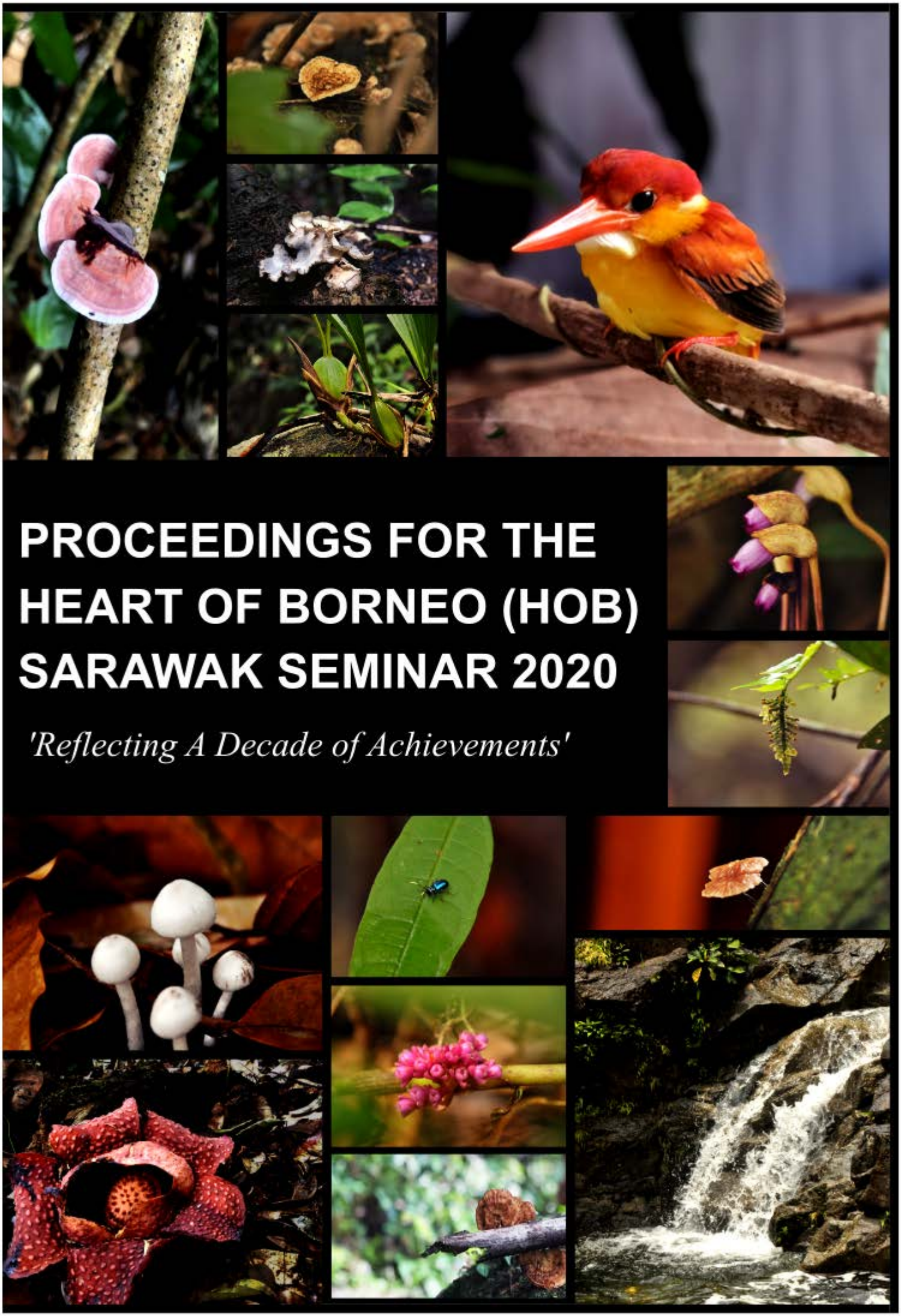

PROCEEDINGS FOR THE HEART OF BORNEO (HOB) SARAWAK SEMINAR 2020

'Reflecting A Decade of Achievements'

Proceedings for the Heart of Borneo (HoB) Sarawak Seminar 2020

‘Reflecting a Decade of Achievements’

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FOREWORD
BY
DIRECTOR OF FORESTS

The trilateral Heart of Borneo Initiative, signed in 2015, is a unique government-led programme supported by NGO following a joint Declaration by the governments of Brunei, Indonesia and Malaysia in 2007. This was a historic agreement by the three countries to share responsibility to sustainably manage and protect this critical and important ecosystem which covers about 22 million hectares (2.7 million hectares in Sarawak), focusing on the remaining intact band of forests in the centre of Borneo.

The HoB area is not only a treasure trove of unique biodiversity but a sizeable population of Sarawak still relies on this rainforests. The aim of the programme is to sustainably manage and conserve the HoB area covered by a mosaic of land uses such as protected areas, logging concessions, agriculture land (including oil palm plantations), and so forth for the benefit of the people who rely upon it by addressing the multifaceted issues confronting the management and conservation of the area. In line with this, the HoB Sarawak seminar 2020 was organised by Forest Department Sarawak held on 22nd September 2020 at Pullman Hotel, Kuching. The HoB Sarawak seminar highlighted various approaches for managing and conserving the HoB area as a response to some pressing global challenges today such as climate change, over exploitation, and habitat change.

Assessment of the natural resources is the cornerstone for conservation and their sustainable management. A paper on the assessment to identify areas with High Conservation Values (HCVs) within the FMU and to provide the necessary management and monitoring recommendations as the way forward in managing critical conservation areas outside the protected areas as well as another paper on the status of the salt licks and their importance to wildlife were also presented. The status of implementation of Sarawak Forest Resource Inventory Project implemented in Sarawak, the methodologies, project areas, field data collection work by Department staff, challenges, the underlying issues and the sharing of preliminary results or data obtained was also highlighted.

Another important and significant resources is biodiversity. A study on selected tree species within HoB were carried out to assess their status of conservation. This paper presented the findings of rare, threatened and endemic (RTE) tree species within HoB and its conservation status, which consequently determine the priority of species conservation effort for the state. The report on fauna is also highlighted and several selected newly described species of herpetofauna, new distribution records using molecular and morphological evidences as well as behavioral study of selected species found in various locations within the Heart of Borneo (HoB) area in Sarawak were presented.

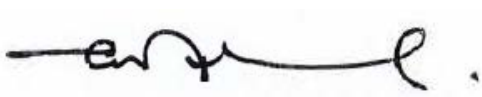
Social forestry and the participation of local communities in conservation and sustainable management of the HoB area is the hallmark of the project which is an equally crucial aspect addressed by this seminar. Safeguarding the integrity of this interaction is crucial to ensure the protection and sustainability of the area. To facilitate the interconnection and interaction between the stakeholders, FDS has established a multi-stakeholder consultation framework at various levels. These

levels are Forest Management Certification Liaison Committee (FMCLC) for inter-agencies, Forest Management Unit Representatives Committee (FMURC) for FMU and Community Representatives Committee (CRC) at community level. This paper will highlight the FMC progress and elaboration of multi-stakeholder framework. Community development and ecotourism is one of the key components in the Heart of Borneo (HoB) project which was initiated by Forest Department Sarawak to improve household income and increase community living standard while maintaining the sustainable use of forest resources. These projects will focus on developing communities within the Heart of Borneo (HoB) area in terms of economy, knowledge, skills, standard of living and quality of life. The conservation of orang-utan habitat while uplifting the livelihood of the local communities is the subject of the paper on the strategy to generate alternative income whilstconserving the pristine forests there under the Orang-utan Strategic Action Plan adopted by the state government and supported by multi-stakeholders including government agencies, corporate and private sectors, international and local NGOs, clubs, associations etc. In this paper, current progress, challenges and opportunities in implementing this project is discussed.

Another key area of focus in this seminar is the Forest Landscape Restoration (FLR) in the HoB area. Forest Department Sarawak has been leading the initiatives to restore and rehabilitate degraded forests with high value timber species with active collaborative engagement with local communities, NGOs and other stakeholders. A paper elaborates on the FLR programmes that have been implemented within HoB area especially rehabilitation and restoration programmes on the degraded forests as well as FLR strategy and action plan to be taken forwards whilst a community forestry project amongst the Kelabit community in Bario using the agrisilviculture system as well as an assessment of the growth performance of trees planted in Bario 20 years ago was shared in this seminar. Another example is restoration of degraded mangrove land due to soil dumping caused by the flood mitigation project. Forest Department Sarawak brought in numerous volunteers from government agencies, private sectors, education institutions, NGO's, associations and local communities to take part in this restoration programme.

The use of modern techniques and tools is crucial for monitoring of forests at the landscape level. To this end, System Application and Development Unit (SADU) presented a paper on the use of hyperspectral sensing to improve the estimates for biomass and carbon in reforested sites.

Last but certainly far from least, I would like to externd my heartfelt gratitude to the International Affairs Division as organiser for the seminar for a job well done.



Datu Hamden bin Haji Mohammad

Director of Forests

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SESSION 1

HIGH CONSERVATION VALUE FORESTS (HCVF) ASSESSMENT WITHIN HEART OF BORNEO (HoB) AREA: A CASE STUDY AT ULU TRUSAN FOREST MANAGEMENT UNIT (FMU) SARAWAK

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Abstract

High Conservation Value Forest (HCVF) assessment was carried out in 2018 for Ulu Trusan Forest Management Unit (FMU) in accordance with the requirements of Malaysian Criteria and Indicators for forest management certification. The FMU is located within Lawas District, covering a forest area of approximately 92,751 hectares and is part of the Heart of Borneo (HoB). The FMU is an integration of Forest Timber Licence (FTL) No. T/9115 and No. T/0280, managed by Samling Group of Companies. The objective of the assessment was to identify High Conservation Values (HCVs) within the FMU and to provide the necessary management and monitoring recommendations. The HCVF assessments involved a group of experts from different fields of interest i.e., flora, fauna, forest ecosystem and social science. It was found that all attributes values listed in the HCVF Malaysia Toolkit (2009) are present, except for HCV 1.1 (protected area). This paper discusses on the assessment findings and management measures for the HCVF areas in Ulu Trusan FMU, which later contribute towards the Ulu Trusan's efforts in forest management certification.

Keywords: HCVF, Sarawak, FMU, HoB, Forest Certification

1.0 INTRODUCTION

Sarawak with a land area of 124,450 km^2 is located along the northwestern region of the island of Borneo (Chai, 2006). Sarawak shares its border with the Malaysian state of Sabah, Kalimantan Indonesia and Brunei. Tropical rainforests form the dominant natural terrestrial ecosystem in the country and is recognized as the richest ecosystem in the world in terms of structure and species diversity (Yamakura *et al*. 1986, LaFrankie *et al.* 2006, Hamzah *et al.* 2009) with the mixed dipterocarp forest as the dominant habitat. However, logging and forest conversion post severe threats to the tropical rainforests (Curran *et al.* 2004, Sodhi *et al.* 2004).

Despite logging being actively carried out annually, Sarawak can still maintain and protect the environment through vast areas of forested land. This is the result of Sarawak's commitment to achieve Sustainable Forest Management (SFM). SFM involves not only the continuous functions and services provided by the forest but also about meeting the global concerns and expectations in managing the forest with greater emphasis on environmental protection and conservation of biological diversity. Well-managed logging practices in production forest which produces certified timber will benefit not only the country's economy but also the conservation of biodiversity (Meijaard and Sheil 2007). One of such practices is setting aside High Conservation Value Forest (HCVF) areas within timber concession areas.

The assessment and maintenance of HCVF is prescribed under Principle 9 of Malaysia Criteria & Indicators for Forest Management Certification (Natural Forest) [MC & I (Natural Forest)] under the Malaysian Timber Certification Scheme (MTCS). HCVFs are forests which have especially high ecological and/or social values. Identifying these values, knowing to whom these values are considered important, and locating the forest areas which harbour these values is an essential step for the effective assessment and management of these values (WWF-Malaysia, 2009).

The objectives of the assessment were:

- to identify HCVFs attributes within the Ulu Trusan Forest Management Unit (FMU), and
- to provide management and monitoring recommendations for the HCVs recorded in the FMU

2.0 SCOPE OF ASSESSMENT

The full HCVF scope of assessment involves six categories of high conservation values as prescribed in the HCVF Toolkit for Malaysia as shown in **Table 1** and in accordance with Principle 9 of the MC & I (Natural Forest).

Table 1: **Types of HCVs**

HCV	Attributes
1	Forest areas containing globally, regionally or nationally significant concentration of biodiversity values
1.1	Protected areas

1.2	Threatened and endangered species
1.3	Endemic species
1.4	Critical temporal use
2	Globally, regionally or nationally significant large landscape-level forests
3	Forest areas that are in or contain rare, threatened or endangered ecosystems
4	Forest areas that provide basic services of nature in critical situations
4.1	Forests critical to water catchments
4.2	Forests critical to erosion control
4.3	Forests providing barriers to destructive fire
5	Forest areas fundamental to meeting basic needs of local communities
6	Forest areas critical to local communities' traditional cultural identity

(WWF Malaysia, 2009)

3.0 METHODOLOGY

The HCVF assessment involved a group of experts from different fields of interest (flora, fauna, social science and ecology). The HCVF assessment required a multi-disciplinary approach and the methodology employed covered the following activities:

- **Delivery of notice -** Formal letter on the HCVF assessment was delivered to Lawas District Office and also to all villages affected by the development of Ulu Trusan FMU. Brief consultation was held with the Administrative Officer of Lawas District Office on the objective of the assessment.

- **Literature review & desktop study** were conducted during the early stage of the assessment. A large volume of secondary data was collected and analysed during the HCV pre-assessment. The Environmental Impact Assessment (EIA) reports and Forest Management Plan (FMP) of Ulu Trusan FMU are important secondary sources of information. Field observation on HCV 2, 3 and 4 were conducted concurrently with the field assessment. Additional secondary data was also obtained during the field assessment phase.

- **Fauna Assessment** was conducted during day and night time by walking; traversing into randomly selecting transects; existing or abandoned feeder road, skid trails, hunting trails for the rapid assessment. Observations were made through direct sightings, calling, marks or signs of mammals, avifauna, herpetofauna and invertebrate. Locations of the significant attribute such as salt licks/wallows and nesting tree were recorded using Global Positioning System (GPS) and displayed in maps generated using the Quantum Geographical Information System (QGIS) or Ozi Explorer. Secondary data on wildlife presence at the area was gathered through informal interview with local communities and camp workers.

- **Flora Assessment** was conducted using random transect survey. Transects were set up randomly within the study sites and observation was made along transects. Random transect methods enable the assessors to cover bigger area and provide

estimation of species diversity. The survey focused mainly on higher plants mainly trees and excluded mosses and fungi.

- **Social Assessment on HCV 5 and 6 -** Data collection was conducted through field visit to Ulu Trusan FMU. Nineteen (19) settlements were visited of which 12 villages are located within FMU while another 7 villages are adjacent to the FMU. Three (3) villages, namely Long Remirang, Long Resian and Pa' Dadar were not visited due to time constraint. A participatory approach through brief visit, dialogue and interview with local community was conducted. The location of the important sites such as burial grounds (both old and present) and historical sites (megaliths, *buaya tanah*, old burial grounds, etc.) are marked using GPS and photos are taken as supporting pieces for reports.

4.0 STUDY SITE

4.1 The Forest Concession

Ulu Trusan FMU covers an area of 92,751 ha and is divided into 25 coupes. However, only 55,406 ha area is operable as other areas are classified as protected areas, Terrain Class IV, buffer zones, water catchment and shifting cultivation areas.

4.2 Location

The Ulu Trusan FMU is located in Lawas District, Limbang Division as shown in **Figure 1**, between latitudes 4° 35'41" N to 4° 11'8" N and longitudes 115° 29'2" E to 115° 40'7" E. The Eastern boundary of the FMU is bordering with the State of Sabah whereas western boundary is bordering international borders with Brunei.

4.3 Physical Attributes and Forest Types

Ulu Trusan FMU mainly consists of hilly to mountainous terrain with elevation ranging from 300 m to 1,800 m a.s.l., with highest peak at Gunung Matallan, in Payeh Maga Conservation Area. Terrain Class IV area is found mainly at the western side of the FMU, near Brunei border. About 20% of the the FMU consists of Terrain Class IV whereas majority of the areas, about 70%, consists of moderately steep to steep terrain of Terrain Class III 20 –35°. Other areas consist of smooth to undulating moderately steep terrain, less than 20° slopes.

Generally, the FMU is mainly logged-over lowland to hill mixed dipterocarp forest, with patches of Kerangas forest and lower montane forest (Payeh Maga Conservation Area). The natural habitats have largely been disturbed, with the present vegetation covers comprising mainly remnant vegetation in various stages of regeneration.

4.4 Local Communities

The settlements identified as relevant to Ulu Trusan FMU are located in Long Semadoh Central and Long Sukang Central. Thirteen (13) settlements are located within the project site while another seven (7) villages are located outside the FMU. The main communities residing is the Lun Bawang and most of them are Christians.

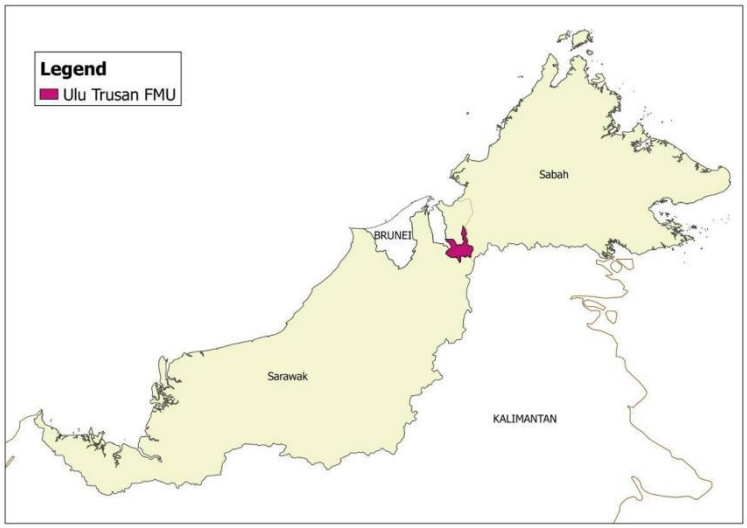

Figure1: **Location of Ulu Trusan FMU**

5.0 FINDINGS

All six HCVs attributes listed in the HCVF Malaysia Toolkit (2009) were present in the FMU. There are four sub-HCVs and three sub-HCVs in HCV 1 and HCV 4 respectively. Out of all these sub-HCVs, only HVC 1.1 is not present.

HCV 1 is on biodiversity values. HCV 1.1 on protected area (legally gazetted under Malaysian legislation) is the only HCV not present. A significant number of biodiversity values present in the study area and its surroundings. There were also signs of critically endangered (CR), endangered (EN), vulnerable (VU) and nearly threatened (NT) flora and fauna (HCV 1.2) observed during the assessment. A total of 37 fauna and 10 flora species are found to be ERT species. There are five (5) fauna and 28 flora species found endemic in the study sites (HCV 1.3). Areas for critical temporal use are also present in the FMU (HCV 1.4).

The area is an important linkage between larger forest complexes as it is surrounded by logging concession, Totally Protected Areas and Forest Management Unit (HCV 2). Lowland and hill dipterocarp forest cover the whole area and this type of forest is becoming rare and endangered as a result of deforestation and degradation of its ecosystem (HCV 3). Kerangas or heath forests present in the FMU are automatically accorded as endangered ecosystem (HCV 3).

Ulu Trusan FMU is located within Trusan catchment in Lawas District, Limbang Division. The landscape is undulating and steep, with some area more than 35° slopes or classified as Terrain Class IV (HCV 4.1). To ensure that this value is maintained or enhanced, a river buffer prohibiting logging operations is required, and the size of the buffer depends on the size of the river or stream (HCV 4.2). Ulu Trusan FMU is adjacent to Maligan VJR in Sabah and Ulu Temburong National Park in Brunei while Ulu Trusan FMU is within the HoB boundary. The Sabah-Sarawak Gas Pipeline (SSGP) cutting through the FMU and area along the pipeline is a potential cause of fire outbreak (HCV 4.3).

Result of the assessment for social and cultural values suggested HCV 5 is present. There are twenty-three (23) settlements found within or adjacent to Ulu Trusan FMU. The forest areas within and surrounding Ulu Trusan FMU is fundamental to meeting their basic needs.

HCV 6 is present as Ulu Trusan FMU contains areas and/or sites important to a local community's cultural, ecological or religious activity.

6.0 RECOMMENDATIONS & CONCLUSION

The management and monitoring recommendations for each HCV attributes are based on conservation specifications and timber harvesting methodology of the Reduced Impact Logging Guidelines. Whereas relevant, reference is made to guidelines developed by the forestry authorities in both Sarawak and Malaysia.

With the exception of HCV 1.1, all other HCVs attributes were present in Ulu Trusan FMU.

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FOREST RESOURCE INVENTORY PROJECT OF SARAWAK PHASE I AT HEART OF BORNEO SARAWAK (2016-2018)

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ABSTRACT

This paper explains the purpose of forest inventory and its importance in producing a sustainable and effective forest management. It also reports on the types of ~~Forest~~ forest ~~Inventories~~ inventories practiced by various countries in the world including Sarawak, the background and implementation objectives of the Forest Inventory project in Sarawak ~~and its implementation objectives in Sarawak~~. Furthermore, this paper also shares on the status of implementation of Sarawak Forest Resource Inventory Project ~~currently being implemented~~ in Sarawak (under the 11th Malaysian Plan), methodologies, project areas, field data collection work by Department staff, challenges, the underlying issues and the sharing of preliminary results or data obtained. The Forest Department's plans for future implementation of the Sarawak Forest Inventory project under 12th Malaysian Plan are also mentioned in this paper.

Keywords: Forest Inventory, Forest resources, Heart of Borneo, Sarawak, 11th Malaysian Plan

1.0. INTRODUCTION

According to Merriam-Webster's dictionary (n.d), the term inventory in general is defined as a complete itemized list of current assets such as property, goods in stock, records or a survey of natural resources in a particular place or area. According to the Food and Agriculture Organization of the United Nations (FAO), forest inventory is defined as a structural collection of data for forest resources available within the particular area. Forest inventory is carried out by using sampling techniques due to cost and time limitations. Forest inventory are conducted to evaluate the current status of the forest. ~~and~~ ~~T~~the latest and most accurate information or data is crucial for Sustainable Forest Management planning and strategies ~~used~~ for decision makers and forest managers ~~to make decisions~~ and at the same time, ~~to~~ enhance the ecological conservation and social benefits.

~~There are s~~Several types of Forest Inventories, as stated by FAO (2007), ~~that have been~~ are practiced ~~by~~ worldwide, ~~countries~~ including Sarawak ~~which are consist of three (3) types~~:

i. **National Forest Inventory (NFI)** also known as **Forest Resource Inventory (FRI)**

It was designed to provide a~~e~~ bird's eye view of ~~the~~ forest resources and to monitor the macro-changes at national or regional (state) levels on a continuing basis (eg: every 10 years) in terms of forest quantity, ~~quality~~quality, and functions.

ii. Forest Management Inventory (FMI)

The management level used for sustainable forest management planning ~~—~~purposes at specific areas such as Permanent Forest Estate (PFE), Forest Management Unit (FMU) or Concession areas.

iii. Forest Operational Inventory (FOI)

Operational level - at micro level/detail inventory for purposes of development or timber harvesting / extraction purposes.

The last FRI was in conducted in 1969 - 1972 with ~~the~~ collaboration from the Food and Agriculture Organization (FAO) covering a total area of 1.2 million hectares of virgin Hill Mixed Dipterocarp Forest. The objectives were mainly to estimate timber stocking and species distribution for timber industry development in Sarawak at that particular time.

