provide recommendations for the selection of CPTs for species improvement, reforestation, and plantation establishment.
- Publication or technical report to support evidence based decision making in forest plantation development.

Timeline: 2025-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.8: Fertiliser trials for Laran (Sawit Kinabalu Group)

Investigators: Pang Kat Nyen Kelvin, Richard Majapun & Veronica S. Guanih

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: This project evaluates the effectiveness of different fertiliser treatments on the growth and nutrient response of Laran under plantation conditions. The results will provide practical recommendations to optimise fertilisation practices, enhance growth performance, and improve the productivity and cost efficiency of Laran plantations.

Objectives:

1. To determine and compare the dosage of fertiliser treatments for Laran.
2. To quantify vegetative growth under different fertiliser regimes.
3. To assess the cost-effectiveness of each fertiliser treatment.

Output:

- Results from this study will be used to produce a guide for best management practice which will benefit Sawit Kinabalu Group and also for other plantations.

Timeline: 2025 - 2030

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.9: Mulching effect study in Laran plantations at Sg Pin Estate, Sawit Kinabalu Group

Investigators: Pang Kat Nyen Kelvin, Richard Majapun & Veronica S. Guanih

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: This project examines the effects of mulching on soil moisture, nutrient retention, and growth performance of Laran in plantation settings. The study aims to identify effective mulching practices that enhance early growth, improve soil conditions, and support sustainable and cost-effective Laran plantation management.

Objectives :

1. To compare Laran growth performance under mulching and non-mulching practices.
2. To identify the costs and benefits of different mulching applications.

Output :

Results from this study will be used to produce a guide for best management practice which will benefit Sawit Kinabalu Group and also for other plantations.

Timeline: 2025 - 2030

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.10: Pest and Disease Monitoring at Sg Pin Estate, Sawit Kinabalu Group

Investigators: Viviannye Paul

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: Forest plantations under the Sawit Kinabalu Group are increasingly exposed to pest and disease risks arising from changing environmental conditions and plantation management practices. This project supports the main collaborative initiative through systematic monitoring, early detection, and documentation of pest and disease occurrences affecting plantation species. The monitoring outputs provide essential technical inputs for timely management interventions and adaptive pest and disease management strategies. Coordination with plantation management ensures alignment with operational needs and field conditions, contributing to improved plantation health and sustainability.

Objectives:

- To support the main project through systematic monitoring, identification, and documentation of pest and disease occurrences affecting forest plantation species in Sawit Kinabalu Group areas.

Output:

- Pest and disease monitoring records
- Technical input for project reporting
- Supporting data for the main collaborative project

Timeline: 2025 - 2030

Remarks: Monitoring activities will be conducted in coordination with the main project team and plantation management. Survey frequency and coverage will be adjusted based on field conditions, plantation schedules, and operational requirements. Findings will be reported periodically to support adaptive pest and disease management strategies.

Project 3.1.11: Field Validation of Seed Size Grading and MRT Propagation for Timber Production in *Terminalia copelandii*

Investigator: Richard Majapun

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: Nursery results indicate seed size affects germination speed and seedling uniformity (Majapun et al. 2026), but these advantages must be validated under operational field conditions where site variability and establishment stress can

change performance. This sub-research therefore tests seed size grading from nursery through field establishment and compares it with Multiple Rootstock Technology (MRT) as an applied propagation option to enhance early growth and survival. By monitoring survival, height and DBH over 3–5 years and analysing treatment effects using GLMs, the study will generate evidence-based guidance for seedling selection and propagation strategies, supporting higher plantation success and reliable timber production.

Objectives:

1. Evaluate the influence of seed size classes on seedling performance from nursery development through to field establishment in T. copelandii.
2. Compare the growth performance of MRT-propagated seedlings with that of seedlings derived from different seed size classes.

Output:

- Majapun et al. (2026) found that larger seeds germinate faster, while medium-weight seeds produce more uniform and taller seedlings. To validate these results under field conditions, a 1-ha trial plot was established at the Sg. Pin Conservation Area for a future joint publication.
- The study also incorporates Multiple Rootstock Technology (MRT), following Majapun & Chen (2022), to evaluate whether MRT can improve early performance of *T. copelandii* compared to seed-size groupings, with the aim of identifying traits for better seedling selection and plantation success in Sabah.

Timeline: 2025 - 2030

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.1.12: Growth Performance and Suitability of Laran (*Neolamarckia cadamba*) Seedlings Derived from Candidate Plus Trees (CPTs) in the Serijaya Industri Sdn. Bhd. Area.

Investigator: Kuina Kimjus

Collaborator:

- Paul Anak (Serijaya Industri Sdn. Bhd. (TSH))

Rationale: Seedlings derived from Candidate Plus Trees (CPTs) are expected to exhibit superior growth and adaptability under plantation conditions. However, their field

performance must be evaluated to confirm suitability for large-scale planting. This study will provide essential field-based evidence to support the selection of high-performing CPT sources and guide future Laran plantation development at Serijaya Industri Sdn. Bhd.

Objective:

- To evaluate the growth performance and suitability of Laran (Neolamarckia cadamba) seedlings derived from selected CPTs under plantation conditions.

Output:

- Data on growth performance and survival rates of seedlings derived from CPTs.
- A technical report or publication-ready scientific paper on the study findings and recommendations.

Timeline: 2024 – 2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.1.13: Establishment of a Smallholder Plantation Model (Phase I)

Investigator: Eyen Khoo

Collaborator:

- Lo Hon Kong (Harimaju Plantation Sdn. Bhd.)

Rationale: Smallholder timber plantations have the potential to strengthen timber supply, in turn reduce pressure on natural forests, however the adoption is limited by technical and cost uncertainties. This Phase I project establishes a pilot Smallholder Plantation Model to test appropriate site preparation, planting density, and silvicultural practices under smallholder management conditions. Early growth performance, survival rates, maintenance and establishment costs data will be consolidated into a practical, evidence-based reference model to guide future support and extension programmes for sustainable smallholder timber plantation development.

Objectives:

1. To develop a smallholder timber plantation model, including site preparation, planting density, and silvicultural practices.
2. To assess early growth performance, survival rate, and maintenance requirements under smallholder management conditions.

3. To evaluate the operational and cost implications of timber plantation establishment for smallholders.
4. To document best practices and lessons learned from the pilot implementation.
5. To produce a practical, replicable reference model to support scaling up of smallholder timber plantations.

Output:

- The project will document best practices and develop a practical, replicable reference model to support future scaling up of smallholder timber plantations.

Timeline: 2022 – 2032

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.1.14: Harvest Yield and Harvest Performance of *Eucalyptus pellita* under Operational Plantation Conditions

Investigator: Eyen Khoo

Collaborator:

- Ng Shi Teng (Lebih Hasil Sdn. Bhd.)

Rationale: Efficient harvesting is essential for the productivity and economic viability of *Eucalyptus pellita* plantations, however site-specific data on harvest yield, log recovery, and operational performance are limited in Sabah's context. This study aims to quantify total volume, log size distribution, volume recovery, and harvesting productivity under current management practices at Lebihasil Sdn. Bhd., while assessing associated costs and operational efficiency. The findings will provide practical, evidence-based insights to improve silvicultural practices, enhance harvesting efficiency and provide better economic decision-making for Eucalyptus pellita plantations in similar site conditions.

Objectives:

The study will try to quantify harvest yield and productivity, including total volume, log size distribution, and volume recovery rate. The information obtained will be used to evaluate the economics of the harvesting operation, including harvesting cost and operational efficiency under current management practices. At the end

of the studies it is hoped to generate site-specific data and recommendations for improving silvicultural practices, harvesting efficiency, and overall economic performance of Eucalyptus pellita plantations in Lebihasil Sdn. Bhd and similar site conditions.

Output :

- Presentation and Publication

Timeline: 2026-2027

Remarks: This project is in line with Sabah Forest Policy Thrust 4, & MFC 19th Resolution 5.

Project 3.1.15: Performance Evaluation of CPT Progenies for Selection of Superior Planting Materials

Investigators: Eyen Khoo & Kuina Kimjus

Collaborator:

- Ng Shi Teng (Lebih Hasil Sdn. Bhd.)

Rationale: The proposed study is designed to evaluate the growth and performance of Candidate Plus Trees (CPTs) and identify top-performing F1 seedlings, which can be selected for the establishment of future seed orchards or clonal trials, ensuring the propagation of superior genetic material. The calculation will provide essential information for planning, management, and optimisation of plantation resources, supporting both sustainable production and the development of high-quality planting material for future forestry initiatives.

Objectives:

1. Carry out growth and performance studies for the CPTS and measure DBH, total height, survival and calculate mean annual increment (MAI) and periodic annual increment (PAI) for each CPT's progeny.
2. Identify top-performing F1 seedlings to establish future seed orchards or clonal trials.
3. Calculate potential yield for each CPT population.

Output:

- Presentation and Publication

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

SUB-PROGRAMME 3.2 – TREE BREEDING

Project 3.2.1: Comparative study on Laran (*Neolamarckia cadamba*) raised by Sapulut Forest Development and FRC

Investigators: Kuina Kimjus & Maria Ajik

Retionale: Differences in nursery practices and seed sources may influence the field performance and survival of Laran (*Neolamarckia cadamba*) seedlings. A comparative evaluation between seedlings raised by Sapulut Forest Development and the Forest Research Centre (FRC) is necessary to identify the most suitable planting material for plantation establishment. The findings will support evidence-based selection of high-quality seedlings and improve the success of Laran plantation and reforestation programmes.

Objective:

To evaluate and compare the growth performance and survival rate of Laran seedlings raised by Sapulut Forest Development and the Forest Research Centre (FRC) under field conditions.

Output:

- Field-based comparative data on the growth performance and survival of Laran seedlings produced by Sapulut Forest Development and FRC.
- Dissemination of research findings through scientific publications, technical reports, and conference presentations.

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.2.2: Field Performance Evaluation of Clonal material (Produced from Stem Cuttings) for Forest Plantation Purposes.

Investigators: Kuina Kimjus & Maria Ajik

Rationale: Clonal materials produced from stem cuttings offer the potential for uniform growth and improved plantation productivity. However, their field performance and adaptability must be evaluated under actual plantation conditions. This study provides field-based evidence on the suitability of Laran Merah and *Eucalyptus* hybrid cuttings to support informed decisions on the use of clonal planting materials for sustainable forest plantation development.

Objective:

- To assess the growth performance and field adaptability of clonal materials produced from stem cuttings under plantation conditions.