~~Since~~ In 2016 - 2018, FRI was conducted by collaborating with the Forest Research Institute of Malaysia (FRIM) within Heart of Borneo (HoB) ~~area~~ with an area of about 2.1 million hectares for FRI Phase 1. In this ~~era~~period, the objectives of FRI became broader. The parameters collected were beyond ~~the~~ timber interest including biomass contents, carbon stocking, medicinal plants and the existence of wildlife.

In 2019 - 2020, FRI Phase 2 is underway and still continuing collaboration with FRIM to cover HoB Extension area (0.565 million ha). HoB was chosen due to its~~their~~ importance for biodiversity conservation, people's welfare and economy development. Both FRI Phase 1 and 2 projects are under the 11th Malaysian Plan.

Future FRI in Sarawak, which is FRI Phase 3 project (2021 - 2025), ~~planning~~ planned under the 12th Malaysian Plan is ~~planned~~ proposed to cover all *Permanent Forest Estate* (PFE) areas in Sarawak (estimated to be~~of~~ 4.6 million hectares). The idea was to integrate advanced technology of Remote Sensing (RS) with field collected data to enhance quality of information or data.

2.0. OBJECTIVES AND SCOPE

2.1. Objectives of Sarawak Forest Resource Inventory Project within Heart of Borneo Area:

i. To provide the latest and most accurate forest resources information for future forest management~~-~~ planning and decision~~-~~-making;

ii. Determine the number of trees, volume and basal area of the stand according to forest strata;

iii. Estimating the net volume of the stand for ~~a~~ certain diameter classes, according to ~~species~~ species-based forest strata;

iv. To assess the quantity of non-timber forest resources such as carbon, medicinal plants, rattan, bamboo and etc; and

v. To detect the presence of wildlife.

2.2. Scopes of Sarawak Forest Resource Inventory Project:

i. To produce current map of land uses within the project area;

ii. To develop an inventory design;

iii. To classify forest types within the project area;

iv. To stratify and map the forest strata;

v. To assess resources, identify status and quantify biophysical elements of all strata;

vi. To conduct training and refreshment courses for staff~~s~~ of FDS; and

v. To produce forest resource inventory report.

3.0. PROJECT AREA

The project started in Heart of Borneo (HoB) area with an area of 2.1 mil hectares for FRI Phase 1 and 0.565 mil hectares for Phase 2 before extend~~ed~~ing to the entire forested area in Sarawak. **Figure 1** shows the project area for Sarawak Forest Resource Inventory under 11th Malaysian Plan. Area with yellow colour is representing the Sarawak FRI Phase 1 in original HoB area (2,124,551 hectares) while area with red-brownish colour (cover from Batang Ai to Tanjung Datu) ~~representing~~ represents Sarawak FRI Phase 2 in HoB Extension area (565,251 hectares).

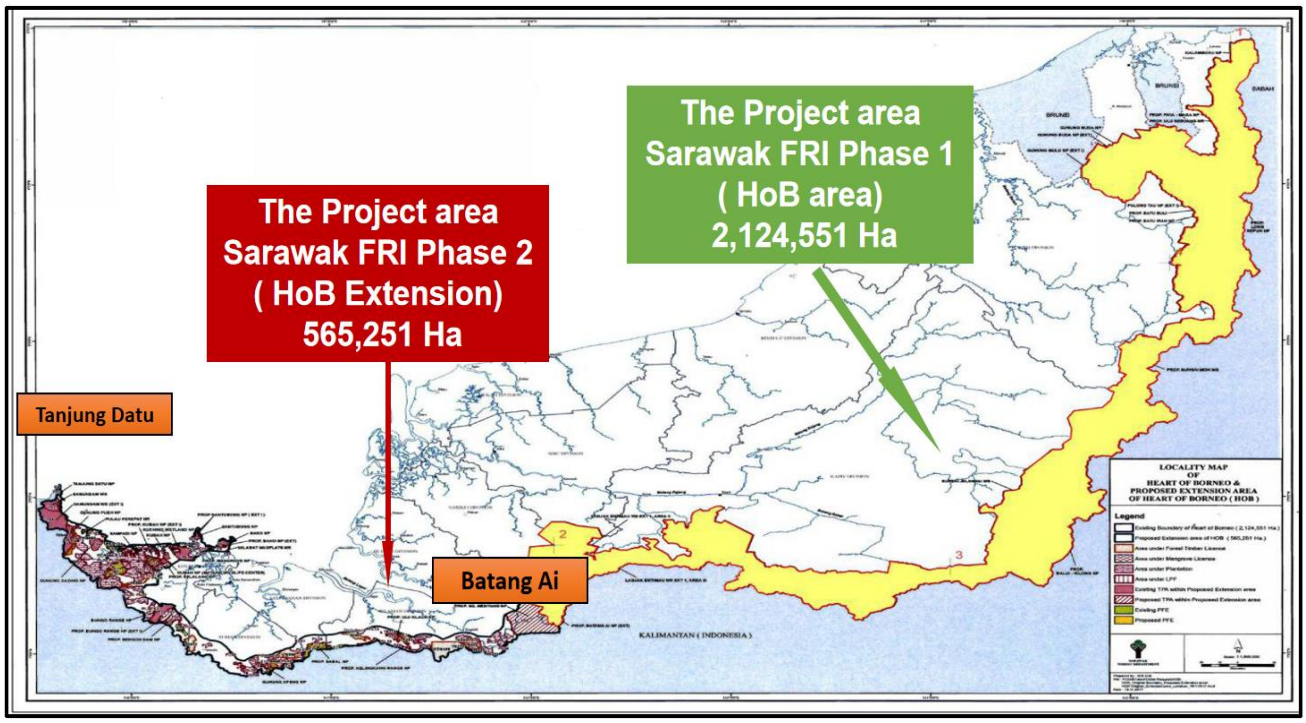


Figure 1: **The Sarawak Forest Resource Inventory Project Area for Phase 1 and Phase 2 located in Heart of Borneo and Heart of Borneo Extension.**

4.0. METHODOLOGY

Before initiating a research, a framework is constructed to provide clear direction as well as to allows better visual and understanding before conducting the FRI. The Framework of FRI within HoB area has been classified into several levels as follows :

i. Land acquisitions

ii. Strata development

iii. Locate sampling points

iv. Field data collection

v. Data analysis

4.1. REMOTE SENSING APPROACH

In order to conductdeliver the project successfully, the methodological approach used for the FRI needs to be effective in all aspects such cost (cost reduction), time (shorter time) and labour (less man-power) without affecting the accuracy of the final result. Thus, some ground measurement information are were used by integrating it with remote sensing technology. To produce a forest resource map that covers the HoB area, a method needed to be developed for data integration. One data should provide the accuracy and the other should provide a complete coverage. As such, the accuracy of the FRI data can be only be achieved by doing ground measurement for the biophysical characteristics of the forest, w. Whereas the usage of remote sensing enable us to produce large scale maps that will provide us with complete coverage. However, remote sensing method does not replace field data but the combination of by combining both methods will provide a better results (FAO, 2010:340). Besides, remote sensing includes all air-borne and space-borne instruments from analogue aerial photography to space-borne digital instruments like LiDAR, RADAR, Hyperspectral, SAR and opto-electronical system.

Remote sensing currently enhances forest inventory in four primary ways:

i. Providing faster and less expensive observation or measurement of some forest attributes;

ii. Increasing the precision of large area inventory estimates, often via stratified or weighted estimation;

iii. Providing inventory estimates with acceptable bias and precision for small areas for which sufficient field data are not available; and

iv. Thematic maps that can be used for purposes such as for timber production, procurement, and ecological studies.

For Forest Resource Inventory, a trial project area will be established to study the effectiveness and to understand the implementation of remote sensing.

Table 1: Four (4) phases of development of Forest Inventory project

Particular		**Process**
Phase 1	Study Phase	1. User needs ~~-~~; 2. Initial investigation; 3. Formulation of study objectives ~~-~~; 4. Determination of the administrative and logistic situations ~~-~~; 5. User review.
Phase 2	Design Phase	1. General system review; 2. ~~Compilatiob~~Compilation of data catalogue and stipulation for measurement; 3. Inventory design; 4. Control requirements; 5. Software, equipment, staff manuals.
Phase 3	Development Phase	1. Implementation planning; 2. Equiment/ spatial data procurement and installation; 3. Field test/pilot survey; 4. Personnel ~~trainin~~training;~~g~~ 5. Reporting requirement plan.
Phase 4	Operation Phase	1. Interpretation of remote sensing data, forest stratification; 2. Field survey; 3. Data evaluation and analysis; 4. Preparation of final report; 5. Performance Evaluation

4.2. FOREST STRATIFICATION

Satellite imaging ~~are~~ is used to classify the forest types and land use classes to provide stratification of forest within the Heart of Borneo area. Forest stratification will influence the

sampling design and the sampling intensity of the forests. For this project, **four (4) levels** of stratification are involved as shown in **Table 2**:

Table 2: **The four (4) levels of forest stratification used for the FRI phase 1**

Level 1: To identify and demarcate the project area (e.g Demarcation of HoB area within Sarawak);

Level 2: To separate forest and non-forest area within project area (e.g Stratification of Forest and Non-forest);

Level 3: To classify forested area based on land elevation (**Table 2**). Digital Elevation Model (DEM) acquired from Shittle Radar Topography Mission (SRTM) is used to perform the classification;

Level 1	**Level 2 (Physical)**	**Level 3 (Physical)**		**Level 4 (Physical and/or management)**		**No. Of Strata**
Locality (HoB)	**Forest Cover**	**Forest Types**	Lowland Dipterocarp (<300m)	Canopy density/basal area/ volume	Low Density (<33%)	1
					Medium Density (33 - 67%)	1
					High Density (> 67%)	1
			Hill Dipterocarp (300-750 m)	Canopy density/basal area/ volume	Low Density (<33%)	1
					Medium Density (33 - 67%)	1
					High Density (> 67%)	1
			Upper Hill Dipterocarp (750 - 1200 m)	Canopy density/basal area/ volume	Low Density (<33%)	1
					Medium Density (33 - 67%)	1
					High Density (> 67%)	1
			Montane Forest (> 1200 m)	-	-	1
			Kerangas Forest	-	-	1
	Non - Forest	**Other Landcover**	Agriculture land (including shifting agriculture) Settlement Plantations Infrastructure Water Body Others	**TOTAL STRATA 11**		

Level 4: Detailed classification of forested area - based on Forest Canopy Density (FCD) (**Table 3**). FCD are able to distinguish the quality of forests as 'low', 'medium' and 'high'. The first iteration of canopy density classification will be generated by using Landsat-8 images, and the detailed classification are done by using high resolution satellite images within ~~eache~~each sampling unit.

Table 3: **Sampling Distribution by Elevation**

Strata	Area (ha)	Composition (%)
Lowland Dipterocarp	28,365.06	13.51
Hill Dipterocarp	81,471.03	38.80
Upper Hill Dipterocarp	79,437.78	37.83
Montane	20,726.13	9.87
Total	**210,000.00**	**100.00**

Table 4: **The composition of FCD in the Project Area.**

Forest Canopy Density (%)	Total Area (Ha)	Percentages (%)
High (> 66)	971,728.23	62.77
Medium (33 - 66)	529,658.29	34.20
Low (< 33)	48,980.37	3.20
	Total	100.00

A few strata are proposed for FRI phase II located from Batang Ai, Sri Aman area towards Tanjung Datu, Lundu:

i. Montane Forest (in Phase 1, Montane Forest has no Forest Canopy Density Classification);

ii. Kerangas Forest;

iii. Peat Swamp Forest; and

iv. Mangrove Forest.

The strata are proposed as such due to the diversity of land use within the HoB extension area as compared to FRI Phase 1. **Table 5** shows the summary of the proposed data for phase 2 based on four (4) levels of forest stratification.

Table 5: **The Summary summary of proposed data for Pphase 2**.

Level 1	Level 2 (Physical)	Level 3 (Physical)		Level 4 Forest Canopy Density	(%)
Locality (Project Area)	Forest Cover	Forest type	MontanaeMontane forest	Low	< 33
				Medium	33 - 67
				High	>67
			Kerangas Forest	Low	< 33
				Medium	33 - 67
				High	>67
			Peat Swamp Forest	Low	< 33
				Medium	33 - 67
				High	>67
			Mangrove Forest	Low	< 33
				Medium	33 - 67
				High	>67

Besides the physical characteristics of the forests, administrative aspects are also taken into account as there are a few concessionaireconcessionaires with active -licenses -for logging within the HoB area.

4.3. SAMPLING DESIGN

4.31. STRATIFIED RANDOM SAMPLING DESIGN

The areas of within HoB area are divided into regular grids measuring 10km x 10km (-10,000 ha). It is unnecessary for the grids to cover HoB area entirely due to irregular shape of the boundary. The grids are used to facilitate the sampling design as well as the sampling unit for inventory work purpose.

4.3.2 SAMPLING UNIT

The size of the sampling unit is represented by the grid. This inventory is covering 10% sampling of the project area. The sampling units are distributed evenly throughout the project areaareas, but accessibility factors also need to be considered. Thus, ground survey is was done before conducting field data collection to enable systematic planning and alsoand rational decision decision-making by taking in the 3 aspects (cost, time, manpower) of project effectiveness into concern–.

4.3.3. SAMPLING PLOT DESIGN

As locations of sampling ~~are~~ were identified prior to the fieldwork, it ~~is~~ was vital to design the sample plot which ~~is~~ was also influenced ~~the~~ by forest strata, topography, environmental factors and road accessibility within the area. This ~~is~~ was to facilitate the movement, increase work efficiency as well as to reduce the risk of incidents during the fieldwork.

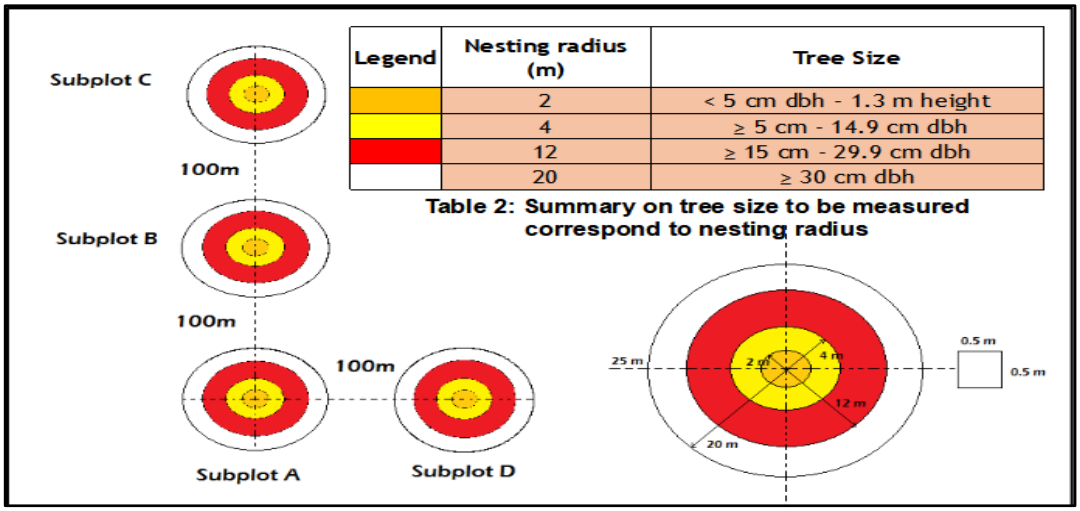
4.3.4. SAMPLING PLOT DESIGN IN MIXED DIPTEROCARP FOREST

The sampling design in this project is a modification ~~according~~ to the standard operating procedure (SOP) that has been developed by Winrock International (Waler et. al., 2012), which follows the IPCC standard (IPCC 2016).

Figure 2 shows a cluster ~~comprises~~ of four (4) circular subplots with a distance of 100m ~~from~~with each other and ~~–~~each subplots contained smaller nests inside. The biggest nest ~~measures~~ measured 20m in radius, followed by 12m and 4m respectively. ~~Whereas i~~In 2m nesting radius, only saplings ~~are~~ were measured. The size of the trees ~~are~~ were measured per nesting radius side and is summarized in **Figure 2.**

A cross transect measuring 25m in radius ~~are~~ were used to measure lying deadwood. However, standing deadwood ~~are~~ were measured within the 20m nesting radius ~~are measured~~. At the end of the transect, a square clip plot of 0.5m x 0.5m ~~are~~ were plotted for ~~non~~ non-tree vegetation (NTV), litter and soil sampling. Other plants such as bamboo, palm and lianas ~~are~~ were also recorded.

Clustering of subplots at each sampling unit ~~is~~ was recommended for natural forest areas and especially areas that have been selectively logged. The designation of the sampling system ~~is~~ was to ease data collection.



Legend	Nesting radius (m)	Tree Size
	2	< 5 cm dbh - 1.3 m height
	4	≥ 5 cm - 14.9 cm dbh
	12	≥ 15 cm - 29.9 cm dbh
	20	≥ 30 cm dbh

Table 2: Summary on tree size to be measured correspond to nesting radius

Figure 2~~-~~: Sampling plot design for Mixed Dipterocarp Forest developed from Winrock International

(Waler et. al., 2012)

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4.3.5. SAMPLING PLOT DESIGN IN PEAT SWAMP FOREST

CIFOR Working Papers 221 on the Protocols for the measurement, monitoring, and reporting of structure, biomass, carbon stocks and greenhouse gas emissions in tropical peat swamp

forests (JB Kauffman *et. al.,* 2016) has provided a suitable approach ~~in order to~~to accurately measure, monitor and report species composition and structure as well as above-ground biomass and carbon stocks of tropical peat swamp forest ecosystem. Standing live and dead trees ~~are~~ were measured in six plots each with a 10m radius with ~~centers~~centres located at equal distances apart from the main transects. The plot radius could be increased or decreased depending on the tree density and the structure of the forest. The purpose of the plot design is to achieve optimal shape, size and sampling intensity to accurately describe the ecosystem properties.

Figure 3 **shows ~~Each~~ each cluster ~~comprises~~ of six (6) circular subplots with 10m radius to measure trees with DBH > 5cm. Whereas subplots with ~~in~~ 2m radius ~~is~~ was to measure saplings (trees DBH<5cm) and the 12m cross transect ~~is~~ was used to measure lying deadwood and standing deadwood ~~ware~~ ere measured within subplots with 10m nest radius. The size of the trees ~~are~~ measured per nesting radius side ~~are is~~was summarized in Figure 4. The distance between every subplot is 50m which makes a total transect line of 250m. Similar with Mixed Dipterocarp Forest, ~~O~~0.5m x ~~O~~0.5m square clip plot ~~are~~ were plotted for ~~non~~ non-tree vegetation (NTV), litter and soil sampling.**

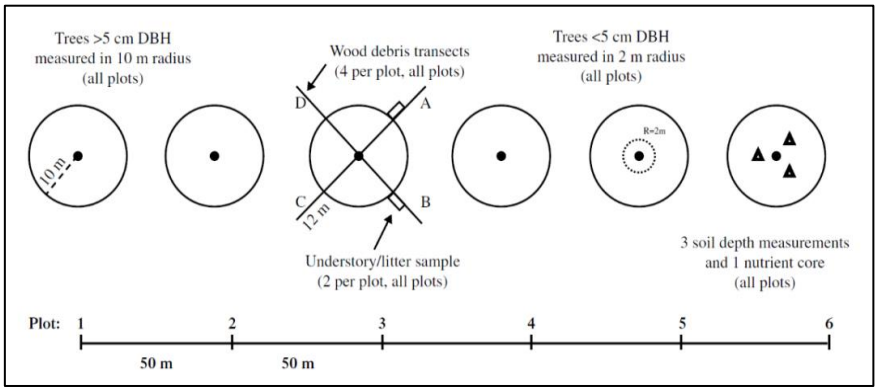


Figure 3: **Sampling plot design for Peat Swamp Forest.**

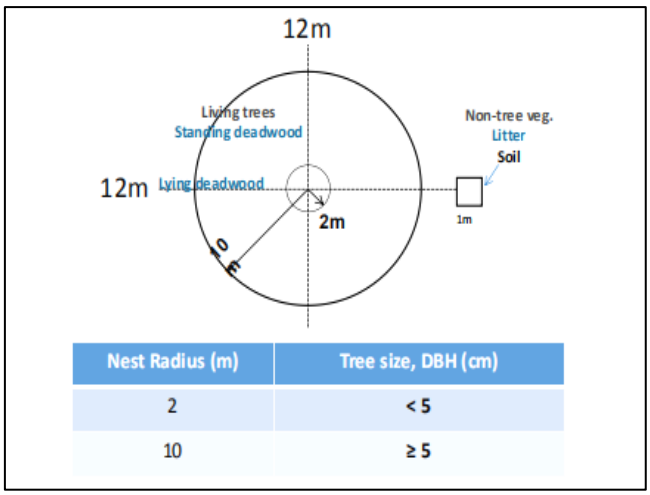


Figure 4: **The size of the trees wasare measured per nesting radius side in peat swamp forest.**

4.3.6. SAMPLING PLOT DESIGN IN MANGROVE FOREST

Center for International Forestry Research's (CIFOR) Working Paper 86: ~~ of~~ Protocols for the Measurement, Monitoring, and Reporting of Structure, Biomass and Carbon Stocks in Mangrove Forests (~~–~~Kauffman *et. al*., 2012) stated that the design for layout of mangrove forest has taken ~~tidals~~tidal elevation gradients relationship into consideration. Thus, this design is recommended due to its linear plot arrangement as well as easier to observe~~d~~ and compare~~d~~ the variation of vegetation along the gradient from the edge and towards the upland.

Figure 5 shows a nested plot design that ~~are~~ is recommended for mangrove forest. Each cluster ~~comprises~~ consists of six (6) subplots with radius of 7m and smaller subplots with radius of 2m. Trees with DBH > 5cm ~~are~~ were measured within the larger radius whereas 2m radius subplot ~~are~~ were for seedlings and trees with DBH <5cm. The 12m cross transects ~~are~~ were to measure lying deadwood ~~and~~, while standing deadwood ~~are~~ were measured within subplots with 7m nest radius. Whereas the square clip plot 0.5m x 0.5m ~~are to~~ plotted~~ted~~ for non-~~–~~tree vegetation (NTV), litter and soil sampling as shown in **Figure 6**. The distance between each subplot ~~is~~ was 25m ~~so~~thus the total transect line is 125m.