Species:

1. Laran Merah cuttings (*Neolamarckia macrophylla*)
2. Eucalyptus Hybrid cuttings (ex SFI)

Output:

- Growth performance data of Laran Merah (*Neolamarckia macrophylla*) and Eucalyptus hybrid cuttings under field conditions.
- Advisory inputs and recommendations on the potential use of clonal cuttings for forest plantation development for forestry stakeholders.
- Dissemination of research findings through scientific publications or technical reports.

Timeline: 2026 – 2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5**.**

Project 3.2.3: Phenological Dynamics of Climate Resilient Trees

Investigator: Rebecca Fung Yun Chong

Rationale: Climate change alters temperature and rainfall patterns, affecting plantation productivity and seed production. Among the main plantation species, Laran

(*Neolamarckia cadamba*), Batai (*Falcataria moluccana*) and Kapur Paji (*Dryobalanops lanceolata*) remain poorly understood due to their phenological dynamics under climate stress (specifically local temperature and humidity). The ability to identify climate-driven shifts in leafing, flowering, and fruiting is essential for climate-smart plantation management and for identifying resilience traits.

Objectives:

1. To quantify the influence of climatic variables (Temperatures and Humidity) of the selected climate -resilient plantation species across season and years
2. To compare phenological responses across sites (lowland vs highland- Laran)
3. To support seed supply planning by improving prediction of flowering and seed production cycles

Species:

1. Laran (*Neolamarckia cadamba*)
2. Batai (*Falcataria moluccana*)
3. Kapur Paji (*Dryobalanops lanceolata*) – planted trees.

Output:

- Seed harvest and supply forecasting System
- Information on the early warning indicators for climate stress (delayed flushing, aborted flowering)
- Dissemination of information in publications, reports & presentations
- Advice and recommendations on potential species for forestry stakeholders

Timeline: 5 years with the assumption that a one full rotation is 2 years for each species (2026-2030)

Remarks: This project is in line with Sabah Forest Policy Thrust 4 (1) & MFC-19 Resolution 5 & Action Plan on Forest Plantation Development, Part 2 Strategy.

Project 3.2.4: Integrated Seed Technology for Enhanced Germination and Storage Quality.

Investigator: Rebecca Fung Yun Chong

Rationale: The plantation species such as Talisai paya (*Terminalia copelandii*), Laran (*Neolamarckia cadamba*) and Batai (*Falcataria moluccana*) are highly sought after by planters, yet their propagation is constrained by inconsistencies in fruit maturity, seed dormancy, low germination, and poor storage. By developing

integrated seed technologies, including maturity assessment, pre-treatment optimisation, and storage protocols, this project supports the development of sustainable plantations, restoration success, and climate resilient forestry system by enhancing germination performance, seed vigour and quality.

Objectives:

1. To determine the optimum fruit maturity stages for maximum seed viability, vigor and germination potential
2. To identify the pre-treatment protocols that enhance imbibition, reduce seed coat resistance and improve germination.
3. To establish optimal storage protocols that maintain high germination capacity over time.

Species:

1. Laran (*Neolamarckia cadamba*)
2. Batai (*Falcataria moluccana*)
3. Talisai Paya (*Terminalia Copelandii*)

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC-19 Resolution 5 & Action Plan on Forest Plantation Development, Part 2 Strategy

---

SUB-PROGRAMME 3.3 – BIOTECHNOLOGY

Project 3.3.1: Enhancing Breeding Potential through Candidate Plus Tree Selection Using Exploratory Factor Analysis (EFA): *Insights from Kimjus et al. (2025) in Sabah*

Investigators: Richard Majapun, Dzulyana Idhamshah, Rebecca Chong, Kuina Kimjus

Rationale: This fundamental project strengthens Sabah's tree improvement and plantation success by making Candidate Plus Tree (CPT) selection more objective and efficient. Current CPT selection can be inconsistent because many traits are correlated and often weighted subjectively. Building on Kimjus et al. (2025), the study will measure key growth, form, crown and (where available) reproductive

traits, then apply Exploratory Factor Analysis (EFA) to identify major trait groupings and develop a statistically weighted selection index. The output will be a ranked set of elite CPTs for breeding populations, seed plots/seed orchards, and clonal testing, while standardising CPT selection criteria for Sabah.

Objective:

1. To assess and quantify key growth, form, and reproductive traits of Candidate Plus Trees (CPTs) in Sabah based on the selection framework of Kimjus et al. (2025).
2. To identify major trait groupings influencing CPT performance using Exploratory Factor Analysis (EFA) and develop an objective selection index (with appropriate trait weighting).
3. To rank and select superior CPTs for breeding and seed production (e.g., seed plots/seed orchards) and recommend practical selection traits to improve plantation success in Sabah.

Output:

Selected CPTs will be proposed for:

- Breeding population development
- Seed plot/seed orchard establishment
- Clonal propagation and field testing
- Standardising Sabah CPT selection criteria

Timeline: 2026-2031

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.3.2: Clonal Propagation and Field Evaluation of Elite Candidate Plus Trees (CPTs) for Plantation Species in Sabah

Investigators: Richard Majapun, Dzulyana Idhamshah

Rationale: Clonal propagation and field evaluation are essential applied research to translate the elite Candidate Plus Trees (CPTs) identified in Sub-research 3.3.1 into operational planting and breeding materials. While the EFA-based selection supports genetic improvement, deployment requires reliable vegetative multiplication and proven performance under nursery and field conditions. This applied study will clonally propagate the top 20 CPTs selected in Sub-research 3.3.1, optimise propagation methods and treatments, and generate robust data on survival and early growth. Establishing a clonal field trial will confirm

adaptability, growth uniformity, and stability across sites, enabling the selection of the best clones for plantation deployment, seed orchards, and advanced breeding in Sabah.

Objectives:

1. To clonally propagate the top 20 selected CPTs using appropriate vegetative techniques (e.g., cuttings, grafting, micro propagation).
2. To evaluate rooting success, survival, and early growth performance of clones under nursery conditions and/or controlled trials.
3. To establish a clonal field trial to assess adaptability and growth uniformity and identify the best-performing clones for plantation deployment and future breeding.

Output:

- Clonal propagation protocol(s) optimised for the target plantation species (including success rates).
- Nursery performance dataset for all 20 CPT clones (rooting, survival, growth).
- Established clonal field trial plot and identification of top-performing clones for operational planting, seed orchards, or advanced breeding.

Timeline: 2026 – 2031

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.3.3: MRT vs Elite Clones: A Comparative Study for Improved Plantation Establishment in Sabah

Investigators: Richard Majapun

Rationale: This innovative study, in relation to Sub-research 3.3.2, aims to establish the most superior planting material for Sabah plantations by rigorously comparing Modified Rootstock Technology (MRT) multi-rooting systems with the finest elite clones identified through earlier CPT selection and clonal evaluation studies. While elite clones offer genetic uniformity and high growth potential, MRT may confer enhanced rooting capacity, vigour, and stress tolerance. Through controlled nursery assessments and replicated field trials, the project will determine whether MRT provides measurable advantages over top-performing clones, thereby

guiding evidence-based decisions on large-scale plantation deployment and advancing innovative tree improvement strategies in Sabah.

Objectives:

1. To compare nursery propagation efficiency between MRT-treated planting materials and conventional elite clones (e.g., rooting %, survival %, plant quality).
2. To evaluate early field performance (survival, height growth, diameter growth, stem form, and vigor) of MRT vs top-performing clones under plantation conditions.
3. To determine the operational value of MRT, by assessing whether MRT provides significant advantages over elite clones for large-scale planting and future tree improvement programs in Sabah.

Output:

- Quantified comparison of MRT vs elite clones, showing differences in propagation success and early field growth.
- Recommendation on best planting material strategy (MRT, clone, or hybrid approach) for Sabah plantation deployment.
- Improved operational propagation and planting guidelines, supporting higher survival and productivity in Sabah's tree plantation industry.

Timeline: 2026 - 2031

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.1: Growth and Performance Evaluation of *Terminalia copelandii* (Talisai Paya) Under Varying Spacing Treatments

Investigators: Richard Majapun & Pang Kat Nyen Kelvin

Collaborator:

- Maxi Self (Jawala Plantation Industries Sdn. Bhd)

Rationale: *Terminalia copelandii* (Talisai Paya) is a promising plantation species in Sabah, yet scientifically validated spacing recommendations remain limited, particularly across varying site conditions. Planting spacing strongly influences stand structure,

competition, growth dynamics and long-term productivity, making empirical evaluation essential for silvicultural optimisation. This study evaluates the growth and performance of *T. copelandii* under four spacing regimes across contrasting terrain conditions, providing evidence-based insights into stand development over time. The results will support informed spacing guidelines, improve plantation planning and management, and contribute to technical knowledge dissemination through reports and peer-reviewed publication, thereby strengthening silvicultural decision-making for Talisai plantations in Sabah.

Objectives:

- To evaluate the growth responses of *Terminalia copelandii* to varying planting spacings and environmental conditions, thereby supporting long-term silvicultural planning for the species

Output:

These findings highlight the dynamic nature of stand development over time and underscore the need for longitudinal monitoring to refine spacing recommendations for Talisai plantations.

Timeline: April 2025 to 2029

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.2: Assessment of Growth Performance of Laran (*Neolamarckia cadamba*) Progeny Trial Plot.

Investigators: Kuina Kimjus & Richard Majapun

Collaborator:

- Maxi Self (Jawala Plantation Industries Sdn. Bhd)

Rationale: Progeny trials are essential for evaluating the genetic potential and field performance of Laran (*Neolamarckia cadamba*) derived from Candidate Plus Trees (CPTs). This assessment enables the identification of superior CPTs based on growth and survival traits, providing a scientific basis for species improvement, reforestation, and sustainable forest plantation development programmes.

Objectives :

1. To evaluate the growth performance of Laran (*Neolamarckia cadamba*) progenies derived from selected Candidate Plus Trees (CPTs) based on height, diameter, and survival rate.
2. To identify superior CPTs and provide scientifically based recommendations for species improvement, reforestation, and forest plantation development programmes.

Output:

- To identify superior Laran Candidate Plus Trees (CPTs) with high growth performance.
- To provide recommendations for the selection of CPTs for species improvement, reforestation, and plantation establishment.
- Publication or technical report to support evidence based decision making in forest plantation development.

Timeline: 2025-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4 & MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.3: Fertilizer trials for Laran (Sawit Kinabalu Group)

Investigators: Pang Kat Nyen Kelvin, Richard Majapun & Veronica S. Guanih

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: This project evaluates the effectiveness of different fertiliser treatments on the growth and nutrient response of Laran under plantation conditions. The results will provide practical recommendations to optimise fertilisation practices, enhance growth performance, and improve the productivity and cost efficiency of Laran plantations.