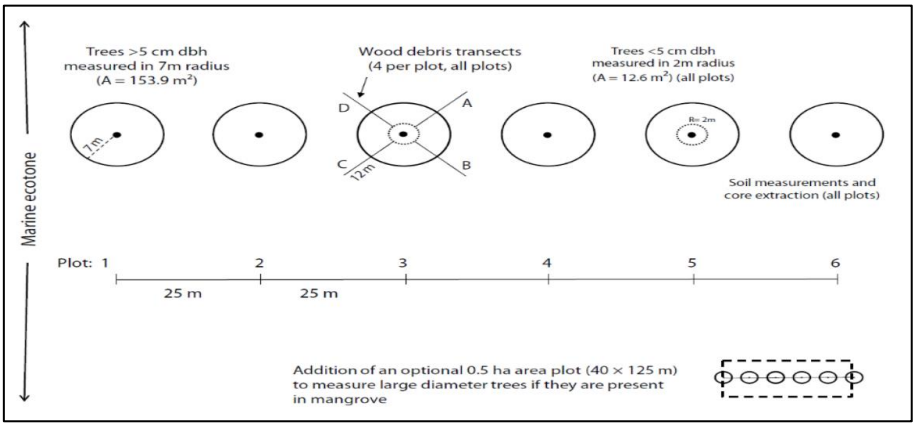


Figure 5~~-~~: **Sampling Plot Design for Mangrove Forest**

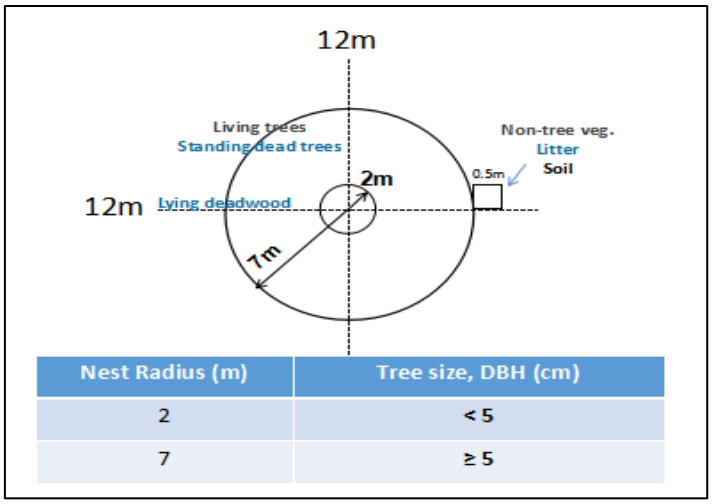


Figure 6-: **The size of the trees ~~are~~ was measured per nesting radius side in mangrove forest.**

4.3.7. ASSESSMENT OF CARBON STOCK

~~A carbon~~Carbon pools ~~is~~ are ~~a~~ capacity system~~s~~ which accumulate or release carbon in mass unit, MG C.

Table 5 shows measured carbon pools in (~~i~~i) above-ground biomass ~~comprises of~~including living vegetation, deadwood and litter and (ii) below-ground biomass ~~comprises~~ of root biomass and soil carbon.

In this FRI, this assessment is conducted by plotting a square clip plot with 0.5m x 0.5m size. The clip is located at the end of the transect line and usually 25m (Mixed Dipterocarp forest) and 12m (peat swamp and mangrove forest) outside the centre of the plot.

Soil samples are also extracted with 30m depth at the same square clip plot after ~~non~~ non-tree vegetation (NTV) and forest litter data ~~are~~ were recorded. Whereas for soil bulk density, iron coring ~~is~~ was used and the soil ~~will be~~was extracted by placing the iron coring in 15cm depth vertically from the ground. Then, all the collected samples will be ~~labeled~~labelled, weighed, ~~recorded~~recorded, and brought to the lab for drying process.

Table 6-: **Descriptions of the measured carbon pools.**

Terrestrial carbon	Pools	Description
Above-ground	Living vegetation	Woody stains, sapling, non--tree vegetation (NTV)
	Deadwood	Standing deadwood Lying deadwood
	Litter	Dead leaves Dead twigs
Below-ground	Root biomass	
	Soil Carbon	

Physical factors such as elevation, slope and aspect, soil type, vegetation type, precipitation, drainage and disturbance history, rural population density, distance from transportation networks or settlements and distance to deforested land or forest edge influence the value of carbon stocks within an area.

4.3.8. PRESENCE OF FAUNA

The presence of wild animals in the sampling unit should be reported by ~~all members in~~ the FRI team. Distinct tracks such as footprints, dropping, broken branches and twigs, tree debarking and obvious claws on tree bark or by sound ~~are~~ were observed and recorded.

5.0. PROJECT IMPLEMENTATION

~~There are~~ 165 Clusters (660 plots) in 15 sampling grids at project area ~~are~~ were selected based on ~~the~~ forest stratification. Each cluster will have 11 sampling plots. The 15 sampling grids ~~are~~ were distributed to four (4) operational regions (**Table 6**) based on Regional Forest Office (RFO) administrative ~~boundary~~ boundaries as follows~~:~~:

i. RFO Kuching - four (4) grids - 33 Clusters;

ii. RFO Sibu - four (4) grids - 44 Clusters;

iii. RFO Bintulu - four (4) grids - 44 Clusters; and

iv. RFO Miri - three (3) grids - 44 Clusters

Table 7: **Sampling Grids distributed to four (4) Operational Regions**

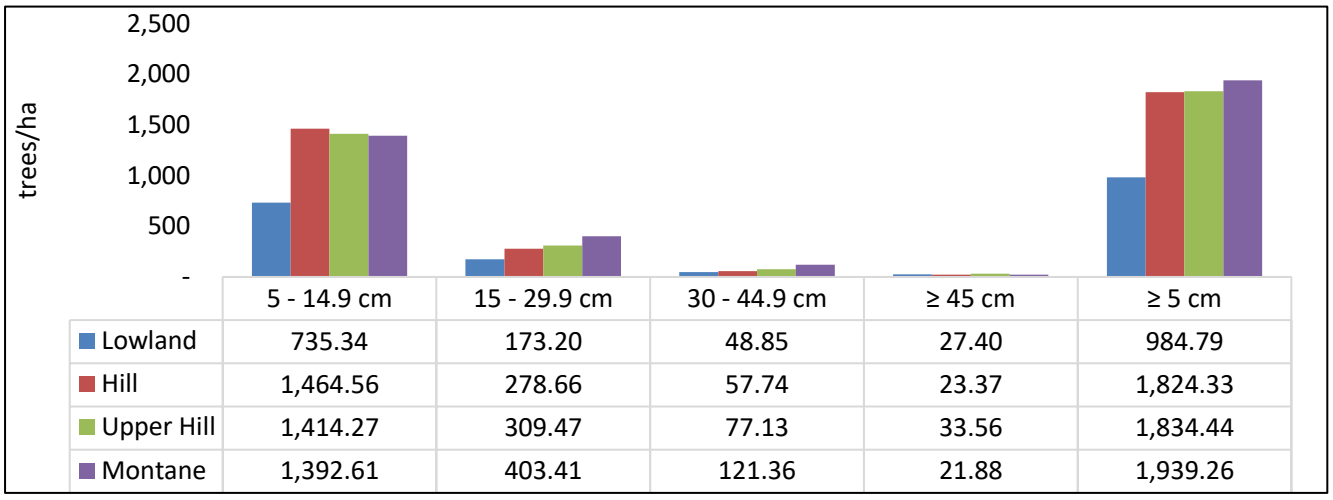
Operational Region	No. of sampling unit (Grid)	No. of cluster	No. of plot
Sibu	4	44	176
Bintulu	4	44	176
Miri	4	44	176
Kuching	3	33	132
Total	**15**	**165**	**660**

6.0. DELIVERABLES

The deliverable and overall contents of the Forest Resources Inventory Report produce the output such as latest forest stratification map for forest of Sarawak and Heart of Borneo extension area, information on Non Timber Forest Product, information on timber stocking in HoB, produce data such as tree height, timber volume, tree species, stand border and basal area that can be applied for state-wide FRI Project in near future for forest management activities in Sarawak, information on carbon stocking and produce ~~Geo~~geo-spatial data processing laboratory for RS Forest Inventory Equipment to support forest inventory works and sustainable forest management planning.

7.0. RESULTS

7.1. Stand Density

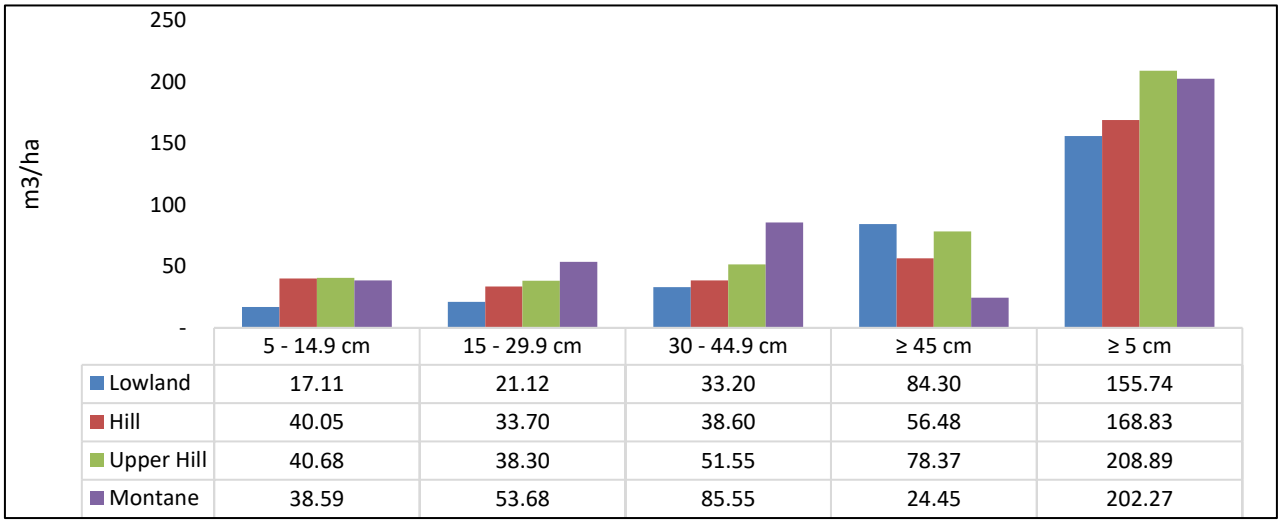


	5 - 14.9 cm	15 - 29.9 cm	30 - 44.9 cm	≥ 45 cm	≥ 5 cm
Lowland	735.34	173.20	48.85	27.40	984.79
Hill	1,464.56	278.66	57.74	23.37	1,824.33
Upper Hill	1,414.27	309.47	77.13	33.56	1,834.44
Montane	1,392.61	403.41	121.36	21.88	1,939.26

Figure 1: **Stand Density (trees/ha) based on diameter classes in each forest type**

The table bar-chart above shows the results on stand density based on trees per hectares on lowland, hill, upper hill and montane forest. The stand density increasing with the increment of altitude from lowland to montane forest. Montane forest has the highest number of trees (1,939/ha, ~~follows~~ followed by upper hill (1,834 trees/ha) and hill forest (1, 824 trees/ha). However, the difference is small between these forests. Lowland forest has shown significant difference with the other forest types. The tree density for lowland forest is estimated at around 985 trees/ha.

7.2. Total Volume Per Hectare



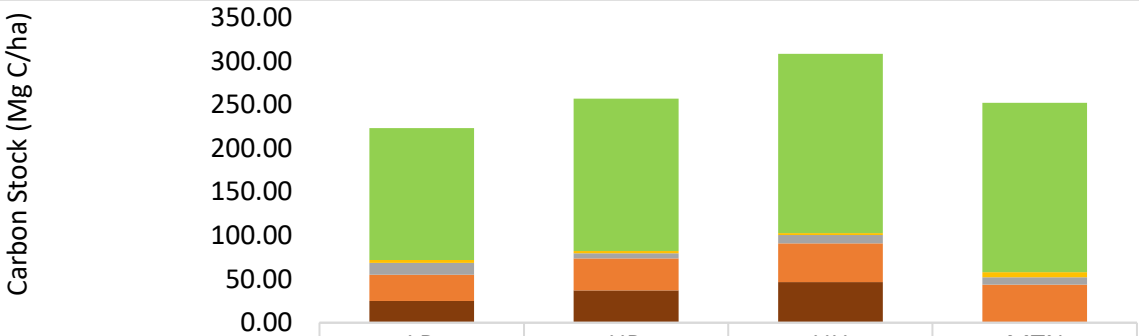
	5 - 14.9 cm	15 - 29.9 cm	30 - 44.9 cm	≥ 45 cm	≥ 5 cm
Lowland	17.11	21.12	33.20	84.30	155.74
Hill	40.05	33.70	38.60	56.48	168.83
Upper Hill	40.68	38.30	51.55	78.37	208.89
Montane	38.59	53.68	85.55	24.45	202.27

Figure 2: **Total Volume per Hectare Based on Diameter Classes in Each Forest Type**

The ~~table~~ bar-chart above shows the results on total volume per hectare based on diameter classes in each forest type. The total volume per hectare in upper hill forest has the highest total volume per hectare (208.89 m^3/ha), ~~follows~~ followed by montane forest (202.27 m^3/ha),

hill forest (168.83 m^3/ha) and lowland forest (155.74 m^3/ha) respectively. In general, total volumes per hectare is increasing with the increment of altitude (for trees with DBH 5 to 44.9 cm). However, the total volume per hectare for trees with diameter class of 45cm and above in montane forest dropped significantly to 24.45 m^3/ha.

7.3. Carbon Stock



	LD	HD	UH	MTN
Aboveground living trees	151.31	174.74	205.74	194.26
Litter falls	3.41	2.41	2.12	6.09
Dead wood	13.43	6.02	9.40	8.54
Belowground living trees	30.13	36.64	44.61	43.55
Soil	25.04	37.16	46.63	0.00

Figure 3: **Carbon Stock Within All Forest Types**

Table 10 shows ~~a~~ significant differences of carbon stock among forest types in the project area. The upper hill Dipterocarp~~s~~ forest has the highest carbon stock as compared to the other forest types. The carbon stock in this area ~~are~~ is influenced by large trees composition and coarse woody debris in the forest floor.

7.4. Non-Timber

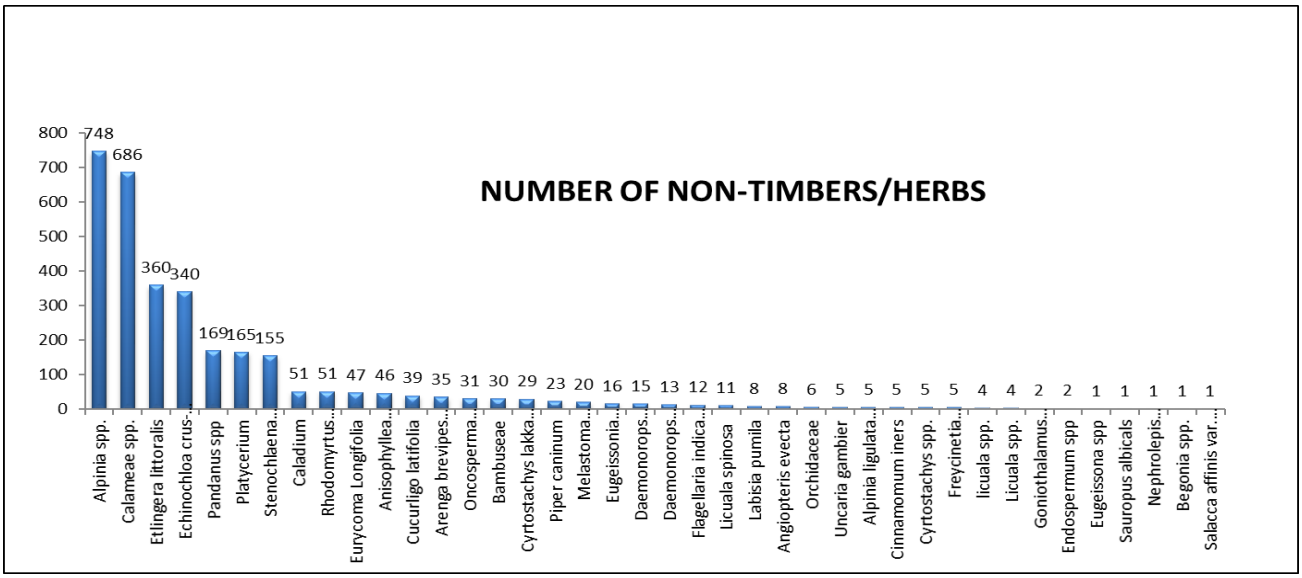


Figure 4: **The Number of Non-Timbers/Herbs recorded in each sample plot.**

Figure 4 **shows data that was collected based on observation at each sample plot. There are 40 non-timber species recorded.**

7.5. Carbon Stock

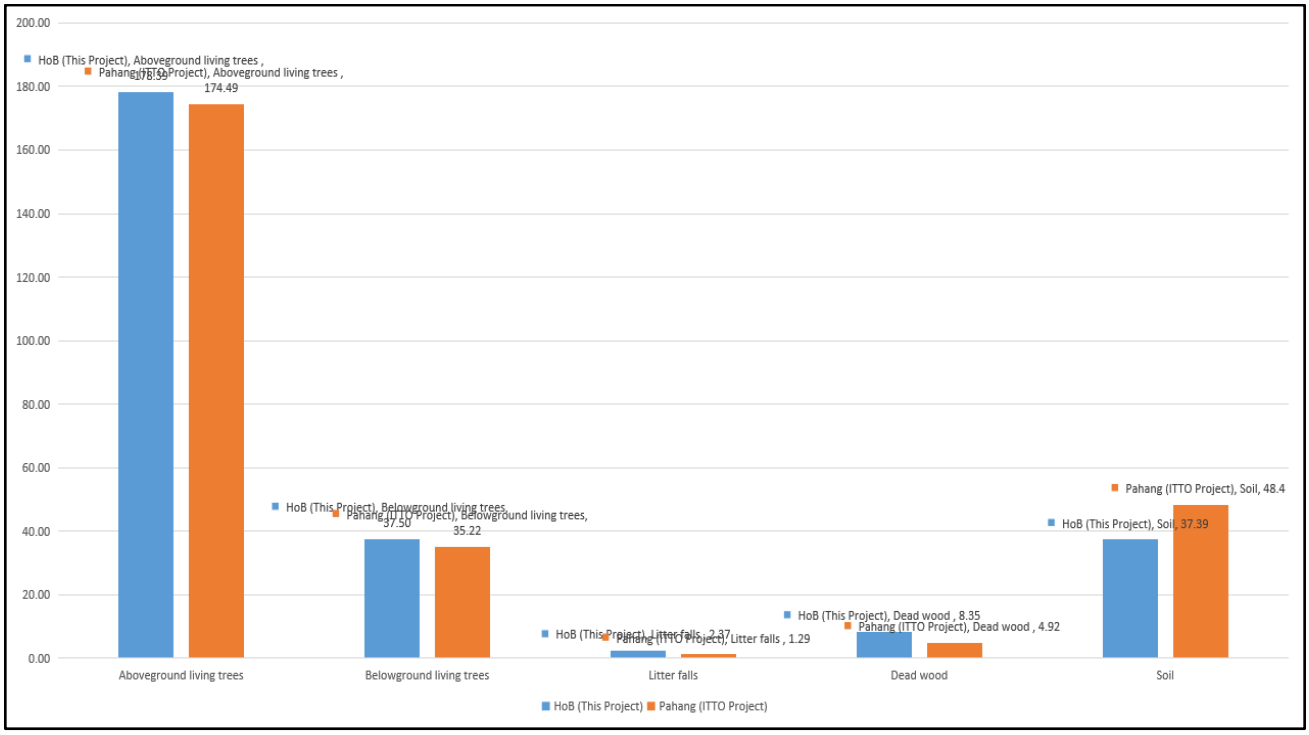


Figure 5: **The comparison of Carbon Stock between HoB Sarawak and Pahang, Peninsular**

7.6. Number of Trees

Parameter (Enumerated)	Number	Remarks
Total number of trees	11,048	Dipterocarp = 16.90 % Non - Dipterocarp = 83.90 %
Number of species	241	
Number of family	59	

Table 7: **Summary of number of trees, number of species and number of family enumerated within the project area for FRI project phase 1**.

For FRI project phase 1, the total number of trees enumerated within the project area are 11,048 which comprises consists of 16.90% of Dipterocarp trees and 83.90% Non-Dipterocarp trees. From the total number of trees, there are 241 tree species and 59 families were identified.

7.7. Tree Species Composition

Table 9: **Tree Species Composition in different forest types**

Forest Types	Number Of of Species			
	DBH ≥5cm		DBH ≥45cm	
	Dip	Non-Dip	Dip	Non-Dip
Lowland Dipterocarp	21	136	17	56
Hill Dipterocarp	26	154	19	68
Upper Hill Dipterocarp	14	120	11	48
Montane	4	31	2	5

Table 8 shows the tree species composition numerated in different forest types in the project area i) Lowland Dipterocarp, ii) Hill Dipterocarp,; iii) Upper Hill Dipeterocarp, and; iv) Montane. For trees with DBH less than 5cm and more thane 45cm within the four (4) forest types, the number of Non-Dipterocarp trees are greater than Dipterocarp trees.

7.8. Wildlife

Table 9: **Presence of Fauna/ Wildlife**

Table 9 shows the data on fauna species. These data were collected by using the same method as non-timber resources data which by doing manually observation within plot and grid towards indicator such as **scratches, foot print, sound, smell, and dunk**. There are thirtyThirty (30) species of fauna are were found and recorded.

No.	Local Name	Scientific Name	Strata	WPO (1998)	IUCN Status
1	Teledu	***Mydaus javanensis***	HD		**LC**
2	Beruang Matahari	***Helarctos malayanus***	HD/LD	**P**	**VU**
3	Burung Gagak	***Corvus brachyrhynchos***	UH		LC

4	Landak	***Hystrix brachyura***	UH	**P**	VU
5	Burung Chilin	***Platylophus coronatus***	UH		
6	Burung Murai Batu	***Copsychus malabaricus***	UH/HD/LD		LC
7	Helang	***Haliastur indus***	UH/HD		**LC**
8	Ayam Hutan (Sepidan)	***Lophura ignita***	UH		**NT**
9	Burung Hantu	***Ninox scutulata***	HD	**P**	**LC**
10	Burung Betitir	***Geopelia striata***	HD		**LC**
11	Burung Keruak	***Amaurornis phoenicurus***	HD/LD/UH		**LC**
12	Burung Bubut	***Centropus sinensis***	HD		**LC**
13	Berok	***Macaca nemestrina***	HD	**P**	**VU**
14	Tupai Pinang	***Callosciurus notatus***	HD	***/***	**LC**
15	Burung Pipit Merah	***Amandava amandava***	LD		**LC**
16	Burung Tiong Batu	***Eurystomus orientalis***	LD/HD		**LC**
17	Burung Enggang	***Bucerotidae***	UH/HD	**TP**	**LC**
18	Burung Kuncit	***Dicaeum trochileum***	LD		**LC**
19	Burung Tajai	***Rhinoplax vigil***	LD	**TP**	**CR**
20	Burung Madu	***Colibri thalassinus***	LD		**LC**
21	Pelanduk	***Tragulus javanicus***	LD		LC
22	Burung Cuit	***Cisticola juncidis***	LD		**LC**
23	Burung Entu Mendu	***Pityriasis gymnocephala***	LD		**NT**
24	Cikada	***Tibicen linnei***	HD		
25	Burung Kelicap	***Cinnyris jugularis***	UH/HD		**LC**
26	Burung Merbah	***Setornis criniger***	UH/HD		**VU**
27	Babi Hutan	***Sus barbatus***	HD/LD/UH		**VU**
28	Burung Belatuk	***Picidae***	HD/UH/LD	***/***	
29	Kijang	***Muntiacus sp.***	UH/LD/HD		
30	Burung Merbah Beringin	***Alophoixus ochraceus***	UH		**LC**

8.0. COMPARISON RESULT WITH PREVIOUS FRI PROJECT

Table 10: **Summary of comparison between previous FRI**

Table 10 ~~summarized~~ summarizes the comparison between the background and the ~~results~~ findings between the FRI project conducted by the FDS/FAO in 1969 to 1972 and the FRI conducted by FDS/FRIM in 2016 ~~–~~to 2018. The FDS/FAO FRI project was concentrated in the middle of Sarawak, covering an area of 1.2 million ha at virgin Hill MDF and the latest FRI project implemented in Heart of Borneo area with covered an area of 2.1 million ha at mostly logged-over Hill MDF.

PARAMETER	RESULTS	
	FDS/FAO FRI (1969 - 1972)	**FDS/FRIM FRI (2016-2018)**
Location of Project Area	Middle of Sarawak	Heart of Borneo (HoB) area
Extent of Area (Ha)	1.2 Million Ha	2.1 Million Ha
Forest Types	Virgin Hill Mixed Dipeterocarp Forest (MDF)	Logged Over Hill Mixed Dipterocarp Forest (MDF)
Objectives	Development of timber industry	Forest Beyond Timber
Average Timber Volume (Tree DBH of 45cm DBH and above	130m^3/ha	34m^3/ha
Number of tree species	a) 606 species b) 61 families c) 60% dominated by four (4) dipterocarp species Meranti, Kapur, Keruing & Mersawa	a) 241 species b) 59 families 83.9% : Non-Dipterocarp species 16.9% : Dipterocarp species
Outcome	a) Establishment of STIDC b) Production of Volume Table c) Forest Engineering Plan d) General Harvesting Plan (GP) and Detailed Harvesting Plan (DP) to be incorporated in FMP	Expected outcome : a) To revise new policy or law on forest management and conservation; and b) Prepare new or revised FMP in FMU or ~~consession~~concession area.

The objectives of FDS/FAO FRI were mainly focused ~~to collect~~on collecting data on commercial trees for developing the timber industries in Sarawak but in contrast, FDS FRI ~~are~~ covered~~d more~~ broader scope on parameters collected with the concept “Forest Beyond Timber”. For FDS/FAO FRI, the results ~~shown~~ showed that the average timber volume

collected for the trees DBH greater than 45cm are **130m^3/ha,** compared ~~with~~ to FDS/FRIM FRI, which is only 34m^3/ha at logged-over forest areas.

About 606 trees species under 61 families has been enumerated during FDS/FAO FRI with 60% of tree species ~~are~~ dominated by four (4) dipterocarp species groups only ~~that~~ namely; Shorea (Meranti), Dryobalanops (Kapur), Dipterocarpus (Keruing) and Anisoptera (Mersawa). For FDS/FRIM FRI, only 241 tree species with 59 families ~~are~~ were enumerated where 83.9% of trees enumerated ~~are~~ were dominated by non-dipterocarp and only 16.9% Dipterocarp trees were found.

FDS/FAO FRI's findings had ~~been~~ contributed to the establishment of Sarawak Timber Industry Development Corporation (STIDC) ~~in order~~ to regulate and stimulate the development of wood-based industries throughout Sarawak. Besides that, the FDS/FAO FRI also contributed to the production of Logs Volume Table book and the development of Forest Engineering Plan that was incorporated in new Forest Management Plan for hill forest that contains General Harvesting Planning (GP) and Detail Harvesting Planning (DP).

For the latest FDS/FRIM FRI project, it is expected that the output of this project can be used as a basis by stakeholders, especially for decision makers/policies or forest managers to formulate new policies for better and more effective future forest management and nature conservation as well as improving Forest Management Plans in forest concession areas.

9.0. CONCLUSION

In conclusion, the results from this project showed the normal trend for tree density, basal area and volume for forest resources data at logged-over hill MDF forest as compared ~~with~~ to similar forest areas in Peninsular Malaysia and other countries in the tropics. Thus, it can be concluded that the data derived from this project are reliable.

Most of the forests within the project area are found to be regenerating as evident from the project area where the large number/stocking of small trees were found. Further recommendations are to enhance the quality of forest through the aggressive forest restoration and enrichment planting programme. Besides that, the proper control of forest harvesting and strictly prevention of illegal encroachment into forest areas can enhance the rehabilitation process of current forest areas in Sarawak.

APPENDICES

Figure 6a

Figure 6 b

Figure 6 a, 6b : **Taking DBH measurement ~~by~~ using tape during FDS/FAO FRI 1969 - 1972**

Figure7a

Figure 7b

Figure 7a, 7b: **Type of communication and medium of transportation used during FDS/FAO FRI 1969 – 1972.**

Figure 8: **Signing the Memorandum of Agreement to appoint FRIM as Project Consultant for FRI Project**

Phase 1 in November 2016.

FOREST MANAGEMENT CERTIFICATION HIGHLIGHTING SOCIAL PERSPECTIVES

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ABSTRACT

Sustainable Forest Management (SFM) is the concept that integrates three equally important pillars; environmentally sound, socially acceptable and economically viable. Sarawak has embraced SFM since the adoption of Statement of Forest Policy 1954. The concept~~s~~ of SFM ~~are~~ is enhanced in Sarawak Forest Policy 2019 and ~~being~~ strengthened through the adoption of Forest Management Certification (FMC) Policy 2019. In FMC Policy 2019, it is mandatory for all long-term forest timber licenses in Sarawak to obtain Forest Management Certification (FMC) by year 2022. The Forest Management Certification is implemented as the credible assurance for SFM practices. Among the SFM three pillars, the most challenging component in forest management is the social aspect. The requirement and importance of social aspect are reflected in 5 major principles in the Malaysian Criteria and Indicators for Forest Management Certification (Natural Forest). The common social issues that often create conflict and major impediment to achieving SFM are forest resources and land dispute. To address these issues, Forest Department ~~of~~ Sarawak (FDS) has initiated a community engagement program for local community and other relevant stakeholders on SFM and FMC awareness. To facilitate the interconnection and interaction between the stakeholders, FDS has established a multi-stakeholder consultation framework at various levels. These levels are Forest Management Certification Liaison Committee (FMCLC) at~~for~~ inter-agency~~ies~~ level, Forest Management Unit Representatives Committee (FMURC) for FMU and Community Representatives Committee (CRC) at community level. This paper will highlight the FMC progress and elaboration of multi-stakeholder framework.

Keywords: Sustainable Forest Management, Forest Management Certification, Social aspect, Stakeholder consultation framework, Liaison Committee

1.0 INTRODUCTION

Sustainable Forest Management (SFM) is the process of managing forests to achieve one or more clearly specified objectives of management ~~with regard to~~regarding the production of a continuous flow of desired forest products and services without undue reduction of its inherent values and future productivity and without undue undesirable effects on physical and social environment (International Tropical Timber Organization, ITTO). It is a concept that integrates three equally important pillars; environment, economy and social.

The concept is to have ~~a~~ forest management that is environmentally sound by ensuring the conservation of forest soils, water, carbon stocks and its biodiversity, also by maintaining the resilience and renewal capacity of forests, including for carbon storage. Besides, it has~~is have~~ to be economically viable for continuous production of timber based on the ability of

forest to supply sustainably, without neglecting the social aspects in supporting the food security, cultural and livelihood needs of forest-dependent communities, also empowering local communities in forest management.

Sarawak has embraced SFM since the adoption of Statement of Forest Policy 1954. The concept~~s~~ of SFM ~~are~~ is further enhanced in Sarawak Forest Policy 2019 and ~~being~~ strengthened through the adoption of Forest Management Certification (FMC) Policy 2019. The adoption of FMC policy by the State is to provide credible assurance that the forest in Sarawak is managed according to SFM element~~s~~ practices and in Forest Management Certification Policy 2019, it is mandatory for all long-term forest timber licenses in Sarawak to obtain FMC by year 2022.

In the effort to achieve~~d~~ FMC, one of the main ~~major issues was on the~~ social issues that often create ~~conflict and major impediment~~obstacles to achieving SFM are forest resources and land dispute. To address this issue, Forest Department ~~of~~ Sarawak (FDS) came out with a conflict resolution mechanism and awareness programme for various stakeholders.

2.0 FOREST MANAGEMENT CERTIFICATION PROGRESS IN SARAWAK

Since the ~~YAB~~ Chief Minister of Sarawak announced ~~the~~ mandatory FMC for all long-term forest timber licenses by year 2022, 14 FMU has since been ~~certified~~certified, consisting ~~comprising~~ of 1.3 million hectares ~~of area~~area. Out of these certified FMUs, 11 FMUs are situated inside the Heart of Borneo ~~areas~~ with an area of 761,037 hectares as shown in **Table 1**.

Table 1: **Certified FMUs in Sarawak and within Heart of Borneo area**

No	FMU	Division	FMU Area (Hectare)	Area within Heart of Borneo (Hectare)
1	Anap Muput FMU	Tatau	83,535	-
2	Ravenscourt FMU	Lawas	117,941	117,651
3	Kapit FMU	Kapit	149,756	74,184
4	Linau FMU	Tubau	74,532	74,486
5	Bahau Kahei FMU	Kapit	45,035	45,035
6	Ulu Trusan FMU	Lawas	92,751	58,636
7	Raplex FMU	Kapit	63,993	-
8	Melatai Para FMU	Kapit	49,524	49,524
9	Gerenai FMU	Baram	148,305	72,094
10	Pasin FMU	Song	132,151	63,516
11	Gaat Mengiong FMU	Kapit	66,190	3,478
12	Entulu Melatai FMU	Kapit	55,112	55,112
13	Mujong Melinau FMU	Kapit	41,696	-
14	Danum FMU	Tubau	200,383	129,850

Total	**1,319,057**	**761,037**

3.0 SOCIAL COMPONENT HIGHLIGHTED IN MALAYSIAN CRITERIA AND INDICATORS FOR FOREST MANAGEMENT CERTIFICATION (NATURAL FOREST) UNDER MALAYSIAN TIMBER CERTIFICATION SCHEME (MTCS)

Among the SFM three pillars, the most challenging component in forest management is the social aspects. Besides, social aspects and particularly local communities' importance well-being areis constantly being highlighted and considered in the Malaysian Criteria and Indicators (MC&I) (Natural Forest) as the standard for FMC.

Out of the 9 principles in the MC&I (Natural Forest) standards, 5 principles are reflecting the requirement and importance of social aspects as a measure of SFM. The principles are as follows:

PRINCIPLE 1: COMPLIANCE WITH LAWS AND PRINCIPLES

"The forest management shall comply with all applicable laws..."

That basically stated the needs for forest manager to be aware and/or knowledgeable on all laws and 'adat' specifically with respects to the importance of local communities including the recordings of violation and actions taken to address them.

PRINCIPLE 3: INDIGENOUS PEOPLE'S RIGHTS

"The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognised and respected"

All related local community information to be incorporated in the forest management plan that spelled out the location of the village and any other important cultural, ecological, economic or religious sites. Besides the availability of Aappropriate mechanisms for conflict resolutions among stakeholders available, includesing the safekeeping of all records of dialogue and consultation with the natives and relevant stakeholders.

PRINCIPLE 4: COMMUNITY RELATIONS AND WORKER'S RIGHTS

"Forest management operations shall maintain or enhance the long-term social and economic well-being of local communities and forest workers"

The forest management to prioritize local communities for employment, training and other services according to the qualification and skills that areis beneficial in forest operations. Social impact of forest operation that is affecting local communities must be conducted and forest management and planning shall consider and incorporate the results of the assessment.

PRINCIPLE 8 : MONITORING AND ASSESSMENT

"Monitoring shall be conducted - appropriate to the scale and intensity of forest management – to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

The forest manager to identify and implement appropriate monitoring procedures and reporting on social, ecological, environmental and economic impacts. Results of monitoring to be updated into the implementation and revision of the forest management plan.

PRINCIPLE 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS

"Management activities in high conservation value forests shall maintain or enhance the attributes which define such forest..."

High conservation value areas to be assessed and the results are consulted to relevant stakeholders. Out of 6 attributes of HCV, 2 attributes isare directly addressing local communities' importance well-being that are HCV 5 for basic needs of local communities including quantification of dependency of local communities over the forest area for a living and HCV 6 that is the identification and management of sites important for local community's cultural, ecological or religious activities. The sites are to be documented, mapped, demarcated and monitored according to suitable measure.

4.0 FDS' EFFORT TO SUPPORT FMC IMPLEMENTATION ON SOCIAL ASPECTS

4.1 Awareness Programme

An Aawareness programmes are is conducted for local communities located within or adjacent to FMU areas as evaluated through social impact assessments. The awareness programmes aims to develop awareness among the local community to better understand the concept of SFM, FMC and conflict resolution mechanism that had has been put in place as a venue for consultation between stakeholders. Besides, with the understanding on SFM and FMC, the local communities can benefit from the forest management and operations through closed communication and consideration for their rights and livelihood.

The awareness programmes wereis led by the department with assistance from the particular relevant FMUs. Briefings given are given on the concept of SFM, implementation of FMC including brief explanation of harvesting method such as Reduced Impact Logging, assessment of social and environmental impacts, High Conservation Value areas identification, Forest Management Plan (FMP) and requirements of FMC. Other than that, the conflict resolution mechanism is was also thoroughly explained to local communities including the consultation framework that consist of multi-stakeholder consultations and the flow of conflict resolution. Some photos as shown in the followingSome photographs from the awareness programmes are shown below.

Photo 2: **Awareness briefing on SFM, FMC and CRC for communities in Rumah Selat, Katibas.**

Photo 3: **Awareness briefing on SFM, FMC and CRC for community leaders of Sungai Katibas, Tekalit and Bangkit from Pasin FMU in Dewan Suarah Song, Kapit.**

Photo 4**: Awareness briefing for communities in Rumah Emong, Ulu Mukah**

Photo 4**: Awareness briefing for local communities in Long Bangan, Belaga**

Photo 5**: Awareness briefing for camp workers and staffs of Mujong Melinau FMU, Kapit**

4.2 CONFLICT RESOLUTION MECHANISM

One of the pillars in SFM is social aspect that has tomust be addressed and managed as it is also a requirementd in the implementation of FMC. In this regard, an important aspect of forest certification involves the human dimension, particularly indigenous peoples and local communities whose livelihood largely depends on the forest. In view of this, industrial harvesting of timber should be done in a manner that enables communities to maintain their forest-based livelihood systems. In Sarawak, issues from social aspect often create conflict and major impediment to achieving SFM. These issues include:

i. Shifting agriculture inside gazetted Permanent Forest Estate (PFE)

ii. Land claim and dispute

iii. Operation by the timber operator without prior inform to directly impacted local communities

iv. Bad experience from past historyexperiences

v. Different uses of resources and incompatible interests and needs

vi. Misunderstanding & misinterpretation of SFM and FMC

Conflict over the above issues usually exists among stakeholders in forest operations especially the local communities or aborigines that are directly impacted by the operations. Disputes may exist within the local communities themselves or between the local communities with other stakeholders such as forest manager, government agencies or non-governmental organization (NGO). As an implementing and monitoring agency, FDS developed a mechanism to resolve conflicts that is the Forest Management Certification Liaison Committee (FMCLC) consultation framework comprises comprising of multi-stakeholder representatives from community level, forest manager levels and various agencies level. This mechanism is to provide platform and practical guidance to forest managers and other stakeholders in addressing and resolving conflicts arising from forest operation activities related to SFM and FMC.

4.2.1 FMCLC Consultation Framework

FMCLC is a consultative framework involving multi-stakeholder representatives from local communities residing within or surrounding the FMU that are directly or indirectly affected by the forest operation, FMUs representatives and Forest Agencies as well other relevant government agencies as and when required. Prior to the formation of FMCLC, the following committee at various levels are to be established or identified, these committees are as follow:

a) Community Level - Community Representative Committee (CRC)

b) FMU Level - Forest Management Unit Representative Committee (FMURC)

c) FMCLC and other and NGOs. - Comprising of CRC, FMURC, Forest Department Sarawak relevant agencies such as Resident and District Offices, Land Survey Department, other ~~upon invitation~~invited agencies and

4.2.1 (a) Formation and Function of Community Representative Committee (CRC)

The CRC members and number of representatives are to be determined by the communities themselves. However, there should be~~it should be well represented of~~ at least one (1) from each village or longhouse~~s~~. F~~A f~~emale representative~~s are is~~ also encouraged to become ~~a~~ member~~s~~.

The function of CRC is to safeguard the interest of the communities in the ~~license~~ licensed area by becoming a platform for communities to express opinions, appeal, objection and suggestion with regards to forest operations. These chosen CRC members will be representing communities in meeting with FMURC and FMCLC.

Before the local communities form their CRC, FMU will conduct Social Impact Assessment to identify the affected communities residing~~ed~~ within or adjacent to the FMU that is directly impacted by forest operation. Once identified, FDS representatives shall conduct awareness briefing on SFM, FMC and CRC concept to all the identified local communities. Once the communities understand all the concepts, they will proceed with nomination of village/longhouse representative and form CRC with the rest of the communities in the FMU. The formed CRC will be endorsed in FMCLC meeting.

4.2.1(b) Formation and Function of FMURC

FMURC is the committee established by company/FMU ~~that is the representatives~~ to represent them to communicate and deal with communities with regards to issues, project and other matters related to forest operations. These representatives will be in meetings with relevant stakeholder~~s~~ such as FMCLC. FMURC must ~~be~~ consist~~s~~ of Camp Manager, FMU Manager and Community Liaison Officers as appointed by the company.

4.2.1(c) Formation and Function of FMCLC

FMCLC is the platform activated as part of the formal conflict resolution process and consists of relevant stakeholders with regards to forest management and operation such as FDS, FMURC and CRC, also, including members that will be invited upon applicable from Resident and District office, Land and Survey Department, Department of Agriculture and other relevant agencies and NGOs. The chairman of FMCLC is the Regional Forest Officers in each region and the secretariats that facilitate the meeting are from Planning and Management Division (Headquarters), FDS.

To ensure the effective implementation of the FMC in the State, the FMCLC functions to endorse the formation and ~~dissolve~~ dissolution of CRC, evaluate and endorse CRC programmes or recommendations and to endorse~~d~~ decisions agreed by CRC and FMURC. Any issues unresolved i~~o~~n the FMCLC meeting will be reported to the higher level by the secretariats as shown in the conflict and forest management issues resolution flowcharts. FMCLC meetings will also be the venue of sharing information on government policies, DF's Circulars and other matters related to forest management.

4.2.2 Conflict and Forest Management Issues Resolution Flowcharts

The conflict resolution mechanism aims to give~~help~~ aggrieved parties ~~feel that they have been given~~ a fair hearing and therefore be~~tter~~ able to accept the decisions better. The basic trust of conflict resolution is to build mutual trust between the parties involved and it serves as a foundation in ~~a~~ conflict resolution. Besides, this ~~this conflict resolution~~ platform also involves negotiation ~~that includes adjustment~~ where all parties find ways to help each other achieve the objectives.

FMCLC being the formal manner in conflict resolutions, it is recommended that when any potential conflict arises with regards to the forest management and operations, it is best solved at the local level between the parties involved such as the local communities and the forest managers. This could be achieved through local consultation, discussion, and negotiation; it is more favourable when the forest managers and local communities can achieve good terms. It is only when the informal consultation fails to resolve the matter; the issues will be taken to higher level as shown in **Chart 1**.

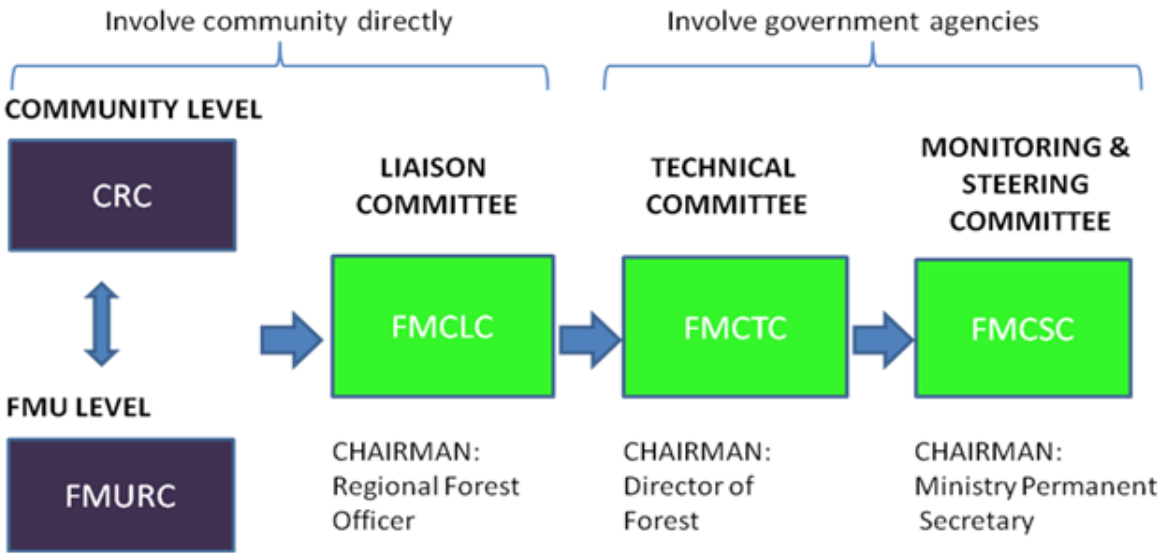

Chart 1: **Conflict and forest management issues resolution flowchart**

Any unresolved issues during informal consultation and FMCLC meeting will be taken to the higher level by the secretariat to the Forest Management Certification Technical Committee (FMCTC) meeting that is chaired by the Director of Forests for decision-making. Besides, issues related to policies will be brought forward to the Forest Management Certification Steering Committee (FMCSC) that is chaired by the Permanent Secretary of Ministry of Urban Development and Natural Resources (MUDeRN).

5.0 CONCLUSION

FMC is a tool to measure and ~~analyze~~analyse ~~one~~ forest management against the concept of SFM, with annual audit by third party and involvement of stakeholders including

the local communities, forest managers/company, government agencies and NGOs , ~~FMC~~ t~~o~~o offer transparency. As ~~requirement~~ required in MC&I (Natural Forest) Standards, local communities' rights ~~is~~ are ~~recognized~~ recognised and taken into consideration prior to any operation by the forest managers as to ensure ~~consideration for~~ community well-being. With the consultation framework and mechanism for consultation process, issues can be addressed properly and monitored. Through the FMCLC platform that involves many stakeholders including government agencies and NGOs, there is opportunity for community development project to be discussed within the framework.

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SESSION 2

A REPORT ON NEW SPECIES AND BEHAVIORAL STUDY OF SELECTED HERPETOFAUNA IN HEART OF BORNEO (HoB) AREA

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Abstract

The aim of this report is to highlight several selected newly described species of herpetofauna, new distribution records and ~~behavioral~~behavioural study of selected species found in various locations within the Heart of Borneo (HoB) area in Sarawak. Molecular and morphological ~~evidences~~evidence revealed a new species description of a toad from the genus *Pelophryne* and a scincid lizard of the genus *Larutia* (Bohme.,1981) from Mount Penrissen, Western Sarawak in 2017 and 2019. Recently in 2020, two new species of toad *Ansonia kelabitensis* and *A. kanak* were described in the highlands of Northern ~~ part of~~ Sarawak. A rare agamids lizard, *Harpesaurus borneensis* and an enigmatic ~~–~~microhylids, *Gastrophrynoides borneensis* was reported from Kubah National Park and Tama Abu PF, respectively. ~~Behavioral~~Behavioural ~~study~~ studies involving lizards and snakes have also been conducted such as a report on a unique feeding behaviour known as 'mandibular sawing' in the blunt headed snail eating snake, *Aplopeltura boa* collected from Mount Mulu. Predation of Keel-bellied whipsnake, *Dryopships rubescens* on *Hemidactylus platyurus* as well as first description of anti-predatory strategy in natricine snake, *Rhabodphis conspicillatus* at Kubah National Park were also reported in this study. As part of HoB initiative towards conserving the biodiversity of its area, high species diversity site such as Gunung Penrissen should be upgraded as totally protected area in the near future.