Objectives:

1. To determine and compare the dosage of fertiliser treatments for Laran.
2. To quantify vegetative growth under different fertiliser regimes.
3. To assess the cost-effectiveness of each fertiliser treatment.

Timeline: 2025 - 2030

Output: Results from this study will be used to produce a guide for best management practice which will benefit Sawit Kinabalu Group and also for other plantations.

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.4: Mulching effect study in Laran plantations at Sg Pin Estate, Sawit Kinabalu Group

Investigators: Pang Kat Nyen Kelvin, Richard Majapun & Veronica S. Guanih

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: This project examines the effects of mulching on soil moisture, nutrient retention, and growth performance of Laran in plantation settings. The study aims to identify effective mulching practices that enhance early growth, improve soil conditions, and support sustainable and cost-effective Laran plantation management.

Objectives:

1. To compare Laran growth performance under mulching and non-mulching practices.
2. To identify the costs and benefits of different mulching applications.

Output: Results from this study will be used to produce a guide for best management practice which will benefit Sawit Kinabalu Group and also for other plantations.

Timeline: 2025 - 2030

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.5: Pest and Disease Monitoring at Sg Pin Estate, Sawit Kinabalu Group

Investigators: Viviannye Paul

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: Forest plantations under the Sawit Kinabalu Group are increasingly exposed to pest and disease risks arising from changing environmental conditions and plantation management practices. This project supports the main collaborative initiative by systematically monitoring, early detecting, and documenting pest and disease occurrences affecting plantation species. The monitoring outputs provide essential technical inputs for timely management interventions and adaptive pest and disease management strategies. Coordination with plantation management ensures alignment with operational needs and field conditions, contributing to improved plantation health and sustainability.

Objectives:

- To support the main project through systematic monitoring, identification, and documentation of pest and disease occurrences affecting forest plantation species in Sawit Kinabalu Group areas.

Output:

- Pest and disease monitoring records
- Technical input for project reporting
- Supporting data for the main collaborative project

Timeline: 2025 - 2030

Remarks: Monitoring activities will be conducted in coordination with the main project team and plantation management. Survey frequency and coverage will be adjusted based on field conditions, plantation schedules, and operational requirements. Findings will be reported periodically to support adaptive pest and disease management strategies.

Project 3.3.6: Field Validation of Seed Size Grading and MRT Propagation for Timber Production in *Terminalia copelandii*

Investigator: Richard Majapun

Collaborator:

- Rashidah Maqbool (Sawit Kinabalu Group)

Rationale: Nursery results indicate seed size affects germination speed and seedling uniformity (Majapun et al. 2026), but these advantages must be validated under operational field conditions where site variability and establishment stress can change performance. This sub-research therefore tests seed size grading from nursery through field establishment and compares it with Multiple Rootstock Technology (MRT) as an applied propagation option to enhance early growth and survival. By monitoring survival, height and DBH over 3–5 years and analysing treatment effects using GLMs, the study will generate evidence-based guidance for seedling selection and propagation strategies, supporting higher plantation success and reliable timber production.

Objectives:

1. Evaluate the influence of seed size classes on seedling performance from nursery development through to field establishment in T. copelandii.
2. Compare the growth performance of MRT-propagated seedlings with that of seedlings derived from different seed size classes.

Output:

- Majapun et al. (2026) found that larger seeds germinate faster, while medium-weight seeds produce more uniform and taller seedlings. To validate these results under field conditions, a 1-ha trial plot was established at the Sg. Pin Conservation Area for a future joint publication.
- The study also incorporates Multiple Rootstock Technology (MRT), following Majapun & Chen (2022), to evaluate whether MRT can improve early performance of *T. copelandii* compared to seed-size groupings, with the aim of identifying traits for better seedling selection and plantation success in Sabah.

Timeline: 2025 - 2030

Remarks: This project is in line with MFC 19th Resolution 5 & Action Plan on Forest Plantation Development, Strategy 2.

Project 3.3.7: Growth Performance and Suitability of Laran (*Neolamarckia cadamba*) Seedlings Derived from Candidate Plus Trees (CPTs) in the Serijaya Industri Sdn. Bhd. Area.

Investigator: Kuina Kimjus

Collaborator:

- Paul Anak (Serijaya Industri Sdn. Bhd. (TSH))

Rationale: Seedlings derived from Candidate Plus Trees (CPTs) are expected to exhibit superior growth and adaptability under plantation conditions. However, their field performance must be evaluated to confirm suitability for large-scale planting. This study will provide essential field-based evidence to support the selection of high-performing CPT sources and guide future Laran plantation development at Serijaya Industri Sdn. Bhd.

Objective:

To evaluate the growth performance and suitability of Laran (Neolamarckia cadamba) seedlings derived from selected CPTs under plantation conditions.

Output:

- Data on growth performance and survival rates of seedlings derived from CPTs.
- A technical report or publication-ready scientific paper on the study findings and recommendations.

Timeline: 2024 – 2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.3.8: Establishment of a Smallholder Plantation Model (Phase I)

Investigator: Eyen Khoo

Collaborator:

- Lo Hon Kong (Harimaju Plantation Sdn. Bhd.)

Rationale: Smallholder timber plantations have the potential to strengthen timber supply, in turn reduce pressure on natural forests, however the adoption is limited by technical and cost uncertainties. This Phase I project establishes a pilot Smallholder Plantation Model to test appropriate site preparation, planting density, and silvicultural practices under smallholder management conditions. Early growth performance, survival rates, maintenance and establishment costs data will be consolidated into a practical, evidence-based reference model to guide future support and extension programmes for sustainable smallholder timber plantation development.

Objectives:

1. To develop a smallholder timber plantation model, including site preparation, planting density, and silvicultural practices.
2. To assess early growth performance, survival rate, and maintenance requirements under smallholder management conditions.
3. To evaluate the operational and cost implications of timber plantation establishment for smallholders.
4. To document best practices and lessons learned from the pilot implementation.
5. To produce a practical, replicable reference model to support scaling up of smallholder timber plantations.

Output:

The project will document best practices and develop a practical, replicable reference model to support future scaling up of smallholder timber plantations.

Timeline: 2022 – 2032

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

Project 3.3.9: Harvest Yield and Harvest Performance of Eucalyptus pellita under Operational Plantation Conditions

Investigator: Eyen Khoo

Collaborator:

- Ng Shi Teng (Lebih Hasil Sdn. Bhd.)

Rationale: Efficient harvesting is essential for the productivity and economic viability of Eucalyptus pellita plantations, however site-specific data on harvest yield, log recovery, and operational performance are limited in Sabah's context. This study aims to quantify total volume, log size distribution, volume recovery, and harvesting productivity under current management practices at Lebihasil Sdn. Bhd., while assessing associated costs and operational efficiency. The findings will provide practical, evidence-based insights to improve silvicultural practices, enhance harvesting efficiency and provide better economic decision-making for Eucalyptus pellita plantations in similar site conditions.

Objectives:

The study will try to quantify harvest yield and productivity, including total volume, log size distribution, and volume recovery rate. The information obtained will be used to evaluate the economics of the harvesting operation, including harvesting cost and operational efficiency under current management practices. At the end of the studies it is hoped to generate site-specific data and recommendations for improving silvicultural practices, harvesting efficiency, and overall economic performance of Eucalyptus pellita plantations in Lebihasil Sdn. Bhd and similar site conditions.

Output :

- Presentation and Publication

Timeline: 2026-2027

Remarks: This project is in line with Sabah Forest Policy Thrust 4, & MFC 19th Resolution 5.

Project 3.3.10: Performance Evaluation of CPT Progenies for Selection of Superior Planting Materials

Investigators: Eyen Khoo & Kuina Kimjus

Collaborator:

Ng Shi Teng (Lebihasil FMU area) & Mr Tu Kui Foh (IWP Sdn. Bhd)

Rationale: The proposed study is designed to evaluate the growth and performance of Candidate Plus Trees (CPTs) and identify top-performing F1 seedlings, which can be selected for the establishment of future seed orchards or clonal trials, ensuring the propagation of superior genetic material. The calculation will provide essential information for planning, management, and optimisation of plantation resources, supporting both sustainable production and the development of high-quality planting material for future forestry initiatives.

Objectives:

1. Carry out growth and performance studies for the CPTS and measure DBH, total height, survival and calculate mean annual increment (MAI) and periodic annual increment (PAI) for each CPT's progeny.
2. Identify top-performing F1 seedlings to establish future seed orchards or clonal trials.
3. Calculate potential yield for each CPT population.

Output: Presentation and Publication

Timeline: 2026-2030

Remarks: This project is in line with Sabah Forest Policy Thrust 4, Action Plan on Forest Plantation Development strategy 2 & MFC 19th Resolution 5.

---

4. FOREST PRODUCE AND PRODUCTS RESEARCH PROGRAMME

Overall Objectives:

- Enhance the utilisation of wood, non-timber, and herbal products.
- Support the viability of forest-based industries and research & development.

Key Subjects & Topics:

- Wood & non-wood utilisation; herbal and medicinal plants.
- Forest certification systems (FSC, TLAS, MTCS); management planning.
- Technical inputs for legality and compliance.
- Curation of the wood library

SUB-PROGRAMME 4.1 – SCIENCE & UTILISATION OF WOOD AND WOODY BIOMASS

Project 4.1.1: Wood quality of timber species in Sabah

Investigators: Jarry K. Lajanga & Zamrie Imiyabir

Objectives:

1. To determine the wood properties (physical and mechanical) of selected species.
2. To determine the proportion of sapwood and heartwood of plantation species.
3. To determine the potential timber utilisation of the selected species.

Study 1: Wood properties and wood characteristics of selected plantation species in Sabah.

Study 2: Wood properties of potential indigenous species in Sabah (such as the local *Batai*).

Study 3: Proportion of sapwood and heartwood of selected plantation species.

Study 4: Potential timber utilisation**.**

Output:

- Database of wood density and other wood properties of plantation species.
- Guidelines for future selection of species for the plantation programme, technical reports & publications/presentations.

Duration: 2026 - 2030

Remarks:

- Supports Thrust 3 (objective 1) of Sabah Forest Policy 2018.
- Supports Sabah Forestry Department Strategies No 17.

Project 4.1.2: Wood anatomy and identification of medicinal plant and lesser-known species in Sabah

Investigators: Jarry K. Lajanga & Zamrie Imiyabir

Objectives:

1. To determine the wood anatomical features (macroscopic and microscopic) of medicinal plants and other tree species in Sabah.
2. To obtain the photomicrographs of wood anatomical features of medicinal plants.

Study 1. Wood anatomical features (macroscopic & microscopic) of medicinal plants in Sabah (focusing only on woody species).

Study 2. Wood anatomical features (macroscopic & microscopic) of lesser-known species.

Output:

- Technical reports, publications & posters. Collection of microscopic slides and photomicrographs of the medicinal plants and other tree species.

Duration: 2026 - 2030

Remarks:

- Supports Thrust 3 (objective 1) of Sabah Forest Policy 2018.
- Supports Sabah Forestry Department Strategies No. 17.

SUB-PROGRAMME 4.2 – R&D OF NON-TIMBER FOREST PRODUCTS

Project 4.2.1: Research on the utilisation & economical value of selected tree resin and tree latex of Sabah

Investigators: Jarry K. Lajanga, Zamrie Bin Imiyabir & Dr Noraidah Haini

Objectives:

1. To determine the chemical properties of selected tree resin and tree latex.
2. To determine the utilisation of tree resin and tree latex by the local communities.
3. To determine the potential value of selected tree resin and tree latex for medicinal purposes.

Study 1. Survey of the economic value of tree resin & tree latex in the market and *tamu* of Sabah.

Study 2. Determine the current utilisation and other potentials of tree resin & tree latex in Sabah.

Output:

- Database Sabah tree resin & tree latex.
- Technical reports, publications/presentations.

Duration: 2026 - 2030

Remarks:

- Supports Thrust 4 (Objective 4) of Sabah Forest Policy 2018.
- Supports Sabah Forestry Department Strategies No 17.

Project 4.2.2: Nutritional Composition and Phytochemical Characteristics of Wild Fruit Species in Sabah

Investigators: Noraidah Haini, Suzana Sabran, Jarry K. Lajanga & Zamrie Imiyabir

Collaborators

- Dr Norazlina Mohammad Ridhwan (Universiti Malaysia Sabah)

Objectives:

- To evaluate the nutritional composition and phytochemical characteristics of selected wild fruit species found in Sabah.

Study 1. Comprehensive data on the nutritional composition of selected wild fruit species in Sabah.

Study 2. Identification and quantification of major phytochemical compounds present in the fruits.

Output:

- Peer-reviewed publications on Nutritional Composition and Phytochemical Characteristics of Wild Fruit Species in Sabah.

Duration: 2025–2030

Remarks: Supports Thrust 3 (Objective 3) of Sabah Forest Policy 2018:

- Forest Biodiversity Conservation.
- Non-Timber Forest Products (NTFPs) Development.
- Community Livelihood and Socio-economic Benefits.

Project 4.2.3: Nutritional and Phytochemical Properties of Medicinal Plants from Sabah Mangroves

Investigators: Noraidah Haini, Marrynah Matami, Jarry K. Lajanga & Zamrie Imiyabir

Collaborators

- Dr Norazlina Mohammad Ridhwan (Universiti Malaysia Sabah)

Objectives:

- To evaluate the nutritional composition and phytochemical characteristics of selected medicinal plants species found in Sabah Mangroves.

Study 1. Comprehensive data on the nutritional composition of selected medicinal plants in Sabah Mangroves.

Study 2. Identification and quantification of major phytochemical compounds present in the medicinal plants.

Output:

- Peer-reviewed publications on Nutritional Composition and Phytochemical Characteristics of Medicinal Plants from Sabah Mangroves.

Duration: 2025–2030

Remarks: Supports Thrust 3 (Objective 3) of Sabah Forest Policy 2018:

- Mangrove and Coastal Forest Conservation.
- Ecosystem Services and Climate Resilience.
- Sustainable Use of Forest Resources.

Project 4.2.4: Bioprospecting of Novel Exosomes from Tuhau (*Etlingera coccinea*) for the Treatment of Neurodegenerative Diseases

Investigators: Rolando Robert & Nurul Syahbillah Amir Mahmud

Collaborators

1. Alessandra Markos (Sabah Biodiversity Centre)
2. Dr Lem Fui Fui (Baden Research & Testing Lab)

Objectives:

1. To isolate and characterise the biochemical and biophysical attributes of exosomes from fresh tuhau extracts.
2. To quantify the bioactivity of tuhau-derived exosomes with respect to antioxidant capacity and selected in vitro neuroprotective assays.
3. To elucidate the biomolecular composition and functional groups within tuhau-derived exosomes that underpin their observed bioactivity.

Study 1. Optimisation and standardisation of exosome isolation and characterisation protocols from tuhau tissues.

Study 2. Biochemical screening and metabolic profiling of tuhau-derived exosomes.

Study 3. In vitro screening of antioxidant and neuroprotective activities of isolated exosomes.

Output:

- Peer-reviewed publications on plant-derived exosomes and their bioactivities.
- Baseline reference datasets for exosomes derived from *Etlingera coccinea*.
- Intellectual property disclosures or patent filings on novel exosome compositions or applications.

Duration: 2026–2030

Remarks:

- Supports Thrust 3 (Objectives 1 & 2) and Thrust 4 (Objective 4) of Sabah Forest Policy 2018.
- Supports Thrusts 1–5 of the Sabah Biotechnology Action Blueprint (2024–2034).
- This project builds up on the bioprospecting of wild ginger (tuhau) project in RMKe-12 (2021–2025).

Project 4.2.5: Bioprospecting of Native Soil Microbes from Forest Reserves in Sabah with Biotechnological Potential

Investigators: Rolando Robert & Dzulyana Idhamsah

Objectives:

1. To isolate and characterise native soil microorganisms from diverse forest and land-use systems in Sabah.
2. To screen native soil microbes for biotechnological traits of relevance to forestry and other industries.

Study 1. Isolation and taxonomic, functional, and genomic characterisation of native soil bacteria and fungi.

Study 2. Functional screening of isolates for selected biotechnological properties (e.g. nutrient mobilisation, enzyme production, stress tolerance).

Output:

- Peer-reviewed publications on native soil microbial diversity and biotechnological potential.
- A curated culture collection and reference database of native soil microbes from Sabah.

- Intellectual property disclosures or patent filings on novel microbial strains, functions, or applications.

Duration: 2026–2030

Remarks:

- Supports Thrust 3 (Objectives 1 & 2) and Thrust 4 (Objective 4) of Sabah Forest Policy 2018.
- Supports Thrusts 1–5 of the Sabah Biotechnology Action Blueprint (2024–2034).
- This project builds on research on the bioprospecting of plant growth-promoting bacteria conducted in 2021–2025.

SUB-PROGRAMME 4.3 – METHOD DEVELOPMENT

Project 4.3.1: Assessing Formaldehyde Levels in Sabah Plywood: A Desiccator Method Study

Investigators: Noraidah Haini, Jarry K. Lajanga & Zamrie Imiyabir

Collaborator

- Sabah Timber Industries Association (STIA)

Duration: 2025–2030

Objectives:

- To evaluate formaldehyde levels in plywood produced by selected suppliers in Sabah using the desiccator method.

Study 1. Determination of formaldehyde concentration (mg/L) in plywood samples collected from selected suppliers in Sabah.

Study 2. Comparative assessment of the variation in formaldehyde levels among different plywood suppliers.

Study 3. Classification of the plywood samples according to formaldehyde emission performance based on established reference standards (e.g. JAS).

Study 4. Assessment of compliance of the tested plywood samples with formaldehyde emission limits.

Output:

- Peer-reviewed publications on formaldehyde levels in Sabah Plywood.

Remarks: Supports Thrust 3 (Objective 3) of Sabah Forest Policy 2018:

- Forest Products Industry Development.
- Environmental Protection and Sustainability.
- Compliance with Standards and Market Access.

Project 4.3.2: Development and Standardisation of Analytical Tools for Sustainable Forest Management in Sabah

Investigators: Rolando Robert, Tom Khoo Meng Chorng, Nurul Syahbillah bte. Amir Mahmud & Dzulyana Idhamsah

Objectives:

1. To develop, optimise, and standardise analytical methods for ecological materials (soil and biomass) to support sustainable forest management
2. To develop DNA fingerprinting and chemotaxonomy techniques for native timber species and medicinal plants in Sabah.

Study 1. Development, optimisation, and standardisation of analytical workflows for soil and biomass analyses from forests in Sabah.

Study 2. Development and validation of DNA fingerprinting and chemotaxonomy methods for selected native timber species and medicinal plants.

Output:

- Standard operating procedures (SOPs) and validated analytical protocols for forest ecology and management applications.
- Peer-reviewed publications and technical manuals on analytical method development.
- Reference DNA and chemotaxonomic libraries for selected native timber species and medicinal plants in Sabah.

Duration: 2026–2030

Remarks:

- Supports Thrust 3 (Objectives 1 & 2) of Sabah Forest Policy 2018
- Builds up on the technical capacity and capabilities for molecular-based research of the Chemistry Section.

Analytical & Technical Services

Activity 1: Reference Wood Collection (Xylarium)

Investigators: Wood Science Section

Description: The curated wood collection in the FRC Xylarium was established in the early 1940s and is continuously expanded since. The curated samples correspond to the SAN Herbarium accessions that together serve as one of the primary references for taxonomic identification of trees in Sabah. Maintaining the collection requires substantial effort in time and human resource.

Output: Physical collection of primary vouchers consisting wood samples and microslides as well as photomicrographs serving as secondary vouchers

Timeline: Continuous / Ongoing

Activity 2: Wood identification and preparation of authenticated wood samples

Investigators: Wood Science Section

Description: This service is provided for SFD District Forestry Officers, timber industries, and the public. A part of the service includes sales of authenticated wood samples prepared according to the standards stipulated by the International Association of Wood Anatomists (IAWA).

Output: Technical reports and provision of authenticated wood samples

Timeline: Continuous / Ongoing

Activity 3: Analysis of ecological samples

Investigators: Chemistry Section

Description: The service comprises analysis of chemical and physical properties of soil, plant, and water samples. The samples analysed are from researchers from within the Sabah Forestry Department and from those collaborating with the department.

Output: Data and technical reports from laboratory analyses

Timeline: Continuous / Ongoing

---

5. FOREST SOCIO-ECONOMICS

Objectives:

- Promote sustainable socio-economic benefits from forests.
- Foster nature tourism and urban forestry initiatives.

Key Subjects & Topics:

- Socio-economic valuation of ecosystem services.
- Nature tourism, forest recreation, urban forestry.
- Capacity building & partnership strategic initiatives.
- Impact assessments on social forestry.