Keywords: HOB Sarawak, pseudoautotomy, mandibular - sawing, *Pelophryne*, *Larutia, Ansonia.*

1 INTRODUCTION

Historically, the campaign for Heart of Borneo (HoB) was first launched in 2004 by the World Wildlife Fund (WWF). The HoB campaign ~~is~~ was considered to be one of the major conservation initiatives ~~initiated~~ to protect vast areas that possess high numbers of biodiversity. HoB was proposed to cover about 220,000 square kilometers in Indonesia, a small region of Brunei and the Malaysian states of Sarawak and Sabah (Persoon & Osseweijer, 2008). The o~~O~~fficial joint declaration was signed by the three governments, Indonesia, Brunei and Malaysia on February 12, 2007 in Bali, Indonesia. This voluntary trans boundary initiative is aimed to protect the biological, ecological, cultural diversity as well as for the conservation of Borneo rainforest (Forest Department Sarawak, 2019).

In Sarawak, HoB presently covers an estimated area of 2.689 million hectare over a contiguous forested land along the state boundaries with Kalimantan, Sabah and Brunei (Forest Department Sarawak, 2019) (Figure 1). The HoB initiative is fully in accord with the existing policies by the state and also federal government. HoB Sarawak ~~is~~ was initially divided into three primary regions namely Northern Region that includes Miri and Limbang divisions, Central Region which covers the Kapit and Belaga districts of the Kapit Division and Southern Region which includes Sri Aman, Sarikei and ~~also~~ Sibu Division. Western Region ~~is~~ was later added in the initiative in 2018 ~~in which it~~ to cover~~s~~ areas from Batang Ai to Tanjung Datu National Park (Forest Department Sarawak, 2020).

As part of the state's agenda in protecting and conserving its vast forested land area, Forest Department Sarawak (FDS) under its Research, Development and Innovation Division (RDID) has long been actively involved in various research initiatives and collaborations with both local and international bodies. In November 2012, a Memorandum of Understanding (MoU) was signed between FDS and the Japan Research Consortium for Tropical Forests in Sarawak (JRCTS) (Sakai et al., 2019). The MoU ~~is~~ aimed to continue and implement research collaboration projects, to develop capacity building for the research division in FDS and to provide research opportunities for the staff.

Under this joint collaboration~~s~~, various research studies have since then been conducted in multiple fields including the biological study of herpetofauna in Sarawak. The author has been working together for many years with Emer. Prof. Masafumi Matsui, Assoc. Prof. Kanto Nishikawa and their team members from Kyoto University of Japan, who~~ich~~ are a group of renowned active herpetologist in South East Asia. We published more than a dozen of scientific reports together on the biodiversity of herpetofauna in Sarawak and some of the papers are included in this report.

Herpetofauna is largely composed of two primary groups of tetrapods, namely amphibians and reptiles. Amphibians in general include ectothermic animals such as frogs, toads, caecilians & ~~salamenders~~salamanders while reptiles are made up of snakes, lizards, alligator~~s~~ and turtles, which are described as oviparous ectotherms with ~~scally~~scaly skin and eggs with shells (Catenazzi et al., 2016). Sarawak is a home to various numbers of cryptic and undescribed species of herpetofauna and unveiling their whereabouts and updating their inventory is ~~essentia~~essential ~~lly important~~ to estimate true diversity for~~towards~~ sustainable conservation. This report aims to highlight our several achievements, i.e.,

selected species of herpetofauna, new distribution records and to report some ~~behavioral~~behavioural study of selected species of herpetofauna, found in various locations within the HoB area in Sarawak.

2 STUDY SITE AND METHODOLOGY

Field surveys have been conducted for many years in various locations in Sarawak and within ~~HOB~~ HoB area. Our focus includes a few ~~interesting targeted~~interesting, targeted locations in the Western and Northern part of the state. These locations include Gunung Penrissen and Kubah National Park ~~which are found~~ in the Western Region while Gunung Mulu National Park and Bario Highlands ~~which~~ are located in the Northern Region (Figure 1). Basic collection methods include~~ing~~ searching near trails and streams at night using torchlight, digging under leaf litter and logs, hand catching and pitfall traps ~~were used~~. Specimens were later photographed, measured, fixed and preserved in 10% formalin, then finally preserved in 70% alcohol as voucher specimens ~~to~~ in RDID. Description of new species was mainly done via morphology traits and molecular works and series of discussion among us. For behavioural study, specific technique and tools were used including the use of infrared video recorder, radio tracking, and others.

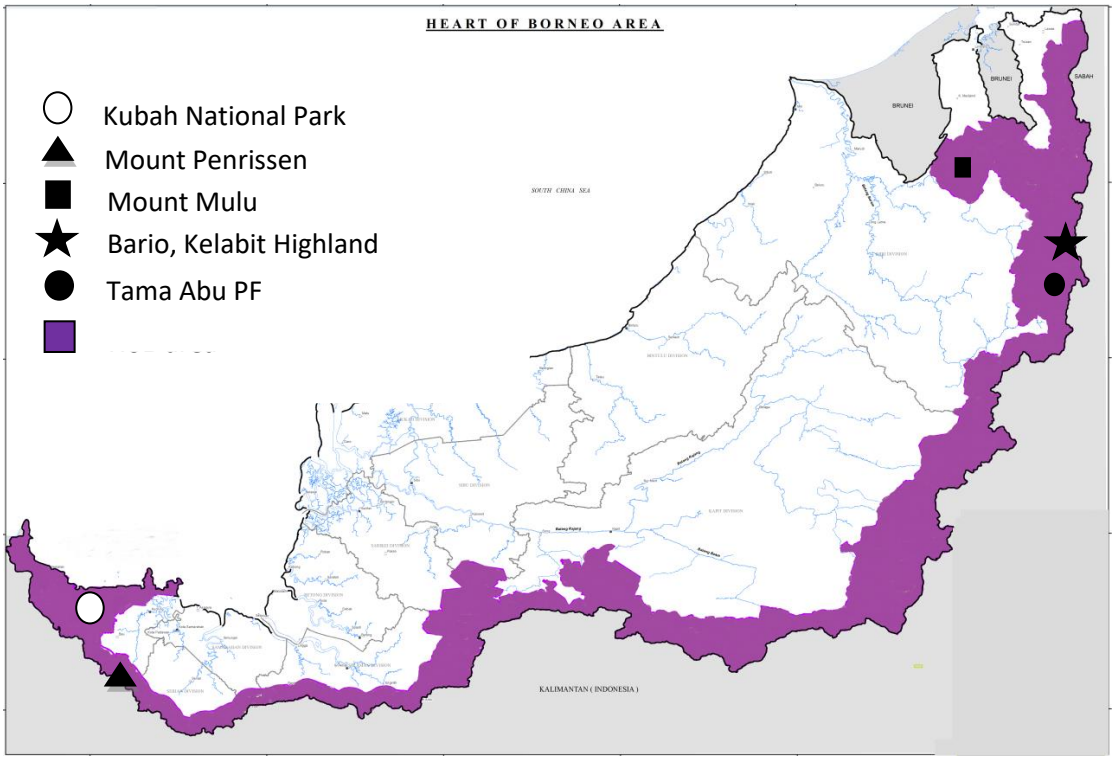

Figure 1: **Map of HoB area within Sarawak of approx. 2.7 million hectare, with the locality of new species and new record of herpetofauna within the area.**

(reproduced from ~~-~~: Forest Department Sarawak [2020])

3 RESULTS AND DISCUSSION

3.1 New species from HoB area

3.1.1 *Pelophryne penrissenensis*

Specimens of *Pelophryne* ~~was~~ were collected during an amphibian survey conducted at Gunung Penrissen in 2017 (**Figure 2**). The specimens were found at a narrow area in a primary forest, on a slope that is surrounded by a rocky mound. The collected specimens revealed stark difference from the synoptic *P.signata* in regards to the larger body size and different colour pattern. The species also showed different morphology from all the known congeneric members except for *P.murudensis* from Das (2008), which was initially collected from Gunung Murud, located 640km away from the type locality. Among the species, the new species is closely related to *P.murudensis* but differs in its body size in regards to its hindlimb length and also its dorsal colour. As the samples of *Pelophryne* sp. from Penrissen are morphologically closely uniform, and are evidently separated from all the known congeners in accordance with the genetic separation, they are hence proposed as a new species as *P. penrissenensis* sp. nov (**Figure 2**).

Figure 2: ***Pelophryne penrisenensis*** **collected from Mount Penrissen. Photo by Masafumi Matsui**

3.1.2 *Ansonia kelabitensis & A. kanak*

The stream toads in the genus Ansonia are confined to South East Asian regions namely Myanmar, Thailand, Malay Peninsular, Sumatra, and Philippines including the large island of Borneo. For years, Borneo is thought to be the origin of this genus (Matsui et al., 2010, 2012; Grismer et al., 2016). A large number of the genus has been collected during various surveys conducted in the past decade where morphological and molecular analyses were conducted to assess their lineages. Based on mitochondrial DNA phylogeny, two lineages of the genus in particular which were collected from Bario, Kelabit Highlands of Sarawak and Mount Mulu of Sarawak (**Figure 1**) are significantly different from other congeners, comparable with those recorded between heterospecific species in the genus (Matsui et al., 2020). They are also morphologically distinguishable from other species, and are therefore considered to represent valid, independently evolving species. The lineages are described as *A. kelabitensis* sp. nov. (**Figure 3**) and *A. kanak* sp. nov (**Figure 4**).

Figure 3: ***Ansonia kelabitensis*** **collected from Kelabit Highland, Bario. Photo by Masafumi Matsui**

Figure 4 : ***Ansonia kanak*** **collected from Mount Mulu. Photo by Masafumi Matsui**

3.1.3 *Larutia kecil*

A specimen of scincid lizard *Larutia* was retrieved also at Gunung Penrissen, which is considered as the second specimen known originally from Borneo (**Figure 1**). The survey was conducted in March 2018, in which the specimen was found under a dead tree log, on the edge of the surrounding primary forest. The specimen has distinctive morphology that differentiate it from *L.puehensis* J.Grismer et al., 2003, which is the only known Bornean species as well as from the other congeners from the Thai and Malay Peninsular and Sumatra. Some of the distinctive features include having a small adult body size (SVL 84 mm), 22 longitudinal scale rows found on the midbody, no yellow or pale spots on the body, two smaller lamellae on second toe. This specimen, hence, is regarded as a new species known as *Larutia kecil* sp. nov. (**Figure 5**). Phylogenetic analyses based on mictochondrial ND1 gene revealed that the specimen is strongly related to *L.serbuatensis* from Seribuat Archipelago (Fukuyama et al., 2019). Currently, Gunung Penrissen is not a protected area despite being the site of many recent new discoveries of reptiles and amphibians. As these animals are negatively affected by potential deforestation threats, this mountain site deserves a conservation initiative in the future.

Figure 5: ***Larutia kecil*** **collected from Mount Penrissen. Photo by Ibuki Fukuyama**

3.2 New records feom HoB area

3.2.1 *Harpesaurus borneensis*

An adult male *Harpesaurus borneensis* (**Figure 6**) was collected on a~~n~~ steep trail in Kubah National Park, Sarawak, Malaysia (**Figure 1**) on August 16th 2017. The reptile is 52.8 mm in snout-vent length and it was collected from a low mountain sandstone massif that is surrounded by primary mixed dipterocarp forests that is 10 to 30 m in height (Hazebroek and Morshidi, 2006). Historically, only four localities of *H.borneensis* have been reported in Sarawak (King, 1978; Lardner et al., 2010; Manthey, 2010) which are from Kapit and Bintulu divisions. Phylogenetic analyses showed that the current new record from Kubah National Park, ~~from~~ Kuching Division that is situated at the west part of Sarawak, is not closely related to the known four localities (Kurita et al., 2020). *H.borneensis* lizards belong to the Agamidae (Squamata : Iguana) family which is distributed in Africa, Eurasia, Australia and the adjacent lands and has diverged commonly in the tropics (Kurita et al., 2020). Agamids are found in various habitats such as rainforests, shrub tree forests, rocky mountain areas, open plains as well as deserts. Harpesaurus inhabits tropical rainforests in the Sunda Islands and is regarded as one of the most obscure lizards in the world (Manthey, 2010).

Figure 6: **Newly recorded *Harpesaurus borneensis* from Kubah National Park, Sarawak. Photo by Ibuki Fukuyama**

3.2.2 *Gastrophrynoides borneensis*

A scientific research expedition was organized by Forest Department ~~of~~ Sarawak in Tama Abu Permanent Forest in August 2017. Tama Abu PF is a dominant mountainous range located in the eastern part of Miri Division, where the highest elevation is the top of Mount Murud. The expedition site~~s~~ is approximately 130km from Miri town and situated to the southern part of the range (Dana et. al., 2019; **Figure 1**). One individual of a fossorial, rare microhylids frogs, *Gastrophrynoides borneensis* (Boulenger, 1897) was collected by the author near the base camp (**Figure 7**). The collection was made during a heavy rain where the specimen was seen jumping away from the rain probably looking for shelter. Matsui and his team, also reported the collection of the same species in 2017 at Batu Kawa, Kuching during a heavy rain where the specimen was collected inside the curling of leaves on the ground. The specimen from Tama Abu PF was dark brown in colour with some small dots around its body similar as reported by Boulenger (1897) and Inger (1966) by the presence of scattered white spots/dots but differs from the unique specimen collected by Matsui and his team, in 2017 with no light spot and uniformly brown in ~~color~~colour, in which they suggested that this might be due to geographic variation or a possible different taxa. The report from Tama Abu PF should be identical to the report from type locality in Baram District (Boulenger, 1897).

Figure 7: **Gastrophrynoides borneensis from Tama Abu PF, Miri, Sarawak. Photo by M. Yazid Hossman**

3.3 Behavioral study of selected species

3.3.1 Mandibular sawing in *Aplopeltura boa* snake

A unique feeding behavior in the blunt headed snail eating snake, *Aplopeltura boa* ~~is~~ was assessed and reported in this study in which the specimen was collected from Gunung Mulu National Park, Sarawak, Malaysia. *Aplopeltura boa* exhibits a set of morphological feeding elements known in other pareids and dipsadines which include short snout, reduced supratemporals, short pterygoids, extended mandibles and comb-like teeth. Its skull in general is short and its orbits are distinctly large. The pterygoids are greatly reduced and their posterior ends are independently detached from the mandibular joint. The long mandibles carry robust set of teeth (Kojima et al., 2020). It was observed that the snake removes and circumvents the indigestible part which is the operculum of its prey in its mouth using long sliding excursion of single side of the mandible while the upper jaws and the other side of mandible grasp the prey steadily. This behaviour is termed as 'mandibular sawing', which is permitted by extraordinary ~~ily~~ independent movements of the elements in the jaws (**Figure 8**). This revelation is a surprising departure from usual feeding pattern in most vertebrates. Feeding behaviour of most species of snakes have not been previously described due to limited access to these tropical, secretive and nocturnal animals.

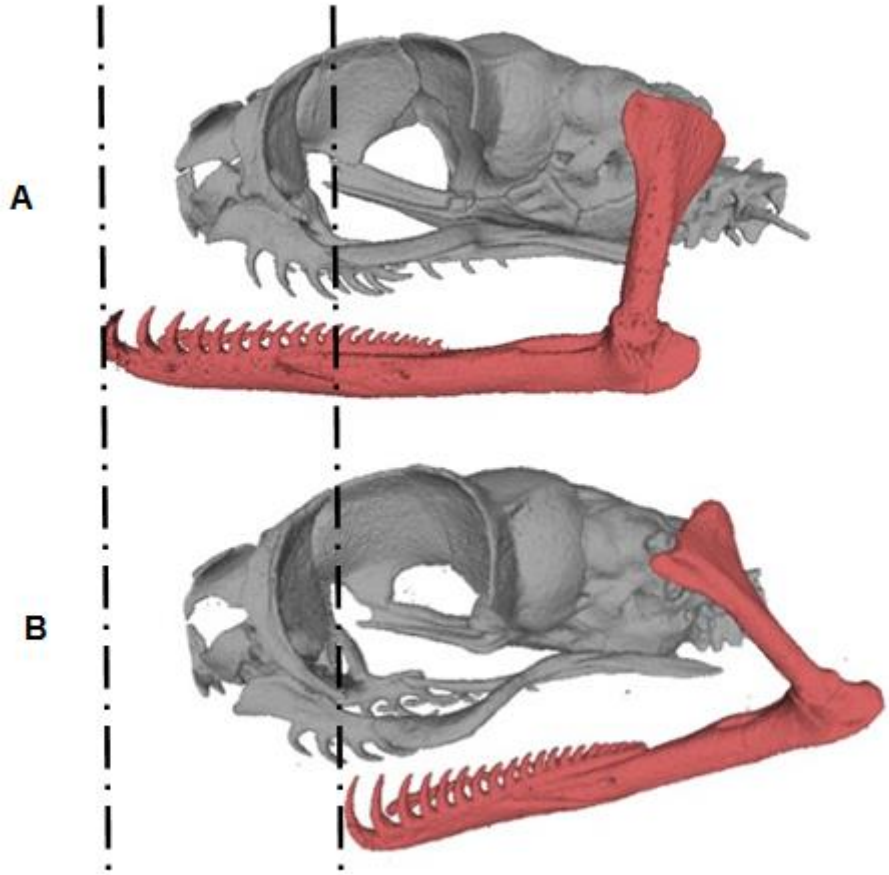

Figure 8: **CT images of the movements of the lower jaw of *Aplopeltura boa.* (A) The skull and the jaws from left lateral view with the mandible protracted and (B) slightly retracted.**

Reproduced photo from Yosuke Kojima.

3.3.2 Antipredator strategy of *Rhabodphis conspicillatus*

Tail-breakage or urotomy is a common antipredator strategy among many squamate reptiles. Urotomy is further divided into autotomy and pseudoautotomy. Autotomy is a type of ~~defense~~ defence strategy in which it involves voluntary intravertebral breakage with regeneration while pseudoautotomy refers to intervertebral breakage without regeneration (Savage and Slowinski, 1996). Autotomy has evolved ~~in~~ across several lineages of lizards and pseudoautotomy is found in several lizards and a few snake species (Fujishima et al., 2020). A small male terrestrial natricine snake, *Rhabdophis conspicillatus*, was captured during the night in August 2018 on a trail surrounded by primary lowland dipterocarp forest in Kubah National Park. While the snake was trying to escape into the leaf litter on the side of the trail, the observer caught the snake by its tail and it then immediately performed undulation and lateral rotation of the body, dropping part of its tail. The dropped tail about 41mm long kept wriggling for less than a minute. Exact duration is not known as it was not recorded. Radiograph inspection of

the detached tail depicted that the tail was broken intervertebrally between the 21st and 22nd vertebrae (**Figure 9**). This is the first report of pseudoautotomy in the genus *Rhabdophis.* The same behaviour however ~~have~~has been observed in other natricine snakes such as *Amphiesma stolatum* (Sharma, 1980), *Xenochrophis piscator* (Ananjeva and Orlov, 1994) and *Nerodia sipedon* (Bowen, 2004). The trait is more commonly shared among members of this subfamily as compared to other snake taxa. This hence can potentially be explored in phylogenetic and ecological studies.

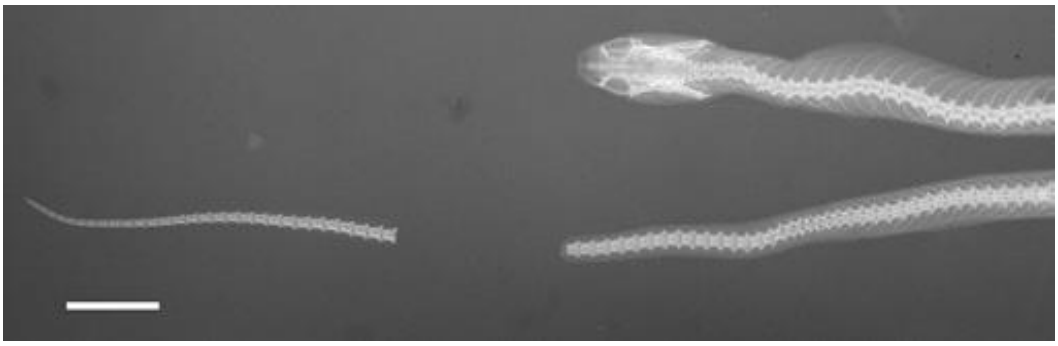

Figure 9: **A radiograph of *Rhabdophis conspicillatus* specimen where tail breakage (pseudautotomy) occur between the 21st and 22nd vertebrae. Photo by Kanta Fujishima.**

3.3.3 *Dryopships rubescens* diet

A herpetofaunal survey was conducted at Kubah National Park, Kuching, Sarawak ~~on~~in August 2019, where ~~ in which~~ a predator and prey ~~behavioral~~behavioural study of Keel-bellied whipsnake, *Dryopships rubescens* was observed. *Dryopships rubescens* is a medium-~~–~~sized, arboreal snake (**Figure 10**), which is commonly found in western Philippines, Java and Sumatra islands, Peninsular Malaysia, South of Thailand, Cambodia and also the island of Borneo. This species is known to generally feed on frogs (Baker and Lim, 2008) and~~,~~ lizards such as *Draco melanopogon* (Boulenger, 1912). Predation of *D.rubescens* on *H.platyurus*, a flat-~~–~~tailed house gecko, a common nocturnal gecko in Southeast Asian countries was observed in this study. The house gecko was initially spotted on the tree trunk and while trying to escape from being observed, it was subsequently attacked by *D.rubescens.* The snake then took an estimated 15 minutes to completely swallow the gecko from its head, with no constriction. This observation suggests that *D.rubescens* is active and typically feeds at night. Diurnal activity however ~~have~~has been previously observed (Das, 2007).

Figure 10*:* ***Dryophiops rubescens*** **preying upon an adult** ***Hemidactylus platyurus*** **in Kubah National Park, Sarawak. Photo by Sally Kanamori.**

4 CONCLUSION

The HoB initiative has had many challenges throughout its establishment and implementation. Nevertheless, it has garnered laudable efforts and successful research studies ~~in regards to~~in regard to its biodiversity conservation of the area. Forest Department Sarawak, in particular, through its forest research division~~,~~ RDID, has been committed in participating and initiating research studies within the area. Our group has focussed on herpetological explorations because of herps' (amphibians and reptiles) position at the middle of the food chain and contribute to ~~keep~~ the local ecosystem. Thus, they could be a good representative of the nature and also an environmental indicator. We ~~has~~have

conducted surveys in various valuable locations in Sarawak under the HoB initiative, ~~then~~ which has led to discoveries of several new species and also allow revelations of behavioral study of selected species. Some of the mentioned study sites such as Gunung Penrissen, harbours unique biodiversity. Our achievements on herpetological surveys show that it would be advantageous if the site could be further protected and upgraded as a totally protected area in the near future.

5 ACKNOWLEDGEMENT

The author and his~~the~~ Japanese counterpart would like to express gratitude to the Forest Department ~~of~~ Sarawak for the opportunity to contribute research works to the HoB initiatives program. Thanks to all ~~the~~ contributors, Emer. Prof. Masafumi Matsui, Dr. Yosuke Kojima, Takaki Kurita, Ibuki Fukuyama, Kanta Fujishima and ~~,~~ Sally Kanamori for the valuable resources and comments, also to RDID staff, Mohd Yusuf Abd Rahman and Mahmud Merdek for field assistant and Halim Z. for literature checking. Special thanks to Assoc. Prof. Kanto Nishikawa for the guidance and motivation, Mdm. Runi Sylvester Pungga, Mr. Paulus Meleng and Hjh M~~N~~ohizah Mohamad for the support throughout the years.