SUB-PROGRAMME 5.1 – FOREST SOCIO-ECONOMICS

Project 5.1.1: Social Information & Governance Systems

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Sustainable forest management in Sabah requires comprehensive and reliable socio-economic information alongside ecological data. Forest reserves are closely linked to surrounding communities, government agencies, private sector actors, and civil society organisations, whose activities, interests, and livelihoods interact with forest landscapes. Currently, information on forest-adjacent communities and relevant stakeholders is scattered across various units, reports, and project records. The lack of an integrated and centralised database hampers systematic planning, coordinated engagement, and effective monitoring of social aspects in forest management initiatives. Therefore, a structured and consolidated database is essential to support informed decision-making and enhance the management of forest resources in Sabah.

Rationale: Addresses the current gap in consolidated community and stakeholder data; supports evidence-based planning, engagement, and certification requirements.

Objectives:

- To establish a database integrating community and stakeholder information related to forest reserves

Study 1: Community and Stakeholder Database for Forest Management in Sabah

Output:

- Sabah Forest-Adjacent Community Database & Atlas
- Forest Stakeholder Mapping & Engagement Database

Remarks: This project is in line with Sabah Forest Policy Thrust 1 (Objective 2), Thrust 3 (Objective 1 & 2), Thrust 5 (Objective 1) & 20th Malaysian Forestry Conference (MFC) Resolution under Sub-Theme 6: Community Involvement & Stakeholders & Sub-Theme 1: Policy & Governance Framework.

Timeline: 2026 – 2030

Project 5.1.2: Participatory Planning & Social Safeguards (demand-driven social assessment services)

Study 1: Social Impact Assessment (SIA)

Investigator: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Forest management activities within FMUs interact directly with surrounding communities and stakeholders, generating both socio-economic benefits and potential risks. Without systematic assessment, these impacts may not be properly understood or addressed. This Social Impact Assessment (SIA) is necessary to develop a socio- economic profile of the affected area and to identify impacts, risks, and opportunities arising from forestry activities. The findings will support evidence- based decision-making, strengthen stakeholder engagement, reduce potential conflicts, and ensure that forest management is implemented in a socially responsible and sustainable manner.

Objectives:

1. To develop a socio-economic profile characterising the activity/ area
2. To identify and analyse the socio-economic impact, risk and opportunities of the activity/ area on the surrounding community

3. To collect representative views of the surrounding community and stakeholders involved in the activity/ area

Outputs:

- Data procured will be disseminated in scientific publications, reports & presentations in conferences.
- Social Impact Assessment (SIA) report
- Socio-economic profile and impact analysis report
- Recommendations for FMUs and forestry stakeholders
- Scientific publications, reports, and conference presentations

Note: Based on requests

Remarks: This project is in line with Sabah Forest Policy Thrust 5 (Social Well-Being) and Thrust 1 (Objective 2), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 6: Social Forestry and Community Involvement and Sub-Theme 1: Policy & Governance Framework.

Timeline: 2026-2030

Study 2: Social Profiling and Stakeholder Engagement in the Preparation of Conservation Area Management Plan (CAMP)/ Forest Management Plan (FMP)

Investigator: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Effective preparation of CAMP and FMP requires understanding the socio-economic conditions and livelihood dependencies of communities living within and adjacent to forest reserves. Without proper social assessment and engagement, management plans may face implementation challenges and limited community support. This study will provide structured social profiling and assess community capacity and willingness to support conservation-oriented management. The findings will strengthen participatory planning, reduce potential conflicts, and enhance the effectiveness and sustainability of forest management implementation.

Objectives:

1. To study the socio-economic and livelihoods status of communities living within and adjacent to the forest reserve

2. To evaluate the local community capacity and willingness to support management regimes aimed at increased conservation of the target forest

Outputs:

- Data procured will be disseminated in scientific publications, reports & presentations at conferences.

Note: Based on requests

Remarks: This project is in line with Sabah Forest Policy Thrust 1 (Objective 2) and Thrust 5 (Objective 1), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 1: Policy & Governance Framework and Sub-Theme 6: Social Forestry and Community Involvement.

Timeline: 2026-2030

Study 3: Socio-Economic Evaluation of Forest Adjacent Communities (Expedition)

Investigator: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Communities living within and adjacent to forest reserves play a critical role in the success of conservation and sustainable forest management initiatives. Their livelihoods, resource dependency, perceptions, and aspirations directly influence how forests are used, protected, and managed. Without understanding local livelihood systems, dependency on forest resources, and community willingness to support conservation measures, management interventions may face resistance or unintended social impacts.

Objectives:

1. To study the socio-economic and livelihoods status of communities living within and adjacent to the forest reserve
2. To evaluate the local community capacity and willingness to support management regimes aimed at increased conservation of the target forest

Output: Research papers and study reports

Note: Based on requests (usually conducted during HoB scientific expeditions)

Timeline: 2026 - 2030

Remarks: This project is in line with Sabah Forest Policy Thrust 5 (Objective 1) and Thrust 1 (Objective 2), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 6: Social Forestry and Community Involvement and Sub-Theme 1: Policy & Governance Framework.

Project 5.1.3: Forest-Based Livelihoods & Enterprise Development

Study 1: Community-Based Enterprise (CBE) Research and Development

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Community-Based Enterprises (CBEs) provide an important pathway to improve livelihoods of forest-adjacent communities while supporting sustainable forest management. However, many community enterprises face challenges such as limited capacity, weak market access, and lack of structured guidance.

This study will document successful CBE models in Sabah and develop a practical training framework to strengthen enterprise development. The findings will support community economic empowerment, enhance local participation in forest-based industries, and contribute to socially inclusive and sustainable forest management.

Objectives:

1. To document best practices and develop case studies of successful CBEs in Sabah;
2. To design training framework for enterprise development.

Remarks: This project is in line with Sabah Forest Policy Thrust 5 (Social Well-Being) and Thrust 4 (Economic Well-Being), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 6 on Social Forestry and Community Involvement in improving local community livelihoods.

Timeline: 2026 - 2030

Study 2: The viability of planting rubber as a commercial crop in forest reserves in Sabah

Investigator: Elne Betrece Johnlee, Jarry Lajanga, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: The introduction of rubber planting within Class II Forest Reserves presents both economic opportunities and management considerations. While rubber has potential to generate income for SFMLA holders and smallholders, its long-term viability within forest reserves must be carefully evaluated in terms of socio-economic benefits, livelihood dependency, and compatibility with sustainable forest management objectives. There is currently limited empirical evidence on the socio-economic performance of planted rubber within forest reserve settings, particularly regarding its contribution to smallholder income, employment generation, and local economic stability. Without proper assessment, decisions on plantation expansion or continuation may not fully account for community impacts and economic sustainability.

Objectives:

1. To determine the socio-economic importance of rubber as a commercial agricultural crop in the Class II Forest Reserve; and
2. To determine the importance of rubber cultivation as a means of livelihood for smallholders.

Outputs:

- Research papers and reports on socio-economic evaluation of planted rubber by SFMLA holders and smallholders

Note: Jarry Lajanga's previous suggested study for his Master's application

Remarks: This project is in line with Sabah Forest Policy Thrust 4 (Economic Well-Being) and Thrust 5 (Social Well-Being), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 5: Plantations in Forests & Beyond and Sub-Theme 6: Social Forestry and Community Involvement.

Timeline: 2026 - 2030

Project 5.1.4: Knowledge, Ecosystem Services & Cultural Integration

Study 1: Traditional Knowledge & Forest Wisdom Study

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Addresses the loss of traditional knowledge and supports its integration into forest planning, cultural conservation, and community-based governance.

Objectives:

1. To document and understand traditional knowledge related to forest use, species, and cultural practices.
2. To identify sustainable community practices and customary rules that support forest management.

Outputs:

- Traditional Knowledge Compilation for Selected Forest Reserves
- Ethnobotanical Profiles of medicinal and useful plants, including:
  i. local names
  ii. uses (medicinal, food, ritual, cultural)
  iii. harvesting practices
  iv. significance to community identity
- Community History Documentation
  i. Interviews with elders, traditional healers, cultural practitioners, and forest guardians.
  ii. Customary Practices & Sustainable Use (taboos, no-take zones, seasonal indicators, community rules) including traditional planting systems (agroforestry).

Remarks: This project is in line with Sabah Forest Policy Thrust 5 (Social Well-Being) and supports the 20th Malaysian Forestry Conference (MFC) resolutions under Sub-Theme 6: Community Involvement & Stakeholders and Sub-Theme 4: Biodiversity Conservation.

Timeline: 2026 – 2030

Study 2: Socio-economic evaluation and contribution of mangrove forest towards the surrounding local communities in Sabah

Investigator: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Mangrove forests provide important ecosystem goods and services that directly support the livelihoods of surrounding coastal communities, including fisheries resources, fuelwood, construction materials, and other non-timber products. They

also play a vital role in coastal protection, carbon storage, and biodiversity conservation. However, there is limited documented information on the quantity of mangrove goods extracted, their economic value, and their contribution to household income and local economies. Without such data, the socio-economic importance of mangrove ecosystems may be underestimated in planning and conservation decisions.

Objectives:

1. To study the socio-economic and livelihoods status of communities living near mangrove forest
2. To identify goods and services obtained from the mangrove forest and
3. To determine its value based on income derived by the local community

Output: Research papers and study reports

Remarks: This project is in line with Sabah Forest Policy Thrust 2 (Protection of Biodiversity and Environmental Services), Thrust 4 (Economic Well-Being) and Thrust 5 (Social Well-Being), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 4: Biodiversity Conservation and Sub-Theme 6: Social Forestry and Community Involvement.

Timeline: 2026 - 2030

Study 3: Linking Ecological Integrity and Social Value: A Multi-Site Study on Forest Ecosystem Services in Sabah (collaboration with FEM)

Investigator: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Forest ecosystem services provide critical ecological functions and socio-economic benefits, including water regulation, carbon storage, biodiversity conservation, and livelihood support for local communities. However, ecological assessments and social evaluations are often conducted separately, resulting in limited understanding of how ecological integrity directly influences social value and community well-being. There is a need for an integrated, multi-site assessment that links ecological condition with the social and economic benefits derived from forest ecosystems. By examining both ecological integrity and community dependence across different forest landscapes, this study will generate evidence to support balanced decision-making, strengthen ecosystem-based management, and enhance the integration of ecosystem services into forest planning and policy development.

Objectives:

1. To assess the ecological integrity and key ecosystem services of selected forest sites in Sabah.
2. To evaluate the social value and community dependence on forest ecosystem services across multiple sites.
3. To analyse the linkages between ecological condition and socio-economic benefits to support evidence-based forest management and policy planning.

Output:

- Research papers and study reports

Remarks: This project is in line with Sabah Forest Policy Thrust 2 (Protection of Biodiversity and Environmental Services), Thrust 3 and Thrust 5, and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 3: Climate Change Mitigation & Adaptation, Sub-Theme 4: Biodiversity Conservation and Sub-Theme 6: Social Forestry and Community Involvement.

Timeline: 2026 - 2030

SUB-PROGRAMME 5.2 – NATURE TOURISM

Project 5.2.1: Forest-Based Tourism Asset & Site Readiness Assessment in Sabah

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Forest reserves in Sabah possess high ecotourism potential, but systematic data on site readiness, trail conditions, attraction mapping, and management capacity remain limited. A structured assessment is required to guide sustainable tourism planning, improve visitor experience, and ensure tourism development aligns with forest conservation objectives.

Objective:

1. To assess the status, readiness, and development potential of forest-based tourism assets under SFD jurisdiction.
2. To survey, document and map priority forest trails and attractions in selected forest reserves.
3. To identify infrastructure gaps, management challenges, and site improvement needs.
4. To provide district-level recommendations for sustainable tourism development.

Output:

- District Forest Tourism Asset & Readiness Profiles
- Forest Tourism & Trail Mapping (GIS-based)
- Site Readiness & Gap Analysis Report
- Strategic Recommendations for Forest Recreation Development

Remarks: This project is in line with Sabah Forest Policy Thrust 4 (Economic Well-Being) and Thrust 1 (Objective 2), and supports the 20th Malaysian Forestry Conference (MFC) Sub-Theme 1: Policy & Governance Framework.

Timeline: 2026-2030

Project 5.2.2: Visitor Market & Economic Contribution Assessment of Forest-Based Tourism in Sabah

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Understanding visitor behaviour and economic contribution is critical for sustainable tourism development. Without reliable visitor data and spending analysis, the economic value of forest-based tourism may be underestimated in planning and conservation budgeting. This study will provide evidence to strengthen tourism positioning and justify conservation investments.

Objectives:

1. To assess visitor perceptions, motivations, spending patterns, and satisfaction levels in selected forest recreation sites.
2. To quantify the economic contribution of key tourism activities (e.g., birdwatching and niche nature tourism).

3. To analyse visitor trends and market segments to support strategic tourism planning.

Output:

- Visitor Perception & Satisfaction Reports
- Economic Contribution & Expenditure Analysis Report
- Market Trend & Demand Analysis
- Policy Recommendations for Visitor Management & Product Development

Remarks: This project is in line with Sabah Forest Policy Thrust 4 (Economic Well-Being) and Thrust 2 (Protection of Biodiversity and Environmental Services), and supports the 20th MFC Sub-Themes on Policy & Governance Framework and Biodiversity Conservation.

Timeline: 2026 – 2030

Project 5.2.3: Community Participation & Livelihood Impact Assessment of Forest-Based Ecotourism

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: While ecotourism is promoted as a livelihood strategy, evidence on its actual impact, benefit-sharing mechanisms, and governance roles remains limited. A structured assessment is necessary to ensure tourism development is inclusive, equitable, and supportive of community wellbeing and long-term forest stewardship.

Objectives:

1. To evaluate community participation, governance roles, and partnership models in forest-based ecotourism.
2. To assess the social and economic impacts of ecotourism on forest-adjacent communities.
3. To analyse the distribution of benefits and the contributions to livelihoods from ecotourism activities.

Output:

- Community Participation & Livelihood Impact Assessment Report
- Benefit-Sharing & Governance Analysis

- Recommendations for Inclusive Ecotourism Development

Timeline: 2026 - 2030

Remarks: This project is in line with Sabah Forest Policy Thrust 5 (Social Well-Being) and Thrust 4 (Economic Well-Being), and supports the 20th MFC Sub-Theme 6: Social Forestry and Community Involvement.

Project 5.2.4: Conservation Financing & Sustainability Model for Forest-Based Tourism in Sabah

Investigators: Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes, Nurul Shabariah Abu Bakar, Mohammad Aminuddin bin Mohd Shukur, Liesavell Liverius

Rationale: Although forest-based tourism generates revenue, its direct contribution to conservation financing and sustainable forest management is often unclear. Strengthening the linkage between tourism income and conservation investment is essential to ensure long-term ecological integrity and financial sustainability. This study will develop a structured financing model to enhance the role of tourism as a sustainable funding mechanism for forest conservation.

Objectives:

1. To evaluate the financial contribution of forest-based tourism to forest management and conservation activities.
2. To assess revenue flows, reinvestment mechanisms, and funding gaps within SFD-managed tourism sites.
3. To develop a sustainable conservation financing framework integrating tourism revenue, partnerships, and ecosystem service valuation.

Outputs:

- Forest Tourism Revenue & Conservation Financing Analysis
- Sustainable Tourism Financing Framework
- Policy Recommendations for Revenue Reinvestment & Governance Mechanisms

Remarks: This project is in line with Sabah Forest Policy Thrust 4 (Economic Well-Being) and Thrust 2 (Protection of Biodiversity and Environmental Services), and supports the 20th MFC Sub-Theme 3: Climate Change Mitigation & Adaptation and Sub-Theme 1: Policy & Governance Framework.

Timeline: 2026-2030

COLLABORATION WITH LOCAL* OR FOREIGN RESEARCHERS

(* non-departmental personnel)

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
1.	Andi Maryani A Mustapeng	Untangling *Aristolochia* Diversity in Sabah, Borneo by Geometric Morphometry	• Mr. Dominik Frank (Eberhard-Karls University Tubingen, Germany) • Dr Sven Landrein (Kadoorie Farm and Botanic Garden, Hong Kong)	2024-ongoing
2.	Andi Maryani A Mustapeng	Contributing to the Fern Flora of Borneo, with Special Reference to Grammitid & Vittaroid	• Associate Prof Dr Yi Shan Chao (National Taiwan Normal University) • Cheng Wei Chen (Biodiversity Research Center, Academia Sinica, Taiwan)	2015 – ongoing
3.	Andi Maryani A Mustapeng	Diversity and Taxonomy of Rainforest Herbaceous Plants in Sabah	• Prof. Dr Martin Dancak • Dr Michal Hrones • Alena Uvfrova (Palacky University, Olomouc)	2023 – ongoing
4.	Dzulyana Idhamsah	Importance of Nitrogen and Metals on Tropical Heath Forest and Ultramafic Forest Ecology	• Dr Francis Q. Brearley (Manchester Metropolitan University, UK) • Dr Giacomo Sellan (UMR-EcoFoG, French Guiana)	2024 – 2027
5.	Elne Betrece Johnlee	National Social Forestry Roadmap	• Dr Huda Farhana binti Mohammad Muslim (FRIM) • JPSM, JP Sarawak, NRES	2025 – ongoing
6.	Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes	Adaptive Landscape Management in Building Socio-Ecological Resilience in Crocker Range Biosphere Reserve, Sabah	• Dr Walter J. Lintangah, Dr Kamlisa Uni Kamlun, Prof. Madya Dr Andy Russell Mojiol & Ts. Dr Hardawaty Yahya (Universiti Malaysia Sabah),	2024 – ongoing

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
			• Ramlah Ag. Jalil, Billie Andrew Jivinson, Vilaretti Atin (Sabah Parks), • Anne Lasimbang, Gordon J. Thomas, Nasiri Sabiah (PACOS Trust)	
7.	Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes	Stakeholder Engagement and Participatory Planning for Sustainable Tourism in Ranau District	• Justine Jay Vaz, Naventhan a/l Ahrasan, Ram Kumar (The Habitat Foundation), • Dr Robert Ong	2025 – 2026
8.	Elne Betrece Johnlee, Jesselyn Kijin, Dessy Ijes	Project on Kit Informasi Penglibatan Masyarakat dalam Perhutanan Sosial (KIPMAPS)	• Elyrice Alim, Vanessa A. Jipiu, Cherlanne Patrick, Jasmine Raffidi & Fadlin Linsai (WWF) • Dr. Ts. Hardawaty Yahya, Dr. Walter J. Lintangah (UMS), • Prof. Madya Dr. Fiffy Hanisdah Saikim (IBTP, UMS)	2023 – ongoing
9.	Eyen Khoo	Drought tolerance in Lithocarpus: eco-physiology along environmental gradients.	• Barbara Neto-Bradley (University of Cambridge, UK)	2023 – 2026
10.	Eyen Khoo	Suan Lamba-The Agroforestry Model	Mr Lo. Hon Kong (Harimaju Plantation Sdn Bhd)	2022 – 2032
11.	Eyen Khoo	Harvesting Economics and Timber Utilization of *E. pellita*	• Ms Ng Shi Teng (Lebihasil FMU area) and • Mr. Tu Kui Foh (IWP Sdn. Bhd.)	2025 – 2027
12.	Eyen Khoo & Kuina Kimjus	Performance Evaluation of CPT Progenies for Selection of Superior Planting Materials	• Ms Ng Shi Teng (Lebihasil FMU area) and • Mr. Tu Kui Foh (IWP Sdn. Bhd.)	2025 – 2030
13.	Forest Plantation Programme	Mini Expo for Engagement with Plantation Owners	Sabah Timber Industry Association and Timber Association of Sabah (TAS)	2026
14.	Forest Plantation Programme and Forest Produce and Products Programme	Research and Development on Wood Quality and Durability of Sabah Industrial Timber Plantation Species	• Mr. Tu Kui Foh (IWP Sdn. Bhd.) • Mr Rahman Khan (Jawala Plantation Industries Sdn. Bhd.)	2023 – 2026

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
			• Dr Adlin Sabrina Muhammad Roseley (UPM)	
15.	Dr. Joan Pereira	Systematics of Bornean *Acranthera* (Rubiaceae)	• Hoo Pui Kiat (Universiti Malaysia Sarawak)	2025 – 2026
16.	Dr Joan Pereira Eyen Khoo	The ecology of scatter-hoarding dispersal for Fagaceae in tropical Southeast Asia and the impacts of anthropogenic pressures on seedling recruitment	• Tan Wei Harn (Universiti Brunei Darussalam)	2023 – 2026
17.	Dr Joan Pereira Alviana Damit Jonathan J. Lucas	Collaborative Research on Metal Accumulation in Ultramafic Flora in Sabah	• Dr Julenah Ag Nuddin (Botanickel Sabah Sdn. Bhd.) • Prof Guillaume Echevarria (Econick, France) • Dr Antony van der Ent (Wageningen University & Research, The Netherlands) • Paul Gangku (Botanickel Sdn. Bhd.) • Sukaibin Sumail (Sabah Parks/Botanickel Sdn. Bhd.) • Rimi Repin (Sabah Parks) • Matsain bin Buang (Sabah Parks • Farnidah Jasnie (TaniLab, UiTM)	2025 – 2030
18.	Julsun Sikui	Investigating The Allometric Growth And Hydraulic Mechanisms Of Shorea Faguetiana For Conservation Strategies Using LiDAR and Field Data	Peking University, Beijing China • Guo Qinghua • Ren Yu • Lai Yunlu • Cui Tao	2025 – 2026
19.	Kelvin Pang Kat Nyen Richard J. Majapun	LOI for Forest Seed Garden (FSG) Development focusing on Laran growth with the application of fertilizer mulching	Rashidah Maqbool and team (Sawit Kinabalu Group)	2026 – 2027