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BIODIVERSITY CONSERVATION: RARE, THREATENED AND ENDANGERED TREE SPECIES IN HEART OF BORNEO

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Abstract

Malaysia is well-known as one of the 12 megadiverse countries in the world. According to the World Development Indicators, Malaysia has only 0.2% of the world's land mass but its diversity of flora and fauna species makes it one of the richest countries in the world in terms of biodiversity per unit area. Sarawak is contributing about 37% land mass in Malaysia and 44% forest cover. Sarawak's natural forests consist of several habitats that harbour many tree species that are unique and some are endemic to Borneo. Forests within the Heart of Borneo (HoB) house many of these tree species and the populations that are located outside the protected areas are threatened by land conversion and unregulated forest harvesting operation. Hence, a study on selected tree species within HoB was carried out to assess their status of conservation. 135 taxa from 18 families of trees were categorised as rare, threatened and endangered (RTE) for Sarawak, as well as globally assessed as threatened were evaluated for this study. This paper highlights the findings of RTE tree species within HoB and their conservation status, which consequently determine the priority of species conservation effort for the state.

Keywords: Tree, biodiversity, conservation, RTE, Sarawak, HoB

1.0 INTRODUCTION

The forest is an important asset to the state, not only for the great economic importance but also its significant value for biological diversity that grasp the balance of forest ecosystem. Sarawak's biodiversity is so rich, where many species are yet to be discovered, but many others are currently being threatened due to the anthropogenic impact. The value of biodiversity is often being neglected and under-appreciated. Biodiversity is important to provide various productive materials for essential needs and economic development. It is also the backbone of the way ecosystems function and give services as well as providing aesthetic value that stimulates senses to nature. Sarawak's HoB is the house of many biological diversity, where some are endemic to Borneo and confined to the distribution in Sarawak. HoB consists of different land uses, where 53% are Permanent Forests (PF), 17% are Totally Protected Areas (TPA), 25% are the State Land & 5% are others. The RTE tree species that is distributed within these various land uses are mostly located outside of the

protected areas. The not protected area (PFs, State land & other land uses) covers 83% of the HoB area and the RTE species in this zone are susceptible to habitat loss and forest operation. Information on RTE species in Sarawak is still inadequate and having the data is important ~~in order to~~to achieve the goals in the National Policy on Biological Diversity (2016-2025). This study aims to determine the distribution of RTE tree species and assess their conservation status. The findings of this study are very crucial to support the decision of conservation measures to be emphasized, particularly of those species that are endemic to Sarawak and with higher threatened category corresponding with the actual status in the state. This paper ~~discussed~~ discusses ~~on the~~ preliminary findings for RTE species in HoB, where in the long run of this research, the coverage of the study will be extended across the state.

2.0 APPROACH

Data ~~were~~ was acquired from herbarium specimens in Sarawak Herbarium, published references and literatures, unpublished technical report (High Conservation Value Assessment reports and botanical collection reports) and raw data obtained from field work. Field surveys were conducted in PFs (Licensed areas and unmanned PF), TPAs and state land (refer to Appendix 1 for the study site). The conservation status, protection on the species and its distribution within HoB area were assessed.

3.0 RESULTS AND DISCUSSION

3.1 Assessment Findings

A total of 135 taxa from 18 families and 35 genera that are under the rare, threatened and endangered category were evaluated in this preliminary finding~~s~~. Species assessment is completed only for the family of Dipterocarpaceae, thus the species count for RTE categorisation is the highest compared to other tree families with 76 taxa is under threatened (**Table 1**). Assessment for other species from the non-dipterocarp family is still on-going and much work is needed in order to have comprehensive results for the study. Species assessment is given higher priority to species with distribution confined to Sarawak, and 55 species endemic to Sarawak were recorded in HoB area. Of these 55 species, three are under Critically Endangered (CR) category as listed in Sarawak Plant Red List and six are under CR listed in the IUCN Red List of Threatened Species.

Table 1: **Preliminary findings of RTE species in HoB area**

Family	Species Count	SPRL				IUCN, 2020			Sarawak endemic	Borneo endemic
		RA	CR	EN	VU	CR	EN	VU		
Dipterocarpaceae	76	1	11	28	36	22	19	26	8	44
Thymelaceae	15	/	/	/	/	2	1	5	5	4
Burseraceae	9	/	/	/	/	/	2	7	8	1
Celastraceae	7	/	/	/	/	/	1	6	7	/
Myristicaceae	6	/	/	/	/	/	/	6	6	/

Moraceae	5	/	/	/	/	/	/	1	5	/
Ebenaceae	3	/	/	/	/	/	2	/	3	/
Rutaceae	3	/	/	/	/	/	/	3	3	/
Anisophylleaceae	1	/	/	/	/	/	/	1	1	/
Annonaceae	1	/	/	/	/	1	/	/	1	/
Cornaceae	2	/	/	/	/	1	/	1	2	/
Goodeniaceae	1	/	/	/	/	/	/	1	1	/
Meliaceae	1	/	/	/	/	/	/	1	1	/
Myrtaceae	1	/	/	/	/	1	/	/	1	/
Oleaceae	1	/	/	/	/	/	1	/	1	/
Oxalidaceae	1	/	/	/	/	/	/	1	1	/
Polygalaceae	1	/	/	/	/	/	1	/	1	/
Sapindaceae	1	/	/	/	/	/	1	/	1	/
Total	135	1	11	28	36	27	28	59	55	49

Notes: SPRL = Sarawak Plant Red List; IUCN = International Union for Conservation of Nature; RA = Rare; CR = Critically Endangered; EN = Endangered; VU = Vulnerable

3.2 Distribution of RTE Species in Heart of Borneo

Distribution of the RTE species ~~are~~is scattered in HoB area. 48% of assessed RTE species in this study are located outside of the ~~the~~ network of TPA, which gives the highest species count (Table 2). Occurrence of the concerned species outside protected areas is the most critical as there is no legal protection that defend the species from exploitation. Hence, measures to protect the species need to be formulated and implemented effectively.

Table 2: **Occurrence of RTE species within HoB area**

Zoning within HoB	**TPA Only**		**Outside TPA only**		**TPA + Outside TPA**	
Family / Species Count	11 / 31 spp.		12 / 65 spp.		8 / 39 spp.	
Threatened Category	SPRL	IUCN	SPRL	IUCN	SPRL	IUCN
CR	1	4	10	13	0	10
EN	6	9	14	11	8	8
VU	2	11	18	30	16	18

3.3 Conservation Plan and Implementation within Heart of Borneo

Implementation of conservation activities to achieve the National Policy on Biological Diversity is one of the challenging undertakings for the area outside the network of TPAs. The Wild Life Protection Ordinance (1998) is one of the Sarawak's legal protection for tree species, thus any species listed that occurs outside the TPAs is automatically protected. However, 83% of HoB area is susceptible to habitat loss and forest degradation, resulted from logging operation, agricultural activities and forest clearing for development. For species that is not listed in WLPO, particularly ~~of~~ those that fall under RTE category, this gives adverse impact to their population. Reduced quality of forest habitat is continuing in Sarawak but to cease the activity that generates the state income for the interest of species conservation would not be beneficial. Therefore, planning and implementation of conservation action for RTE species and areas at PFs is initiated.

Conservation activities are being carried out throughout the state. The activities for the RTE species are (i) phenology & population monitoring of targeted RTE species to determine the health of existing population and to study the threats, (ii) collection and raising of RTE species wildings for *ex-situ* conservation (see Figure 1), (iii) restoration and enrichment planting to improve population (see Figure 2), (iv) identify area for High Conservation Value Area (HCV) 1 for protection of RTE species and HCV 3 for conservation of threatened ecosystem (see Figure 3). Ecosystem conservation in PFs is an effective measure to safeguard existing *in-situ* population and improve recovery of highly threatened species population in their natural habitat.

Developing conservation measures to protect the RTE species ~~has to~~must be ~~in~~ holistic~~e approach~~ for it to be effectively executed. Recommended strategies to attain successful biodiversity conservation for Sarawak are ~~as the~~ follow~~sing~~:

- Address the primary causes of biodiversity loss by main-streaming biodiversity issues across government, industries and society,
- Enhance and improve the implementation of activities through participatory planning, management and capacity building,
- Reduce pressures on biodiversity and promote sustainable use and practices,
- Improve the status of threatened biodiversity by safeguarding ecosystems, species and genetic diversity,
- Enhance and improvise the benefits of biodiversity and ecosystem services through tourism ~~ty~~ activities.

Figure 1: **The wildings of Gaharu species, *Aquilaria beccariana* (left) and *Aquilaria microcarpa* (right) were collected and raised in the nursery of Research, Development & Innovation Division for *ex-situ* conservation**

Figure 2: **The seedlings of *Gonystylus bancanus* (Ramin telur) were collected at Ulu Mendalam, Gunung Mulu National Park and temporarily kept at nursery for restoration and enrichment planting**

Figure 3: **Demarcation of forest area for the protection of critically endangered Sarawak endemic species, *Shorea rotundifolia* (middle photo) as HCVA 1 and threatened ecosystem of heath forest as HCVA 3 by Anap Muput FMU**

4.0 CONCLUSION

It is our responsibility to commit ~~for~~ to ~~an~~ effective management, conservation and sustainable development of forest biodiversity. The significant value of our biological biodiversity should be protected to secure its perpetual existence~~t~~, not only within HoB area but throughout Sarawak. This study has pinned down the focus on what to be prioritized in conservation action for biodiversity component. Nevertheless, this study is still in the beginning of the implementation to achieve its ultimate target that is to conserve the biological diversity and to promote sustainable use of natural resources. Implementation of conservation action could be reinforced with the support of advanced research via molecular genetics study. Biotechnology provides tools conserving, evaluating and using genetic resources where it requires germplasm as raw material to obtain the genetic information. It is recommended to conduct genetic fingerprinting study on the RTE species for easy and reliable identification of plant species as well as to develop genetic profile for future reference. ~~The~~ Gg~~g~~enetic profiling ~~–~~could be applied for tracking the species origin (DNA forensics) in the use of detecting illegal RTE species trading. At the same time, germplasm conservation is also required to conserve the important genetic traits of the endangered and commercially valuable species.

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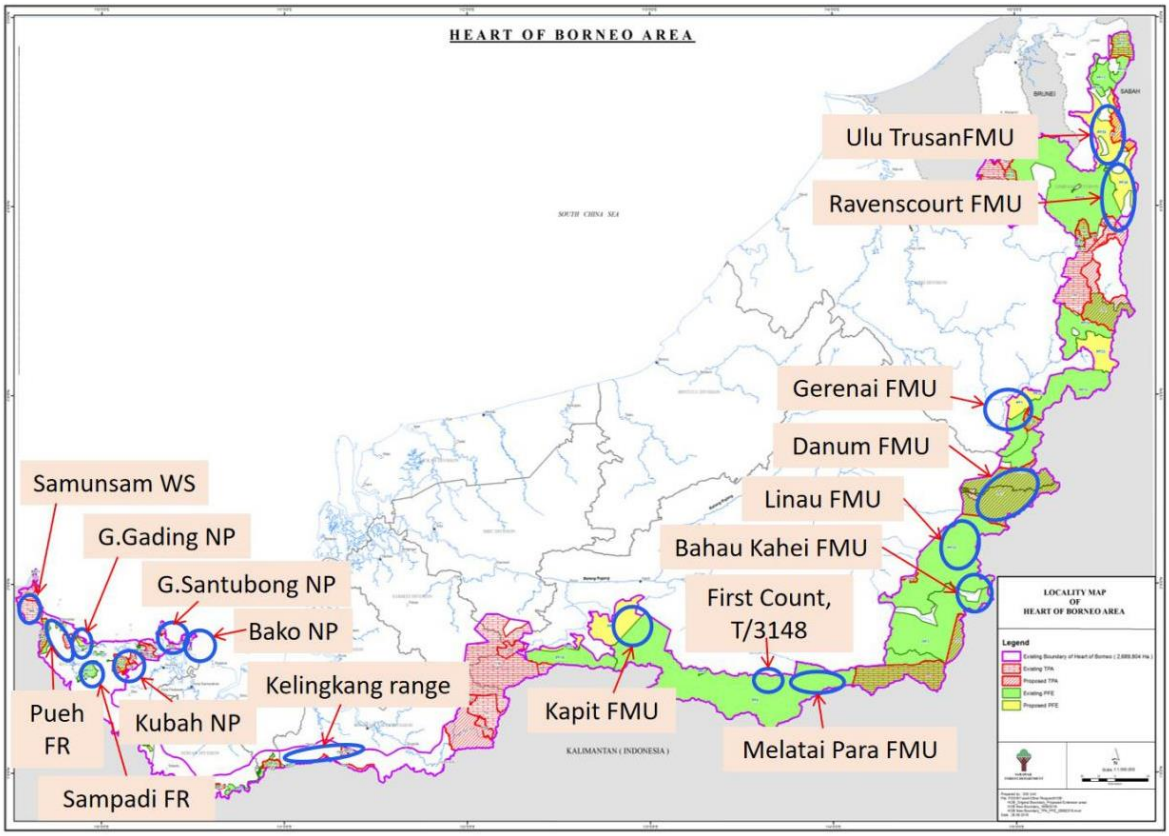
6.0 APPENDICES

Appendix 1: **Map of surveyed area within Heart of Borneo (HoB) area for RTE assessment**



SESSION 3

PLANTING GAHARU TREES AT ULU SUNGAI MENYANG : STATUS UPDATE

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ABSTRACT

Gaharu is the vernacular name for the aromatic resinous wood produced by species of evergreen tropical trees from the genus *Aquilaria*. The tagline "*Beginning of A Journey …*" was invented in 2017 by the Forest Department Sarawak as the brand ambassador and ground-breaking conservation business model implemented within Ulu Sungai Menyang Conservation Area at Batang Ai. It is about planting gaharu trees. It is about gaharu tea. It is about conserving orang utan habitat while uplift the livelihood of the local communities. It is part of the strategy to generate alternative income while conserving the pristine forests there under the Orang-utan Strategic Action Plan adopted by the state government and supported by multi-stakeholders including government agencies, corporate and private sectors, international and local NGOs, clubs, associations etc. In this paper, current progress, challenges and opportunities in implementing this project will be discussed. We will also report on project achievements thus far. Conservation is still the fundamental pillar of this business model; striking a balance between conservation objectives while generating realistic alternative livelihood for the local communities. Unlike traditional idea of gaharu cultivation, the gaharu farmstead established at Ulu Sungai Menyang is for its leaves — to be turned into gaharu tea. The advantages and environment friendliness of gaharu cultivation, such as zero deforestation, zero weedicide and pesticide policy will be deliberated. From a business perspective, this model is viable because of the involvement of a Sarawak-based company that has already marketed its own brand of premium gaharu tea. The potential income generated from gaharu leaves is estimated to be in the range of RM4,500 – 5,400/acre/year. In addition, this project is slowly bringing in a second source of income, i.e. gaharu-themed ecotourism and homestay. The profit margin for a 3D2N package involving roughly 40 guests is between RM3,500 – RM4,500 per tour. Because of these high impact successes, this project has won a state level recognition — the High Performance Team Award in 2019. In 2020, the progress of project this project is slowed due to pandemic covid19. As a conclusion, planting of gaharu trees for gaharu tea is a game changer in balancing conservation aims while satisfying the aspirations of the local communities in Ulu Menyang. The State Government through Forest Department Sarawak

and other stakeholders are in the process to replicate this model to other communities in Ulu Menyang area.

1. BACKGROUND

1.1. What is Gaharu?

Gaharu is the Malay word for agarwood, and can be considered one of the most valuable natural wood products. The sweet aromatic fragrance of smouldering agarwood is treasured by many cultures. The antiquity of agarwood usage is embedded in the custom and culture in Middle East (Antonopoulou et al., 2010), China (Anon., 2005), Tibet, and Japan (Compton & Ishihara, 2005) over the millennia. Agarwood is used in Ayurvedic, Tibaten and traditional East Asian medicine (Chakrabarty et al., 1994). Medicinally, agarwood is used to treat nervous disorders, exhaustion, acroparalysis, relieve pain, asthma, enhance blood circulation as well as promotion of *qi* (Kim et al., 1997). It is also used in religious rituals, i.e. Hindus, Buddhists and Muslims, in the form of meditation incense or splinter chips to calm the mind, and to drive away evil spirits. Agarwood has also been sculptured into religious, usually Buddhist figurines, in China.

The highly prized section is the heartwood of the *Aquilaria* tree that is saturated with resin when subjected to certain pathological infections or physical wounds (Ng et al., 1997; Barden et al., 2000; Mohamed et al., 2010), and over times this had hardened and solidified into aromatic resin. The healthy wood is soft, even-grained texture and whitish in colour. The resinous infected heartwood emits an aromatic scent and appears blackish in colour. The best grade agarwood is hard solid black colour and sink in water. Inferior agarwood is paler in tone but still good for distillation of agarwood oil for perfumery — a luxury essential oil.

1.2. Ulu Sungai Menyang Conservation Area

Sungai Menyang in Sri Aman Division is one of the many tributaries of Batang Ai river that drains into the reservoir of Batang Ai Dam.Ulu Sungai Menyang Conservation Area, covering approximately 14,000 hectares, is a special area in Sarawak created for the protection of the orang-utan (*Pongopygmaeus*) populations. This special area for orang-utan conservation was mandated by the then Honourable Chief Minister Pehin Sri Haji Taib Mahmud on 28 March 2013. For the first time in the history of conservation in Sarawak, the legal provision Section 28 of the Wild Life Protection Ordinance, 1998, is invoked to protect the landscape of Ulu Sungai Menyang for the benefits of the orang-utan populations found outside the existing totally protected areas (TPAs), namely Batang Ai National Park and Lanjak-Entimau Wildlife Sanctuary.

In 2015, Forest Department Sarawak and Wildlife Conservation Society (WCS)-Malaysia Program produced the Ulu Sungai Menyang Orang-utan Strategic Action Plan, which outlines several key time-bound interventions and implementation plans

to protect the orang-utan habitat there. The paper entitled "*Beginning of A Journey : Implementation of Gaharu Agronomy at Ulu Sungai Menyang Conservation Area.*" presented here is the on-going pilot project implemented here since 2016.

1.3. Community Structure at Ulu Sungai Menyang

The community at Ulu Sungai Menyang, Batang Ai, LubukAntu is predominantly from the Iban ethnic group. There are eight longhouses in Ulu Sungai Menyang, with about 70 families altogether living in harmony with nature. The only accessibility to this area is by river transport across the Batang Ai Dam.

Because of the remoteness of this area without any road access, there is not much economy activity or opportunity. Subsistence farming, hunting and collecting of jungle produces is everyday life for these people. But these communities also aspired to be involved in mainstream economic activities and modern amenities, which is basic human right.

1.4. Beginning of A Journey …

The tagline "*Beginning of A Journey …*" is the brand ambassador of Forestry Department Sarawak's ground-breaking community-based conservation initiatives for Ulu Sungai Menyang Conservation Area. The soul and fundamentals of this initiative is the protection of the pristine forests at Ulu Sungai Menyang and conservation of the orang-utan populations outside Batang Ai National Park and Lanjak-Entimau Wildlife Sanctuary. "*Beginning of A Journey …*" is a metamorphic representation of such undertakings.

The heart of "*Beginning of AJourney …*" is to plant *Aquilaria* trees for the production of gaharu leaves as an alternative livelihood for the inhabitants at Ulu Sungai Menyang. So far, this project has touched the heart and soul of many who have come into contact with it. It is a rather galvanizing and innovative idea. The Forest Department Sarawak, in collaboration with WWF-Malaysia (Sarawak Program), kicks start the journey and bridging the local communities with Aquilaria Plantation Sdn. Bhd. — a Sarawak-based private business entity who have produced and marketed their own brand of premium gaharu tea — to market the final product. Eventually, the former parties will take a back seat allowing the local communities to sell directly to the private company like any normal business transaction.

1.5. Gaharu Agronomy

The Iban communities at Ulu Sungai Menyang are very receptive to the orang-utan conservation initiatives because this animal is culturally significant and occupies a mythical spot deeply embedded in their folklores. In return to agreeing not to log or convert the pristine forests at Ulu Sungai Menyang (i.e. an important orang-utan habitat outside totally protected areas) into commercial plantation for short-term

monetary gain, one must provide sustainable alternative livelihood that is environmentally friendly and economically attractive to them.

Many community-based initiatives had been carried for conservation purposes in the past, but almost all fell short of the intended desirable outcome. This is mainly because most of the non-timber forest product (NTFP) promoted could not compete with existing cash crops such as pepper or oil palm in terms of economic returns. Now, the department is adopting a totally different approach, a rather refreshing innovative idea — gaharu agronomy.

Nonetheless, this approach is totally different from traditional notion of planting gaharu tree for its valuable resinous wood after artificially inoculated these trees with chemical inoculant. There are not many successful examples because the effectiveness of these inoculants is extremely variable, and the time span is very long, taking no less than 7 years cycle.

So, in this new approach, instead of cutting down the cultivated gaharu trees for its aromatic resinous wood, this ground-breaking conservation business model capitalising on a new market product — gaharu tea — as alternative cash crop to uplift the livelihood of the local communities. In short, we are planting *Aquilaria* trees for their leaves.

Gaharu agronomy may well be a game changer in balancing conservation aims while generating realistic economic benefits to the local community. Never in the history of conservation efforts in Sarawak that such a bold plan have ever been conceived. It is perhaps there is not a single NTPF, at least not until now, that is valuable enough to offset competition from other cash crop.

1.6. Gaharu Tea

In a strict sense, the word “tea” is specifically referred to the infusion from the leaves of tea bush (*Camellia sinensis*). Any herbal infusions from other plant species should be called tisane. However, these terminologies are loosely applied because we often hear “herbal tea” rather than “herbal tisane” even if the product does not contain *C. sinensis* leaves. This is the same for gaharu tea. It is a product made from the leaves of gaharu trees (*Aquilariamicrocarpa*); altogether a totally different plant family from the common tea bush.

Studies have shown that the chemical composition of gaharu leaves extracts contain mainly phenolics compounds such as flavonoid, phenolic acid, anthocyanidin, and tannins (Qi et al., 2009; Feng et al., 2011). In layman’s terms, these are antioxidants. However, one interesting group of compounds is the iriflophenone. Pranakhon et al. (2015) reported that iriflophenone 3-*C*-β-glucoside lowered the blood glucose levels in experimental mice by 40.3% as compared to insulin (41.5%).

There are other benefits of gaharu tea, which is beyond the scope of this paper. Suffice to say, the gaharu tea produced by Aquilaria Plantation Sdn. Bhd. is

organically grown without using weedicide or pesticide. It is a refreshing beverage either taken hot or cold. Its wonderful golden coppery infusion is smooth to the palate without the hash astringency of typical herbal health drink.

2. OBJECTIVES

The primary objective of this community based undertaking is to establish plots of gaharu farmstead at selected longhouse communities at Ulu Sungai Menyang. This ground breaking conservation initiative is to conserve the pristine forests there and protect the orang-utan habitat. In return, the gaharu farmstead is to become a source of viable alternative income*in lieu* for the local communities' aspiration to open-up the land to plant other cash crop.

In short, the objectives of this initiative can be summarized as list below:-

- To conserve the pristine forests, biodiversity and its associated ecological integrity of Ulu Sungai Menyang Conservation Area, especially the protection of the orang-utan habitats.
- To uplift the economic livelihood of the communities at Ulu Sungai Menyang exploiting an innovative non-timber forest product, i.e. gaharu leaves, to generate an alternative livelihood that is economically appealing, viable and environment friendly.
- To guarantee sustainable land use and zero deforestation policy while generating realistic incomes via gaharu tea production and related tourism spin off.
- To implement a ground-breaking conservation businesses model incorporating the Forest Department Sarawak, the communities from Ulu Sungai Menyang, NGOs and an established private commercial entity that have already created a market demand for their premium gaharu tea.
- To stimulate spin-off from gaharu-themed tourism product in collaboration with existing tourism players such as the AimanBatang Ai Resort and Retreat next door.