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
20.	Kuina Kimjus	Progeny trial of CPT Laran	Mr Maxi Self and team (Jawala Plantation Industries Sdn. Bhd.)	2024 – 2030
21.	Kuina Kimjus	Progeny trial of CPT Laran. (2 CPT Laran)	Mr. Paul Anak (Serijaya Industri Sdn. Bhd. (TSH))	2023 – 2030
22.	PG Mohd Sahlan Bin Salam	Usage of nest box in the tropical rainforests of Sabah, Borneo	• Tokyo University of Agriculture, Japan	2025 – 2026
23.	PG Mohd Sahlan Bin Salam	Monitoring wild cats and their prey in key forest reserves	• Panthera Malaysia	2024 – ongoing
24.	Razy Japir Dr Arthur Chung	Diversity and distribution of praying mantises (Insecta: Mantodea) in Kabili-Sepilok Forest Reserve, Sabah	• Cyril Ann Daniel • Dr Nazirah bte Mustaffa (Universiti Malaysia Sabah)	2025 – 2026
25.	Razy Japir Dr Arthur Chung	Contribution to the taxonomy and ecology of Orthoptera in Sabah	• Dr Tan Ming Kai (Institut de Systématique, Evolution et Biodiversité (ISYEB), Paris, France)	2019 – ongoing
26.	Razy Japir Dr Arthur Chung	Diversity and distribution of mantids, phasmids and cockroaches of Borneo	• Dr Philip Edward Bragg (Independent researcher)	2022 – 2026
27.	Razy Japir Dr Arthur Chung	Riparian protection versus pest and disease control in oil palm plantations	• Dr Chiew Li Yuen • Dr Eleanor Margaret Slade (Nanyang Technological University, Singapore)	2021 – 2026
28.	Razy Japir Dr Arthur Chung	The distribution of species along elevation gradients: the impact of traits, phylogeny and climate change	• Dr Chiew Li Yuen • Dr Eleanor Slade • Yim Wen Han Marx (Nanyang Technological University, Singapore)	2022 – 2026
29.	Richard Majapun	Growth and Performance Evaluation of *Terminalia copelandii* (Talisai Paya) Under Varying Spacing Treatments	• Mr Maxi Self and team (Jawala Plantation Industries Sdn. Bhd.)	April 2025 – 2028
30.	Richard Majapun	Field Validation of Seed Size Grading and MRT Propagation for Timber Production in *Terminalia copelandii*	• Mrs Rashidah Maqbool and team (Sawit Kinabalu Group, CBU)	November 2025 – 2030
31.	Rolando Robert	Ecology and distribution of invasive alien plant species in Kinabalu Park	• Vanielie T. Justine (Board of Trustees of Sabah Parks)	2024 – 2026

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
32.	Rolando Robert	TRAILS 2— Agroforestry Plantations for Biodiversity and Ecosystem Services	• Prof. Alain Rival (CIRAD, France) • Dr Muhammad Firdaus Bin Sulaiman (Universiti Putra Malaysia) • Dr Marc Ancrenaz (HUTAN)	2024 – 2028
33.	Rolando Robert	Testing Regeneration Outcomes, Plant-Hyphal Interactions, and Climate in Tropical Forests (TROPHIC)	• Dr Michael O'Brien • Maria Alejandra Romero Espinosa • Miguel Muñ0z Mazon • Dr. Alejandro Blanco Quintana (EEZA-CSIC, Spain)	2024 – 2028
34.	Rolando Robert	Characterising the Soil Microbiome in the Batu Apoi Lowland-Mixed Dipterocarp Forest and Badas Peat Swamp Forest in Brunei Darussalam	Universiti Brunei Darussalam, Brunei Darussalam • Assoc. Prof. Dr. Rahayu Sukmaria Sukri • Dr Salwana Jaafar	2025 – 2027
35.	Rolando Robert,	Investigating the Impacts of Intensifying Land-Use and Extreme Weather Events on Soil Biodiversity and Functioning	• Dr Michael O'Brien (Estación Experimental de Zonas Áridas, Spain)	2026 – 2030
36.	Sandy Tsen Tze Lui	Developing the method to monitor biodiversity and carbon at a Sabah scale with machine learning techniques	Kyoto University • RYOTA Aoyagi • KANEHIRO Kitayama • YUSUKE Onoda • CHIKA Mizukami • KOTARO Komatsu • SATORU Kojima • MONE Hirata • NOBUO Imai (Tokyo University of Agriculture) • TAIKI Mori (Forestry and Forest Product Research Institute) • MANA Tsuruta (University of Yamanashi) • RYUICHI Takeshige (National Institute for Environmental Studies) • YU Hirano (Sinshu University)	2023 – 2027
37.	Sandy Tsen Tze Lui	Thermal Safety Margins of Earth's Tropical Forest (THERMOS)	University of Leeds, UK • Emma Mae Docherty • Martin Acosta Oliveira	2025 – 2027

No.	Local collaborator(s) / collaborator via MoU	Project title	Researchers (Institution)	Year
			• Antony Mundaca Ramirez • Calil Torres Amaral	
38.	Sandy Tsen Tze Lui	Linking wood anatomical properties to drought tolerance in tropical trees across the edaphic gradient	Czech University of Life Sciences • Prague Palasiah Jotan Mendel University in Brno, Czech Republic • Martin Svatek Cardiff University • Paulo Bittencourt University of Exeter • Ajaree Thonglim	2025 – 2028
39.	Sandy Tsen Tze Lui	Seeding Success: Understanding the reproductive and early-stage demographic barriers to forest recovery after logging	UK Centre for Ecology & Hydrology • Dr Elizabeth Raine • Dr Lindsay Flynn Banin • Jeffrey Pascual Mancera	2024 – 2026
40.	Suzana Sabran	The evolution and reproductive ecology of figs (*Ficus*, Moraceae)	• Elliot Gardner (Leader) • Yun Ye Ho • Kasey Pham • Mose Langway • (Case Western Reserve University, USA) • Prof. Yanqiong Peng (Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences)	2024 – 2026
41.	Veronica S. Guanih	Potential of *Anthoshorea roxburghii*@ Meranti Temak Nipis as a forest plantation species.	• Dr Rosdi Koter (FRIM)	2026 – 2030
42.	Viviannye Paul	Pest and Disease Monitoring in Forest Plantation Areas (Sawit Kinabalu Group)	• Mrs Rashidah Maqbool and team (Sawit Kinabalu Group, CBU)	2026 – 2030

FRC SCIENTIFIC REFERENCE COLLECTIONS

Scientific reference collections (e.g., herbarium, insect collection, xylarium) are essential support facilities for forestry-related research. The collections themselves promote *ex-situ* conservation of biodiversity. The herbarium, which currently houses about 11,000 plant species from more than 282,209 specimens, is among the largest collections in this region. The insect collection, with over 180,000 mounted specimens representing more than 18,000 species, is the largest in Sabah. The xylarium holds more than 5,600 wood samples. Additionally, FRC has expanded its taxonomic coverage over the past five years to include vertebrate reference collections, such as fish (approximately 96 species from more than 100 specimens) and frogs (over 66 species from 70 specimens). These facilities make significant contributions to ongoing research not only at the Forest Research Centre but also globally. Many visiting scientists and university students utilise these collections for their research purposes.

FACILITY 1: PLANT COLLECTION (HERBARIUM)

Section-in-charge: Systematic Botany

Objectives: To curate plant specimens collected from the forests of Sabah

Status: Ongoing

Results: The herbarium is the centre of botanical reference for various researchers and students. As of 2025, the herbarium houses about 11,000 plant species from more than 282,209 specimens.

FACILITY 2: INSECT COLLECTION (FRC INSECT MUSEUM)

Section-in-charge: Entomology

Objectives: To curate insect specimens collected from the forests in Sabah

Status: Ongoing

Results: The museum is the centre of reference for various entomologists and students, either from local or foreign institutions. The insect museum currently houses more than 180,000 mounted specimens with more than 18,000 identified species. It is divided into two parts, namely the insect exhibition at the main FRC Complex and the main insect collection in a compactor system at the former Institut Perhutanan Sabah (IPS) building.

FACILITY 3: WOOD COLLECTION (XYLARIUM)

Section-in-charge: Wood Science

Objectives: To store wood samples from various timber species in Sabah. The collection (established 1940s) serves as a reference for researchers and students.

Status: Ongoing

Results: A reference collection of wood samples and microslides, as well as photomicrographs. At this stage, the collection houses 1,075 species from 5,638 samples.

FACILITY 4: FISH & FROG COLLECTION

Persons-in-charge: Pg. Sahlan Pg. Salam

Objectives: To store fish and frog specimens from various forest reserves in Sabah. The collection will serve as a reference for researchers and students.

Status: Ongoing

Results: A reference collection of fishes and frogs. At this stage, the collection houses 96 fish species and 66 frog species.