3. THREATS AND CHALLENGES

The Iban communities had settled in Batang Ai over the millennia, and the forests around any human settlements had been cleared for shifting cultivation of hill paddy or for subsistence farming. Therefore, the landscape of Ulu Sungai Menyang comprises of mosaics of human settlements, farm lands, abandoned fallows, secondary forests and old re-growth along the hilly slopes of the valley and fringes of the reservoir. In contrast, the primary vegetation up-rivers, i.e. mixed dipterocarp forests, in the inaccessible undulating hills and mountain in the interior are relatively untouched and very pristine.

The biggest threat to the pristine forests is the aspirations and wishes of the local community. Cash economy has impacted on them, and somehow has shaped their desires. They wanted to cash-in on the land. They wanted to open up the area for rubber or oil palm plantation, because this is the only cash-crop they knew. This is reality.

What are the alternatives available to these people in exchange for not cutting down the forest, or further open-up the surrounding area. Promoting fruit tree cultivation or food crop is futile when there is no ready access to the consumer market. Oil palm is a good crop but hard to argue from a conservation perspective, and so is rubber.

Without a road access, the cost of production in whatever economic venture is definitely going to be extremely high. Transportation cost alone, i.e. time and fuel will be a logistic impediment. The only solution to satisfy the communities' aspirations and conservation goal concurrently is producing high value products. The question is which commodity fit into these criteria?

4. REMEDY AND MITIGATION MEASURES

As per the argument above, the precondition for the solution is this commodity must be something valuable, non-perishable like fresh fruits or vegetable, and so valuable that the logistic cost to transport it from Ulu Sungai Menyang to commercial centre like Kuching City is none issue. This solution also must be something easy to produce or cultivate. Its production must not require sophisticated technology or electricity as this is out of reach for the community. Another non-negotiable prerequisite is no forest shall be cut down in the process.

What option is economically attractive and socially or morally acceptable? Looking at the remoteness of the area, most profitable agriculture activities practiced in the coastal regions is not realistic options. Logging is extremely lucrative but not compatible with the project's conservation goals. Other non-timber forest product (NTFP) such as rattan and medicinal herbs will not generate the desired quantum of profit or to cover the production and transportation cost from Ulu Sungai Menyang.

From the beginning, it can be easily ruled out rubber or oil palm from a conservation point of view. Without road access, there is nowhere the local communities can dispose of the freshly collected palm fruit. Rubber latex can be semi-processed for easy transportation but the price for rubber does not make it economical viable. Unfortunately as a matter of fact, these two crops will require large tracks of land to be cleared and converted into mono-culture plantation — something not compatible with the conservation objectives of sustainable land use.

Opportunity presented itself in 2013 — cultivated gaharu — a historically valuable NTFP yet no stranger to the local communities. Hence, gaharu agronomy may be the answer. For a start, gaharu tree (*A. microcarpa*) is native to Sarawak. So, we are not introducing exotic or alien species to the local flora composition. Gaharu is easy to grow. It does not have any major pests or diseases. Furthermore, gaharu cultivation does not need large tracks of land. In fact, it is an ideal tree species for enrichment planting in abandoned *temuda*, which is plentiful at Batang Ai.

Another unique feature of gaharu agronomy is that other cash crops cannot match the environmental friendliness of gaharu cultivation. The root-hairs of *Aquilaria* trees are vulnerable to chemicals and very sensitive to weedicide application. Therefore, weedicide use is strictly prohibited and this is good for the environment. Since the trees

are now planted for the leaves to turn into gaharu tea, we can designate it as food crop, and when we adopt organic farming, no pesticide use is allowed. Zero weedicide and pesticide policy is imposed.

In summary, cultivating gaharu trees for their leaves to be made into gaharu tea offers many advantages and fit into the strict criteria for conservation initiatives at Ulu Sungai Menyang. These include:-

(i) Gaharu tree from the genus *Aquilaria* is native to Sarawak. Historically, it is part of the local floristic diversity. In addition, the gaharu from Sarawak is revered for its quality.
(ii) Given the correct cultivation techniques, *Aquilaria* tree is easy to grow.
(iii) Unlike other cash crop like rubber or oil palm, gaharu cultivation does not need large tracks of land. A small plot of several thousand trees can have significant economic return.
(iv) It can be planted in any vacant land around the village. It can be inter-cropped with existing fruit trees. It is also good for enrichment planting in secondary forests.
(v) No pesticide is needed in its cultivation. This is a conservation selling point.

Gaharu versus other cash crops

Cultivated gaharu has many advantages, be it economic or conservation reasons, over other existing cash crops such as pepper, cocoa, rubber, oil palm, etc.Gaharu agronomy, i.e. planting *Aquilaria* trees for their leaves to be made into gaharu tea, is the only option simultaneously fulfilling the conservation goals and able to generate economically attractive alternative livelihood. This species can be cultivated in abandoned fallow or use for enrichment planting, hence preserving the pristine forests and conserve the biodiversity at Ulu Sungai Menyang. For example, 1,000 *Aquilaria* tree requires only slightly over one acre of land. Any space among the village dwellings or nearby secondary scrub can be rehabilitated for this purpose.

Secondly, gaharu trees are easy to maintain. They grow relatively fast if given the proper care. Furthermore, this tree species has multiple uses (e.g. gaharu tea, resinous heartwood, aromatic oil, etc.). Hence, it has a huge potential as a high value NTFP because the leaves can now be processed into premium gaharu tea.

Another clear advantage of cultivating gaharu tree over other commercial crops is NO chemical is used (e.g. weedicide, fungicide or pesticide). So, this can be considered organic farming. Gaharu trees are very hardy plants and there are no major diseases or pests that attack it. The only known serious pest (i.e. a type defoliate caterpillar) can be controlled easily without using chemical. Therefore, the economic benefit outweigh the risk, which is minimal or almost none existence. The table below shows the benefits of cultivating gaharu versus other cash crops.

Table 1. **Comparison of gaharu cultivation versus other common cash crops.**

	Gaharu	**Oil Palm**	**Pepper**	**Cocoa**	**Rubber**

Density	800/acre (1,980/ha)	48/acre (120/ha)	800/acre (1,980/ha)	450/acre (1,111/ha)	190/acre (470/ha)
Year to harvest	3 (for leaves)	4	3	4	4
Production	200 – 300 kg/acre	0.4 – 0.8[1] ton/acre/month	266 kg/acre/month	224 – 271[2] kg/acre/year	Latex[3] 607 – 1,214 kg/acre/year
Market Price	RM6/kg	RM0.7/kg[4]	RM9 – 15/kg[5]	RM8.7/kg[6]	RM5/kg Latex.

Finally, within an established gaharu farmstead, 10% of the trees can be used for inoculation to produce the aromatic resinous gaharu heartwood in the long run, while the others are used for leaf production. Additionally, the rows and rows of neatly planted gaharu trees can be the selling point for potential tourism spin-off.

5. FEASIBILITY AND VIABILITY

The major hurdle of balancing conservation needs and agriculture land use is solved with gaharu agronomy simply because there is no need for large tracks of land to produce the desire economic output. For example the gaharu farmstead at RumahManggat occupied roughly 4 to 6 hectares (≈ 12 – 15 acres) of abandoned fallow or *temuda* land. Comparing to the 14,000 hectares of Ulu Sungai Menyang Conservation Area, this represents merely 0.0004% of land area! Secondly, there is plenty of idle land within Batang Ai area, especially surrounding the reservoir fringes.

As stated above, gaharu is a hardy and indigenous trees species. Planting them is a low risk undertaking as long as the local communities work hard for it. Aquilaria Plantation (Sarawak) Sdn. Bhd. is more than willing to transfer the knowledge of managing a gaharu farmstead and cultivation techniques to the local communities. The company adopts organic agriculture practices, and had already set the benchmark. No pesticide is used to control the defoliate caterpillars' infestation because they have studied the moth's breeding pattern and devised ways to fence off such massive attack. All needs to be done by the local communities is basically learning and duplicating what this company is doing.

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[1]Fully matured plantation of 6 – 7 years old. 1 – 2 ton/ha/month

[2]Taking the average for the reported range of 0.45 – 0.68kg/tree/year = 0.56kg/tree/year.

[3]Latex = 1,500 – 3,000kg/ha/year

[4]Oil palm highest price in 2012 at RM700/ton.

[5]Pepper price. This is the average price of black and white pepper from the year 1990 – 2016. Please note the huge price fluctuation.

[6]Cocoa price 2015, range RM8,500 – 9,050/ton. 2016 = RM7,300 – 7,650/ton.

This project has a high chance of success because this local company has already marketed its premium gaharu tea, with or without the current program at Ulu Sungai Menyang. Whenever the local communities can deliver quality gaharu leaves to them, they will buy it. At this point of time, this is a realistic and workable solution.

The next question to ask now is it feasible? Aquilaria Plantation (Sarawak) Sdn. Bhd., a partner in this project, has pledged to buy back the freshly harvested leaves at RM6/kg provided the leaf quality met the minimum standard and no weedicide or pesticide is used. An acre of land can be planted with roughly 800 plants, and an acre of 2 to 3 years old well-nurtured gaharu farmstead can yield roughly 200 – 300kg of fresh leaves per harvest. This translates to approximately RM1,200 – 1,800/harvest/acre. The same tree can be pruned every four months, meaning there can be 3 harvests per year.

6. IMPLEMENTATION — THE JOURNEY SLOWLY UNFOLDS

6.1. Creating 11,000-tree Gaharu Farmstead in Six Months

The pioneer full-fledged gaharu agronomy project at Rh. Manggat called for the establishment of a gaharu farmstead with 11,000 *Aquilariamicrocarpa* trees. And the window for planting during the rainy seasons is a mere six months from late October 2017 until early April 2018. It is impossible to expect the inhabitants of Rh. Manggatwith 17 households, and mainly comprising of elderly and womenfolk to complete this colossal task of planting 11,000 gaharu seedlings within six months.

One ingenious solution came from the first author in the form of volunteer tree planting program mirrored the undertakings at Kuching Wetland National Park, the first RAMSAR site in Sarawak. These volunteers came from all works of life and of all ages; from university students, polytechnic trainees, educators from teacher training college, nature-based social clubs, government agencies, etc. This volunteer tree planting program was repeated over and over again for seven times from late October 2017 to early April 2018 involving a total of 250 participants.

As stated above, the original purpose of the volunteer tree planting program is to mobilize significant numbers of people to Rh. Manggat to help plant the 11,000 gaharu seedlings targeted for this area. In return these volunteers enjoyed a so called “3D/2N paid holidays” to experience authentic Iban hospitality at Rh. Manggat. Surprisingly, this tree planting program received overwhelming responses beyond our expectation, and we have received many requests from many groups of people wanting to participate.

Additionally, this program had turned out to be an excellence advocacy strategy, achieving many conservation education awareness objectives beyond original expectations. For a start, the volunteers thought that they are therejust to plant gaharu seedlings, but at the end they realized their effort is ultimately saving the habitats of orang-utan at Ulu Sungai Menyang. They also gain some knowledge on gaharu cultivation, and were captivated by the gaharu tea — the corner stone of this innovative conservation model.

6.2. Potential Gaharu-themed Tourism Spin-off

The conservation model presented thus far is tapping on gaharu agronomy to generate alternative livelihood while conserving the pristine forests at Ulu Sungai Menyang Conservation Area. The alternative income generator is basically the freshly collected gaharu leaves. However, unexpected opportunity presented itself along the way, resulting in new plausible additional revenue stream in the form of gaharu-themed eco-tourism spin-off. This is basically re-packaging the volunteer tree planting program into a hospitality product.

Plans are already in the pipe line to modify the volunteer tree planting program into viable tourism packages. In this 3D/2N package, guests will experience the rich cultural history of the Iban community and simple longhouse-style homestay with friendly hosts. The ambient setting is simply perfect, tucked away in the mist of tropical rainforests and serene jungle; away from crowded bustling cities. Visitors are expected to arrive at Rh. Manggat in the afternoon on the first day. The 20-minute long-boat trip from the main jetty to Rh. Manggat across the vast expanse of the reservoir is breath-taking. On the second day, paying guests are expected to keep themselves busy for a few hours in the cool morning helping the longhouse folk tending their gaharu farmstead or maybe help harvesting gaharu leaves, enjoying authentic local cuisine and BBQ picnic lunches by the lakeside. For those who lovewater-body, after a siesta, they can dipin the vast reservoir under hot afternoon sun to cool off. In the evening, after a sumptuous dinner, they can continue partyingand marrying into the night singing and dancing away while drowning locally brew rice wine (*tuak* and *langkau*).

Incidentally located right next door to Rh, Manggat is the 100-room luxury AimanBatang Ai Resort and Retreat (formerly Batang Ai Longhouse Resort managed by Hilton). The proposed gaharu-themed tour can be another value-for-money option for the resort guests. They can opt for a half-day excursion to see the gaharu farmstead and help to harvest the gaharu leaves at their leisure. Or they can do the highly recommended overnight package at Rh. Manggat to experience the longhouse lifestyle. All these are good tourism spin-off, and we strongly believe many will feel satisfied knowing that portions of their tourist money is channelled into conservation efforts to protect the orang-utan habitat at Ulu Sungai Menyang and assisted, in some forms or another, to uplift the wellbeing of the inhabitants of Rh. Manggat.

7. IMPACTS AND BENEFITS

Outcomes from the implementation of this project can be measured from two angles, i.e. the local community prespective and the project itself. From the community point of views, they would receive the ready-to-plant *Aquilaria* seedlings if they leave the pristine forests intake to conserve its biodiversity and protect the orang-utan habitat. Otherwise,

the local community would not have the financial means to purchase these seedlings. Although they can source the seedlings from the forests, but that would defeat the purpose because when they chance upon any large matured mother tree, it will definitely be cut down by someone hoping to secure the much valuable resinous gaharu.

The young gaharu farmstead is the focal point and income generator. While waiting for the gaharu trees to grow to maturity, the tourism spin-off will kick in. Paying tourists will come to relax and enjoy the local hospitility as mentioned in section 6.2 above. This will represent an immediate direct income for the longhouse inhabitants derived from tourists' spendings.

When the gaharu trees are large enough for prunning, the gaharu leaves can be harvested for sale.An acre (or about 800 plants) of 3-year old *A. microcarpa* tree can easily produce between 200 – 300 kg of fresh leaves per prunning, and the same tree can be harvested every four months or three harvests per year. At RM6/kg of fresh leaves, this translate to roughly RM3,600 – 5,400/acre/year.

From the government stand point, the measurable benchmark is the conservation of the pristine forests and the protection of orang-utan habitat at Ulu Sungai Menyang. The local communities residing within this area wanted to open up the land for large-scale commercial oil palm plantation to uplife their social-economic livelihood. However, this is not compatible with the conservation goal. Therefore, as alternative, the Forest Department proposed gaharu agronomy to produce gaharu leaves for making gaharu tea. In addition, gaharu agronomy also has a good chance to stimulate others compatible eco-tourism spin off, hence creating another revenue stream.With proper implementation and commitment, Forest Department Sarawak can actually produce another sustainable land use model which the state can be proud off.

8. IMPACT OF COVID-19

Side-effect and complete lockdown due to Covid-19 pandemic has actually caused a lot of losses in the business world in general, and the gaharu tea market is also severely affected. The lock-down and restriction of air-travel has interrupted or even destroyed the established supply-marketing chain. During the MCO all retail shops are ordered to close. But the most damaging factor is the international and national travels. All airlines worldwide are suffering and many needs bailout or restructuring. The domino effects are very widespread. The number of visitor coming and departing from Sarawak almost comes to a standstill. This mean retail sales also dropped to almost zero. Aquilaria Plantation Sdn. Bhd. is not spared from the negative effect of Covid-19 because gaharu tea is not essential foodstuff (this is the first time in our business history that we have a large quantity of stock)

As to the question when can business resume and back to normal. The question is what is the new normal? For as long as no effective Covid-19 vaccine, all air travel and tourism related activities will not pick up. Without tourist (international as well as locals) there is no business. The way we see it, the prospect until end of 2020 is very gloomy. The first half of 2021 is yet unknown and very challenging (assuming a vaccine can be mass produced by end of 2020).

The second revenue stream for alternatively livelihood is gaharu-themed eco-tourism. Before covid-19, there are at least few large groups of domestic visitor participating in this program. In the past, students from IPT or other vocational institutes are main participants of this gaharu-themed volunteer program. However, everything stopped during MCO and even not it is very unrealistic to conduct such tourism activities because of the need for social distancing. Again, this is the unforeseen effect of covid-19.

9. CONCLUSIONS

The project was conceptualised in 2016 and actual full-fledged planting started at the end of October 2017 until April 2018. This involved seven groups of volunteers totalling 250 able bodies to help the inhabitants of Rh. Manggat to plant 11,000 gaharu seedlings during the favourable rainy seasons. Now that the young gaharu farmstead has been planted and established, the project enters the next phase of nurturing these young trees into healthy mature gaharu plants.

The orang-utan habitats at Ulu Sungai Menyang are now protected, and the communities is benefiting from this ground-breaking conservation business model implemented by Forest Department. The idea of planting *Aquilaria* trees to produce gaharu leaves to be value-add into premium gaharu tea involving a Sarawak-based private business entity having years of experience in cultivating gaharu is very sensible collaboration. Gaharu agronomy may well be a game changer in balancing conservation goals while generating realistic economic benefits to the local community. This is because there is not a single NTPF, at least not until now, that is valuable enough to offset competition from other cash crop.

Another important fact is that out of the 14,000 hectare within Ulu Sungai Menyang Conservation Area, only 4 to 6 hectares at Rh. Manggat (or 0.0004% of the total area) is used to create the 11,000-tree gaharu farmstead. This small insignificant area compared to the overall landscape is basically abandoned fallow and no prime forests are cleared for this project. This is an amazing accomplishment. And this small patch of gaharu farmstead is expected to be able to general between RM1,500 – 1,800/harvest/acre from the sales of freshly collected gaharu leaves. And each mature tree can be harvested three times every year.

Now in addition to gaharu leaves, it seems extra income from gaharu-themed tourism spin-off is very promising. This is basically re-packaging the volunteer tree planting program into hospitality tour package. This opportunity presented itself because almost all volunteers had a great time during their stay at Rh. Manggat; all were full of smiles and laughter.

Early indications pointed to positive development. This high impact conservation model has received admirers both internationally and locally. The WWF-Germany team that came in November 2017 was highly impressed how this model addresses a win-win situation between balancing orang-utan conservation and rural communities need for economic improvement. Finally, this program has also caught the eyes of other state and has been elevated as Key Focal Area under the State Rural Transformation Agenda.

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SOCIAL FORESTRY PROGRAM IN HEART OF BORNEO (HoB) AREA

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Abstract

Social forestry is the involvement of the local community through the initiative of the local community itself or in collaboration with stakeholders in forest management from a social, economic, cultural and environmental aspect for the sustainability of life. Amidst current global developments, forest ecosystems are also one of the important elements to support social, economic and cultural life of local communities in rural areas. The Heart of Borneo (HoB), covering an area of 2.1 million ha in Sarawak has more than 27 communities of different ethnicities and cultures such as Iban, Malay, Bidayuh, Chinese, Orang Ulu and so on. The diversity of local cultures and believes make it an important element for the economy stability of the population, especially in rural areas. Community development and ecotourism is one of the key components in the Heart of Borneo (HoB) project which was initiated by Forest Department Sarawak to improve household income and increase community living standard while maintaining the sustainable use of forest resources. These projects will focus on developing communities within the Heart of Borneo (HoB) area in terms of economy, knowledge, skills, standard of living and quality of life. There are four (4) main activities that was carried out under this component namely Communication, Education and Awareness Public (CEPA), Human Capital Development, Upgrading and Quality of Community Living and Infrastructure Construction in HoB Sarawak area. These development activities was implemented with the involvement from various government agencies, non-governmental organizations (NGOs) and private agencies through Corporate Social Responsibility (CSR) strategy.

Keywords: local community, economy, ecotourism

1 INTRODUCTION

Community development projects are part of the Social Forestry objectives with a purpose to improve living standards and reduce the poverty rate of local communities in the Heart of Borneo (HoB) areas. Together with community involvement, forest management can be implemented sustainably to protect forest resources and interests of the local communities as part of their daily routine. There are two definition of Social Forestry in Malaysia, namely the national definition and the State Government definition. The National Definition is “the

involvement of the natives and the local community on their own initiative or with the cooperation of internal stakeholders forest management for the survival of social, economic, cultural and environmental aspects" (Malaysia Social Forestry Strategic Plan, 2020-2025). While the State Government Definition means local community involvement in sustainable forest resource management for meet the socio-economic, cultural and environmental needs with the cooperation of various parties of related interests.

The Social Forestry Division (SFD) of Forest Department Sarawak has been established in March 2016 and Heart of Borneo (HoB) unit was placed under the supervision of the SFD in March 2017. As of 2020, there were 25 staff including three vocational skilled personnel and also part-time workers (PSH). The Social Forestry Division has several functions under the auspices of the Deputy Director of Forest I (Forest Conservation and Development). Among the functions of Social Forestry Division are as follows:

1.1 To establish a long-term development plan as well as to obtain various sources of funding from within and outside of the country to implement SF programs throughout Sarawak;
1.2 To plan and implement human capital development for capacity empowerment of the relevant stakeholders;
1.3 To collect, organize and update all SF information database through resources survey, in which the data is crucial to support the technical aspect during project implementation;
1.4 To coordinate and monitor SF projects, programmes and activities for the purpose of documentation;
1.5 To form and expand communication networks with stakeholders and organizations within local, national and international levels as well as holding consultations on issues related to SF;
1.6 To implement educational-based programmes specific to the environment and nature that encompass the role and function of forests to the communities, school students, and related stakeholders;
1.7 To implement public awareness programmes and activities on the functions and roles of the Department as well as publicizing and promoting SF projects through mass media (media printing, electronic media, social media) and so forth;
1.8 To plan, develop, implement projects and programmes on agroforestry activities as well as forest restoration through community involvement;
1.9 To develop, manage and promote non-timber forest products (NTFP) through community active involvement;
1.10 To provide services and basic facilities to the community living surrounding Permanent Forest Estates (PFE) as a social responsibility;
1.11 To assist in the management of wildlife conservation with the involvement of related communities and stakeholders ;
1.12 To establish and develop urban forestry management with the objective to maintain the aesthetic values of urban area for recreational and eco-tourism activities;
1.13 To create, formulate and develop strategies or action plans as part of managing integrated communal forests in Sarawak and subsequently implement development programs and activities;

The total allocation received by SFD under Heart of Borneo (HoB) fund forthe 11th Malaysian Plan from year 2016 to 2020 was RM 26.24 million. The breakdown of the allocation is provided in the table below:

Table 1: **Year of implementation and activities carried out.**

Year	Allocation (RM)	Activities
2016	1,745,000.00	HoB Community Development
2017	6,850,000.00	i. HoB Community Development; ii. HoB Conservation.
2018	4,510,000.00	i. Wildlife survey in Usun Apau on April 2018; ii. Organizing Tama Abu Expedition Seminar and MoU signing with Copenhagen Zoo in June 2018; iii. Construction of HoB Interpretation Center in Kayangeran FR Lawas.

2 APPROACH

Social Forestry Division (SFD) carries out activities based on five (5) pillars as well as Forest Department Sarawak Strategic Plan from 2016 until 2020 session. The five (5) pillars are:

2.1 Communication, Education, & Public Awareness (CEPA);
2.2 Increase Income & Uplifting Livelihood of Local Communities;
2.3 Training & Capacity Building;
2.4 Social Works & Community Services;
2.5 Forest Resource Restoration Through Social Forestry.