Rainforest Discovery Centre (RDC)

1. Objectives and scopes

1.1. To develop and deliver Environmental Education Programmes for students, youth, teachers and communities.

1.1.1. Scope:

i. Designing structured environmental education (EE) modules and learning materials
ii. Conducting guided educational tours and interpretive sessions
iii. Organising seminars, workshops and conferences
iv. Facilitating school, IPT and agency learning visits
v. Developing youth-based programmes (e.g., Youth Camp, Sepilok Jr Rangers)
vi. Producing educational content (print, digital, exhibition-based)

1.2. To promote conservation awareness

1.2.1. Scope:

i. Promoting understanding of sustainable forest management (SFM) (e.g. EERace, talks)
ii. Showcasing forest biodiversity and conservation initiatives
iii. Supporting state, national and international environmental campaigns
iv. Developing interpretive materials that communicate forestry policies and conservation practices
v. Engaging media and public communication platforms for awareness

1.3. To provide and manage Interpretive Facilities & Experiential Learning

1.3.1. Scope:

i. Managing and enhancing interpretive infrastructure (trails, canopy walkway, Plant Discovery Garden, galleries)
ii. Curating and updating exhibitions and interpretive panels
iii. Ensuring safe, engaging and educational visitor experiences
iv. Improving facility quality to meet educational and eco-tourism standards

1.4. To engage with Communities through Outreach activities

1.4.1. Scope:

i. Conducting outreach programmes beyond RDC (HoB Roadshows, EE outreach)

ii. Engaging local communities, schools and NGOs
iii. Building strategic partnerships with institutions and agencies
iv. Supporting inclusive and accessible environmental education initiatives

2. Details of programmes, projects and studies

Programmes	Output
1. Students' Environmental Education (EE)	60-80 school groups are targeted each year
2. EERace: An Environmental Education Course for teachers and educators	1 six-day course with 42 participants is planned annually
3. Sepilok Jr. Rangers	At least 20 educational activities are planned and conducted for the Jr. Rangers throughout the year, including an annual nature camp
4. EE Outreach Programme	Activities are conducted based on requests from schools outside RDC. In 2025, we conducted 14 outreach activities.
5. HoB Roadshow	Two Roadshows are planned annually in line with SFD's target area for HoB
6. Internship Programme	RDC accepts interns throughout the year and provides training in environmental education, nature interpretation & guiding, visitor management, facility management, facilitating EE activities for students, etc
7. Environmental events/seminar/ conferences	1. Borneo Bird Festival: Annually 2. Malaysian Environmental Education Conference (MyEEConference): Every 2 years (2027 & 2029) 3. Hosting the Sepilok Jazz: Annually 4. International Day of Forests: Annually Tamu RDC: Annually

3. Collaborations:

Programmes	Collaborators

EERace	Sabah Education Department, Sandakan Municipal Council (MPS), Sabah Wildlife Department, Sabah Parks, Bornean Sun Bear Conservation Centre (BSBCC), Hutan, IOI Group, Seratu Aatai, KOPEL, Cahaya Society, Orangjuga, Sawit Kinabalu, Wild Asia, HRD Corp, Bestaria Eco Tourism (KOMURA), etc
HoB Roadshow	Sabah Wildlife Department, Orangutan UK Appeal, BSBCC, Seratu Aatai and Tropical Rainforest Conservation and Research TRCRC
Youth Camp	KBS, Kementerian Belia dan Sukan, MPS, BSBCC dan Sabah Wildlife Department, etc
Borneo Bird Festival	Borneo Bird Club and Sabah Tourism Board
Malaysian EE Conference	Environment Protection Department, Department of Environment, Sabah Wildlife Department, BSBCC and WWF Malaysia.
Sepilok Jazz	Friends of Sea Turtle Education and Research (FOSTER)

APPENDICES

SABAH FOREST POLICY 2018
(THRUSTS & OBJECTIVES)

1. **Objectives for Thrust 1 (Sustainability of Forest Resources)**:
   a. To maintain at least 50% of Sabah's land mass under forest reserves and tree cover for long term multiple forest use;
   b. To ensure the systematic and transparent administration and management of forest reserves;
   c. To strengthen forest enforcement and laws; and
   d. To create public awareness on the importance of sustainable forest resource management.

2. **Objectives for Thrust 2 (Protection of Biodiversity and Environmental Services):**
   a. To allocate adequate areas under Totally Protected Areas (TPAs) for environmental services;
   b. To ensure all forest types, ecosystems and their biodiversity are adequately represented and protected;
   c. To ensure all degraded forests are restored to enhance their ecological functions; and
   d. To minimize the impact of forest management activities on environmental services.

3. **Objectives for Thrust 3 (Research, Development, Commercialisation and Innovation)**:
   a. To strengthen research, development, commercialisation and innovation (RDC&I) programmes in support of forest management; and
   b. To explore and apply the use of new technologies and innovation.

4. **Objectives for Thrust 4 (Economic Well-being)**:
   a. To ensure the sustainability and viability of the wood-based industry;
   b. To optimise forest rent captured from natural forests and forest plantations;
   c. To explore the potential of Payment for Ecosystems Services (PES) for generating revenues;
   d. To explore alternative revenue sources from Non-Timber Forest Produce (NTFP);
   e. To promote forest recreation and nature-based tourism; and
   f. To advance Sabah towards receiving carbon and climate change related payments.

5. **Objectives for Thrust 5 (Social Well-being)**:
   a. To strengthen the participation of local communities in the implementation of forest management activities.

6. **Objectives for Thrust 6 (Human Resources Development)**:
   a. To strengthen skills and competency of human resources at all levels through continuous capacity building; and
   b. To strengthen organisational structure to support efficiency and innovation in all core administration and management activities.

7. **Objectives for Thrust 7 (State, National and International Cooperation and Obligation)**:
   a. To observe compliance to all state laws, federal laws and binding international convention; and
   b. To encourage collaboration at the state, national and international level for long term mutual benefits.

19th MALAYSIAN FORESTRY CONFERENCE RESOLUTIONS
(12th – 15th June 2022)

RESOLUTION 1 **Recognising the importance of policy reforms, sustainable practices, certification and innovative technologies, the conference resolved that:**	
1.1	Policy reforms, sustainable harvesting, extensive restoration and innovative revenue-generating to balance environmental protection, economic viability and social responsibility.
1.2	Promote protection and conservation of biodiversity outside permanent forest estate to prevent further biodiversity loss and deterioration of ecosystem services
1.3	Emphasize sustainability, legality, and social responsibility in forestry to mitigate deforestation risks, promote ethical corporate practice, and contribute to global efforts against climate change and biodiversity loss
1.4	Innovative technologies to improve biodiversity protection
1.5	Enhance field officers competency in the usage of innovative enforcement skill to protect natural resources
RESOLUTION 2 **Recognizing the importance of partnerships, innovative approaches and improving forest landscape connectivity through SFM implementation, the conference resolved that:**	
2.1	Protecting natural forests, restoring habitats, and promoting sustainable production through collaboration between governments, communities and private enterprises
2.2	Implementation of innovative approach in improving sustainable forest management and ecosystem preservation through enhanced data acquisition and decision making
2.3	Improve partnership and cooperation efforts with international and national organisations to enhance forest management, conserve biodiversity, and combat climate change
2.4	Enhance connectivity and network of forest complexes to mitigate biodiversity loss and improve socio-economic development efforts
RESOLUTION 3 **Recognizing the importance forest ecosystem services for food, water, energy and climate change, the conference resolved that:**	
3.1	Forest carbon initiatives and Payment for Ecosystem Services (PES) mechanism for new wealth be regulated and/or intensified
RESOLUTION 4 **Recognizing the importance of conservation, restoration and protection of forest biodiversity, the conference resolved that:**	
4.1	Long term financing for the establishment and maintenance of ecological corridors be made available
4.2	Local communities and other stakeholders' participation in restoration activities be enhanced
4.3	Potential high-risk areas prone to natural disaster within PRF/PF/FR be identified and mapped out.
4.4	Biodiversity conservation program to be intensified
RESOLUTION 5 **Recognizing the importance of forest economic and commodity, forest plantation, wood-based industry and non-timber forest product, the conference resolved that:**	
5.1	Transformation of forest plantation development be explored and implemented
5.2	Smallholder participation in tree farming to support timber production be encouraged
5.3	Monitoring mechanism in forest plantation be enhanced to achieve planting target
5.4	Issues related to forest plantation certification be addressed
RESOLUTION 6 **Recognizing the importance of forest livelihood, social forestry, ecotourism and CEPA, the conference resolved that:**	
6.1	Sufficient and sustainable financial support be made available for social forestry program.
6.2	The Model of "Malim Gunung Perhutanan" be explored and introduced as a new approach in nature-based recreation activity in PRF/PF/FR
6.3	Assessment of socio-economic contribution from forest products and services be determined and periodically monitored
6.4	Individual, public, private sector and NGOs participation in greening program be intensified
6.5	Appropriate agroforestry model with the application of the latest technology be established
6.6	Local community-based ecotourism be encouraged

20th MALAYSIAN FORESTRY CONFERENCE RESOLUTIONS
KOTA KINABALU (29th – 30th October 2024)

RESOLUTION 1 **Recognising the importance of policy direction and good governance framework in sustainable forest management, the Conference resolved that:**	
1.1	Environmental and social sustainability, integrity, legality and economic viability be strengthened
1.2	Conservation initiatives outside permanent reserved forests and forest estates be further strengthened
1.3	Innovative approaches to improve forest resource management, biodiversity protection, forest recreation and enforcement be enhanced
1.4	A regional working group to address forestry threats and issues be established, with emphasis on negotiation skills, capital resources and capacity building
RESOLUTION 2 **Recognising the significance of international cooperation and partnership, the Conference resolved that:**	
2.1	Partnerships and cooperation efforts with international and national organisations, among governments, communities and private enterprises in sustainable forest management be strengthened
2.2	Technology transfer to improve sustainable forest management and ecosystem preservation be intensified
2.3	Ecological connectivity and network establishment of forest complexes to mitigate biodiversity loss be enhanced
RESOLUTION 3 **Recognising the importance of climate change mitigation and adaptation, the Conference resolved that:**	
3.1	Nature-Based Solutions (NBS) as strategies for supporting biodiversity conservation, protection of ecosystem services and addressing climate change be enhanced
3.2	Forest carbon initiatives to mitigate and adapt climate change, and to promote sustainable forest management be intensified
3.2	Proper planning and zoning for water and soil protection in forest catchment areas be enhanced
RESOLUTION 4 **Recognising the significance of biodiversity conservation, the Conference resolved that:**	
4.1	Collaborations and innovative technologies in research and monitoring ecological integrity of critical biodiversity areas be enhanced
4.2	Restoration on degraded forests in ecosystem services and climate-change impacted areas be given priority
4.3	Local community empowerment to balance biodiversity conservation and economic development be encouraged with funding
RESOLUTION 5 **Recognising the need to balance economic, ecological and social benefits for tree plantations and beyond, the Conference resolved that:**	
5.1	Industrial tree plantation development, innovative management and sustainable timber production be enhanced
5.2	Technological integration, collaborations, skills, resources and knowledge transfer be enhanced
5.3	Research and Development (R&D) to ensure ongoing engagement and knowledge-sharing of industries and government agencies be strengthened
5.4	Tree planting by smallholders, mechanism, market access and outreach be explored
RESOLUTION 6 **Recognising the significance of social forestry initiatives with multisectoral stakeholders, the Conference resolved that:**	
6.1	Social dimension of forestry through participatory approaches to achieve sustainability in the conservation and management of natural resources be promoted with sustainable funding
6.2	The livelihood of local communities living adjacent to/and within the forest continues to be improved through social forestry initiatives
6.3	Capacity building for community-based nature recreation be enhanced