3 ACHIEVEMENTS

3.1. Communication, Education, & Public Awareness Program (CEPA)

This programme was conducted to foster the level of public awareness of the local communities and school students in the vicinities of the Permanent Forest Estate (PFE) and Totally Protected Area (TPA). One of the activities carried out was the dialogue session or better known as *randau ruai* session. This activity was carried out to brainstorm for potential programmes or development projects that can be implemented in the communities or in school areas. The session also continued with public awareness talks based on the importance of forests and nature conservation. For school level, activities such as bird watching or environmental talks were done to give exposure to the younger generation on the importance of conserving nature. Participating students were also given recognition in the form of the Junior Forest Ranger (JFR) award to foster enthusiasm in protecting the environment and their responsibility towards conserving forest resources. In HoB area, CEPA programme was conducted mainly at SK Long Luping, SK Long Semadoh, and also

SK Ba'Kelalan. This program involves a total of 95 students and the activities conducted were both indoor and outdoor such as environment art and food-web activity, forest walk and blind walking.

3.2 Increase Income & Uplifting Livelihood of Local Communities

The local communities in Ba'Kelalan uses salt lick water as a natural source of table salt for daily use. The salt water was available at the foot of the mountain and to produce salt, the community uses the traditional method of boiling the salt water to obtain coarse salt. Realizing the need to speed up the conventional method, the Social Forestry Division has taken the initiative to assist the community in Ba 'Kelalan, Lawas to improve their facilities. With the construction of a new salt production hut, the salt yield will increase exponentially as well as the quality of the salt produced will be of better quality. Thus, the quality of life will improved resulting from their increased income and open up for ecotourism opportunities. Construction of the new salt hut commenced in January 2015 and was completed in 2016. Apart from that, SFD were the organizer for the Non-Timber Forest Carnival Product (NTFP) which was held at the Kuching Waterfront from 2016 until 2019. The carnival was attended by local communities from the various parts of HoB area. The objective of this carnival is to promote goods from different cultures and ethnic background which include non-timber forest products such as machetes, medicine-local medicines, salts, beads. In addition, the SFD also implemented the Tagang System in Batang Ai, Lubok Antu in collaboration with the Department of Agriculture Sarawak. The main purpose of Tagang System is to benefit the local communities by providing basic facilities to rear fish such as fish nets with buoys, fish spawn as well as fish fertilizer. Through the implementation of the Tagang System, it was hoped that the community will improve their income from fish farming while maintaining the river ecosystems specifically for hydroelectricity.

3.3 Training & Capacity Building

One of the main functions of the SFD is to provide training to the local communities to improve their ability and improve their skills. Some of the trainings conducted were basic carpentry and furniture course as well as electrical and wiring course. In 2016, a training was held with the Penan community in seven (7) longhouses in Tegulang as well as in Murum. Training was conducted for three (3) consecutive days and attended by 263 participants from various age groups. The instructors for the training were from the SFD's staff and has produced several skilled attendees from the exercise. The following schedule below shows the number of communities attending the training that has been organized by Department.

Table 2: **Number of participants attending the training.**

No.	Location	Number of participants	
		Basic carpentry and furniture course	Electrical and wiring course
1.	Long Singu	29	28
2.	Long Tangau	18	18
3.	Long Luar	20	20
4.	Long Menapa	23	19
5.	Long Wat	27	18
6.	Long Malim (Penan)	12	12
7.	Long Malim (Kenyah)	5	15
	Total	133	129
		Overall total	263

Trainings that have been organized by the Social Forestry Division are as follows:

3.3.1 Basic Carpentry and Electrical Wiring Course for the Penan Community – in collaboration with MERCY Malaysia at Ba'Medamot, Ulu Limbang on July 18 until August 1 2016;

3.3.2 Study tour to Peninsular Malaysia participated by local communities in the HoB area from 18 September to 25 September 2016;

3.3.3 *Kembara Ilmu Siri I* Visit by Heart of Borneo Communities to Sandakan, Sabah on 2017;

3.3.4 Agarwoord Inoculation training in collaboration with the ITTO TBCA Project and the Department of Forestry, Indonesia at Nanga Ju Ranger Station, Ulu Mujok, Julau in 2017;

3.3.5 *Kembara Kreativiti Siri* I & II: Craft Course entitled 'Creative Crafts Creating Dried Flowers' at Nanga Sumpa, Ulu Menyang & Lawas Training Center in 2017;

3.3.6 *Kembara Kreativiti Siri* III: Bemban Weaving Skills Workshop at Rumah Ninting, Nanga Jambu in 2018;

3.3.7 Basic carpentry and electrical wiring course at Rumah Ninting and Rumah Manggat, Lubok Antu in 2018;

3.4 Social Works and Community Services

Under this programme, SFD carried out developmental activities in community areas through communal work (*gotong-royong*) such as construction of longhouse facilities, jetties and also jungle trails. These works were specifically carried out to improve the available basic facilities for the communities in order to improve their lives in harmony with living in urban areas. All facilities were carried out using funds or allocations from the main allocation for HoB. The list below was the achievements from previous social work and community service programmes conducted.

3.4.1 Construction of Long Lidong suspension bridge in Lawas (2017);

3.4.2 Construction of jungle trails and Tagang System facilities for eco-tourism at Rumah Ninting, Nanga Jambu, Ulu Delok in 2018;

3.4.3 Construction of mini hydro dam for gravity water supply at Rumah Manggat, Menyang Taih in 2018;

3.4.4 Rumah Manggat longhouse repair work in Menyang Taih (2018);

3.4.5 Delivery & distribution of home building materials for the community Penan at Pa'Tik A & B and Long Lobang, Ulu Limbang on 26 Feb- 4 March 2018;

3.4.6 Building materials delivery for the construction of the dam in Long Kerong, Ulu Baram on 12-19 March 2018.

3.5 Forest Resources Restoration Through Social Forestry

Restoration is defined as restoring forest areas that have been degraded with enrichment planting to maintain the complexity and for securing the ecosystems for the sustainability of forest resources. As such, the Social Forestry Division has been entrusted to carry out restoration activities with the involvement of the local communities to carry out work such as collecting seedlings and replanting degraded forest with high quality trees and non-timber species. With the re-establishment of the present Forest Department nurseries, the communities around the HoB area have been hired to collect high quality timber seeds and to ensure planting stock was adequate. The collection was carried out by the communities in Murum, Ba'Kelalan, Lawas, as well as in Ulu Mujok, Julau. Local communities were also supplied with seedlings such as agarwood, rattan and bamboo to carry out planting activities in their respective areas. The yield will be harvested by local communities which benefited profits generated from selling the products. Hence, this effort to some extent assist the community in increasing local income. The list below are the restoration activities that had been carried out in the HoB area.

3.5.1 Joint project collaboration with Sarawak Energy Berhad (SEB) – rattan planting with Penan community in Long Wat, Tegulang, Murun in 2017;

3.5.2 Delivery of rattan seedlings to the communities in Menyang Taih, Ulu Menyang in 2017;

3.5.3 *Shorea macrophylla*, *ensurai, bilat,* and *pitoh* seed collection with local communities in Rumah Anthony Bau, Ulu Mujok in 2019;

3.5.4 Collection and planting of bemban seedlings in Rumah Manggat, Menyang Taih in 2020;

4 CONCLUSION

Forest Department Sarawak through the Social Forestry Division had carried out various activities and community development programmes as guided by the established HoB pillars. Through the active involvement from the local communities, sustainable forest management and conservation of forest resources was enhanced

COMMUNITY-BASED MANGROVE RESTORATION IN KUCHING WETLAND NATIONAL PARK - RAMSAR SITE

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Abstract

Kuching Wetland National Park (KWNP) is the first designated Ramsar Site or Wetlands of International Importance in Sarawak. The national park covers an area of 6,610 hectares and located near Kuching town (15-20 km) makes it prone to housing and development threats. One of the impacts of development in KWNP is degradation of mangrove forests along one of it's rivers, Sg. Lemidin due to the Kuching flood mitigation project. The project activities which includes soil dumping affected a total of 121.40 hectares of mangrove forests. Since the flood mitigation project activities ceased in 2009 Forest Department Sarawak took the initiative to restore the degraded land by planting mangrove trees. The department also brought in numerous volunteers from government agencies, private sectors, education institutions, NGO's, associations and local communities to take part in the restoration programme. As of now, 103,000 of mangrove trees were planted in the area. With 90% survival rate, the planted trees are growing and spreading more seedlings to a point that a new mangrove forest is forming in the once degraded area.

Keywords: Kuching Wetland National Park, Ramsar site, mangrove, restoration, community

1. INTRODUCTION

Kuching Wetland National Park is located inside a much larger area known as Sarawak Mangrove Forest Reserve. The Sarawak Mangrove Forest Reserve was gazetted in 1924 to regulate the harvesting of mangroves and covers an area of 17,153 ha. After many excisions, 6610 ha of the SMFR was gazetted as a totally protected area (TPA) in 2002 namely Kuching Wetland National Park (KWNP). In 2005 KWNP was listed as a wetlands of international importance under the Ramsar Convention or also known as a Ramsar site, the fifth in Malaysia and the first in Sarawak. KWNP fulfills four out of nine Ramsar Site criterion.

A Ramsar site is a wetland site designated to be of international importance under the Ramsar Convention. The Convention on Wetlands or Ramsar Convention, is an inter-governmental treaty established in 1971 by UNESCO in Ramsar, Iran. The Convention's

mission in the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world (RAMSAR COP8, 2002). There are presently 159 Contracting Parties to the Convention, with 1869 wetland sites, totalling 183,681,110 hectares, designated for including in the Ramsar List of Wetlands of International Importance. Malaysia, a signatory of the Ramsar Convention, has to date designated six Ramsar sites, the latest being the Lower Kinabatangan-Segama Wetlands.

2. PROBLEM STATEMENT

KWNP is the nearest national park to Kuching city being the southern part of the park is only 15 to 20 km away. The area is surrounded by fishing villages and also housing as well as commercial buildings which made the area prone to pollution and encroachment threats.

In the past, Kuching has faced major flood problems and one of the solutions were to implement the Kuching Flood Mitigation Project. The project involves digging and dumping of soil at *Sg Lemidin* which was located within the Kuching Wetland National Park. As a result from the flood mitigation project activities, 121.4 Ha of mangrove forests in KWNP were affected .

3. APPROACH

As the flood mitigation project activities subsided in 2009, a part of KWNP was already degraded and the area was very visible from the satellite image. To address this problem, Forest Department Sarawak initiated the Mangrove Planting project. Along with that, community-based mangrove planting and awareness programs were conducted since 2012. The objectives of this program are to restore at least fifty percent (50%) of the degraded area of KWNP by 2020 and to educate and spread awareness to the public on environmental protection and conservation. Mangrove seedlings are planted in an area that is inundated by tidal water with 2m times 2m spacing and sometimes 1.5m times 1.5m spacing. To supply seedlings for planting activities, temporary nurseries were constructed within the park. Volunteers were sometimes asked to do nursery works such as propagating mangrove seeds in poly-bags. Local communities in the nearby *Kampung Salak* were also engaged to set-up mangrove nurseries. At times where mangrove seedlings in the park were insufficient, volunteers would pay the local communities for supplies before any planting activities.

Environmental education and awareness is one of the most crucial part of wetlands management. Therefore, awareness talks and enviromental camps were organized with targeted schools annually. World Wetlands Day that is celebrated annually on February 2nd has becoming a platform of spreading awareness on wetlands to the public especially the communities living near Ramsar site. Activities such as awareness talks, competitions and games were held throughout the month and would be reported and published in the Ramsar website.

As part of the promotional efforts of KWNP-Ramsar Site, a media tour was conducted in 2014. The 1st Sarawak Ramsar Seminar 2018 was also conducted to share information and knowledge among stakeholders and other Ramsar Sites managers in Malaysia. Apart from that the top contributors of Kuching Wetland restoration program were awarded during the seminar.

4. RESULTS

Since 2012, numerous volunteer groups including government agencies, educational institutions, schools, NGO's, private sectors as well as local communities participated in the mangrove restoration program. KWNP began to be a popular site for Corporate Social Responsibility (CSR) and volunteering works among companies in Kuching such as Naim Holdings, CMS *Berhad*, Petronas, Fuji Xerox Malaysia Ltd, IJM Land and many more.

As at December 2019, there are 103,000 mangrove trees planted in KWNP by Forest Department Sarawak with the help of volunteers. The survival rate of the planted trees are about 90% as long as the roots are inundated by salt water from time to time. At the moment, total degraded area that has been planted in KWNP is 96 Ha or 79%. The rest of the degraded area is not suitable for mangroves as the soil is too hard and dry.

Apart from local participants, KWNP Mangrove Restoration also received International participants such as the performers of the annual Rainforest World Music Festival assisted by Sarawak Tourism Board. Thus, KWNP mangrove planting program has been featured on papers, journals and blogs internationally.

Table 1: **Total Mangrove trees planted through community-based Mangrove Restoration Program in KWNP in 11th Malaysia Plan (RMK-11)**

Year	**No. of trees planted**	**Area (Ha)**	**Participants involved**
2016	6,064	2.43	1,435
2017	6,000	1.92	967
2018	6,100	1.36	807
2019	2,500	0.54	412
TOTAL	**20,664**	**72.8**	**3,621**

Figure 1: **Aerial photograph of Mangrove Planting Plot I in *Sg. Lemidin*, KWNP taken in 2020.**

5. CONCLUSION

The management of KWNP-Ramsar Site has been handed over to Sarawak Forestry Corporation in 2020. However, Forest Department Sarawak contributed a number of success for KWNP including the restoration of mangrove, boosting tourism and volunteering activities, services and leverage for local community's economy and promoting wetlands awareness. The department will continue to work with other agencies to achieve the State's common environmental goals.

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QUESTIONS AND ANSWERS

SESSION 1

Rapporteur: Aurelia Dulce Chung				
Title of paper: High Conservation Value Forests (HCVF) Assessment Within Heart of Borneo (HoB) Area: A Case Study at Ulu Trusan Forest Management Unit (FMU) Sarawak				
Presenter: Malcom Demies			Organization: PMD, Forest Department Sarawak	
Date: 22 September 2020			Session: 1	
No	*Name	*Organization	Question	Answer
1.	Ricky Martin (via Zoom)	Sabah Forestry Department	1. What are the problems and how are they solved especially in HCV 5 and HCV 6: basic needs and traditional cultural identity aspects	The scope of HCVF assessment does not include solving the problems but rather to highlight the problems happening in the area. If we were to solve the problems, it is going to be an unending one.
			2. How would FMU manage and monitor the areas which are occupied by 13 villages inside Samling FMU?	Samling has a good relationship with the local communities. During the assessment, the locals admitted that the company (Samling) provides and maintain the road system and water supply for them. Samling shows good corporate social responsibility (CSR) in the project area.

Rapporteur: Aurelia Dulce Chung				
Title of paper: Forest Resource Inventory Project of Sarawak – Phase 1 (Heart of Borneo) Area				
Presenter: Haji Ahmad Ashrin Mohd Bohari			Organization: PMD, Forest Department Sarawak	
Date: 22 September 2020			Session: 1	
No	*Name	*Organization	Question	Answer
1.	Marfaisal Marzuki	ODPD, Forest Department Sarawak	1. From the data in your presentation, can we conclude that our biodiversity has worsened? Are our biodiversity decreasing based on the inventory done by FAO in 1969-1970 and FDS in 2016-2018 which shows a decrease in plant species from 606 species to 241 species?	FAO Inventory which was carried out in 1969-1970 was done in virgin Hill Mixed Dipterocarp Forests (HMDF) when most forests were still in good condition compared to the current forest inventory starting from 2016 in HoB forests which consisted mostly of logged-over HMDF. However, the number of species identified during the current inventory (c. 300 species) is the same as the number of species identified based on studies in similar forest conditions done in Peninsular Malaysia and other countries. Over the years, many anthropogenic activities such as logging, shifting cultivation and conversion of forest land into agriculture had contributed to biodiversity losses.
			2. The timber volume recorded by FAO is 130 m^3/ha but in 2016 the record was around 35 m^3/ha. Does it show that our Sustainable Forest Management (SFM) policy	The current inventory was done in mostly logged-over forests in areas that practiced conventional logging that do not subscribed fully to the requirements of SFM until 2014 when the FMC was emphasized; thus a decrease in tree volumes. However, the average tree volumes recorded in the current

			was unsuccessful?	inventory was similar to the timber volumes for secondary forests recorded elsewhere. The results of the current inventory are important in the department's effort to improve the forest policy to better manage our forest sustainably. Besides that, encroachment by shifting cultivation, illegal logging and forest disasters also contributed to the decrease in timber volume today.

Rapporteur: Aurelia Dulce Chung				
Title of paper: Forest Management Certification Highlighting Social Perspectives				
Presenter: Santey Berikom			Organization: PMD, Forest Department Sarawak	
Date: 22 September 2020			Session: 1	
No	*Name	*Organization	Question	Answer
1	Madeline George Pau	CCD, Forest Department Sarawak	1. Based on your experience in engaging with local communities from various part of the State, how do you find the response from the different ethnic communities with regard to Forest Management Certifictaion (FMC). eg: Iban, Orang Ulu, Penan, etc	The communities response to FMC has been very encouraging. Some of the communities had informed that they regretted that FMC started very late. Generally we can say that their acceptance to FMC depended very much on the history of logging in their particular area. Good management and communication means good perspective by the communities. Some timber companies provide them with basic amenities such as water supply, electricity and proper roads for their mode of transportation. At the moment, we do not classify their acceptance to FMC by ethnicity.

SESSION 2

Rapporteur: Paulus Meleng/ Pang Shek Ling

Title of paper: Supporting Conservation Programme within the HoB through Forest Technology Application				
Presenter: Khadeeja Wahab			Organization: FDS	
Date: 22 September 2020			Session: 2	
No	*Name	*Organization	Question	Answer
3.	Mohd Amir Fais (via Zoom)	Forest Research Centre, Sabah Forestry Department	1. How accurate is the hyperspectral in identifying targeted tree species?	It depends on the classifications First we need to have the training data, which is extracted from the tree samples, then we need to have verification data. Only then can we determine the accuracy of the classification. The accuracy depends very much on the algorithm used and the number of data that we collected. The more data that we collected, the more accurate will our identification be. Our identification on *red selangan* was 85% accurate. Some samples do not have wide distribution and this will affect the accuracy of the identification.
			2. How accurate is the system in identifying young and juvenile trees which are less than 10 m in height?	The hyperspectral imagery that we have has a resolution of 0.5 meters, the crown is visible and it can be detected, but if it is in a forest which has different strata and covered by most forest canopy, I do not think it is possible for us to see them. If we are talking about restoration, yes we can discriminate as it is a single strata. Hyperspectral sensing is optical imaging, it is not microwave, it doesn't penetrate through the canopy. If you have juvenile or even under the canopy

				understorey trees, you will not be able to detect it. But some below the canopy and between the gap, yes we are able to detect it.
			3. Have you done this on mangrove species?	Yes, we have done our study at Kuching Wetland National Park in 2012. We used the method to identify mangrove species as well as for the study on biomass and carbon estimation
Rapporteur: Paulus Meleng/ Pang Shek Ling				
Title of paper: Kandungan Mineral Air (Salt Licks) dalam Kawasan Heart of Borneo Sarawak				
Presenter: Safeeq			Organization: FDS	
Date: 22 September 2020			Session: 2	
No	*Name	*Organization	Question	Answer
4.	Belinda Lip	WWF	1. How are the plan for conservation and management of the salt licks?	In Sarawak, there is no legal stature to conserve and manage our salt licks. Peninsular Malaysia and Sabah have included the conservation of their salt licks in their Enactment and Act. At the moment, it is only protected under SFM Certification. Apart from that we can have awareness through CEPA programme and for long-term strategy, we must amend our ordinance to include protection and conservation of salt lick.
Rapporteur: Paulus/ Pang				
Title of paper: Forest Landscape Restoration (FLR) within HoB Area: Uodates and the Way Forward				

Presenter: Rohanie			Organization: FDS	
Date: 22 September 2020			Session: 2	
No	*Name	*Organization	Question	Answer
5.	Mr. Jack Liam	Forest Department Sarawak	1. Apakah jenis kajian yang boleh dilakukan untuk membantu FLR di Sarawak?	Some of the researches that can be done are: i. Site species matching ii. Growth and yield iii. Pests and diseases iv. Tree improvement v. Seed testing and seed quarantine for quality seed production vi. Carbon trading vii. Drone seeding
Rapporteur: Paulus/ Pang				
Title of paper: Biodiversity Conservation: Rare, Threatened and Endangered Tree Species in Heart of Borneo				
Presenter: Vilma Bodos			Organization: FDS	
Date: 22 September 2020			Session: 2	
No	*Name	*Organization	Question	Answer
5.	Mdm Madeline	Forest Department Sarawak	Are these 66 rare, threatened and endangered (RTE) species outside PFE? Will there be any publication from the work done?	They are found mostly outside TPA. Some are found within PFE, licensed area, stateland (Lundu area). The work is still on-going but yes, we will publish the findings.

SESSION 3

Rapporteur: Shirley Chip & Khairunnisa Othman				
Title of paper: Planting Gaharu Trees At Ulu Sungai Menyang : Status Update (Beginning of A Journey Project)				
Presenter: Suliman Jamahari			Organization: Forest Department Sarawak	
Date: 22 September 2020			Session: 3	
No	Name	Organization	Question	Answer
1.	Jack Liam	Forest Department Sarawak (FDS)	How to ensure the sustainability of Gaharu project in Ulu Sg. Menyang (USM) that are also being affected by Movement Control Order (MCO) due to pandemic Covid-19?	The sources of income for the community involved in the projects are from direct selling of Gaharu leaves to produce tea and indirectly from the ecotourism activities through accomodation and boat rental. Smart partner of the project, Dr. Lim from Aquilaria Plantation has informed that the sales of Gaharu tea now is very low since there is no foreign buyer especially from China. However, few local volunteer groups are interested to visit USM despite the MCO and this is the opportunity to restore the income of the locals. Increase in the local tourism activities is one way to sustain the project.

2.	Zarina Hj. Shebli	Forest Department Sarawak	Is there any research done on the composition of chemical content in Gaharu tea especially after few applications of fertilizer?	Many research projects on the chemical content of Gaharu leaves have been conducted by local and international researchers. The research reports or information on the content can be reached easily through online search. Gaharu tea is believed to have chemical properties that are able to regulate blood level. FDS and Aquilaria Plantation have recorded a few testimonies on the benefit of consuming Gaharu leaves from those having health problem.

Title of paper: Lesson Learnt from Bario Community Forest Agroforestry Systems in Sarawak				
Presenter: Dawend Jiwan			Organization: Forest Department Sarawak	
Date: 22 September 2020			Session: 3	
No	Name	Organization	Question	Answer
1.	Aurelia Dulce Chung	Forest Department Sarawak	Can the growth rate data of indigenous and endangered species that have been planted in Bario (eg. *Agathis* spp.) be used as reference for future trial planting? Is *Agathis* sp. a good species and is it possible to use it in enrichment planting?	The growth rate data is a reliable reference for the decision on development preference in certain area. Like for example, the low growth rate in terms of diameter can be used to recommend certain area to be classified under conservation.
2.	Belinda Yip (via Zoom)	World Wide Fund for Nature (WWF)	Beyond Bario, is there any plan to expand community agroforestry in Sarawak and where? Is it being aligned with Sarawak's Agriculture	The Sarawak Agriculture Master Plan was developed for a period up to 2010, and agroforestry was stated as one of the strategies to address food security. However, since 2011,

			Masterplan?	the agroforestry aspect was discontinued. Therefore, in 2019 our YAB Chief Minister as well as the team under the Stateland Native Task Force has directed the department to implement this agroforestry project. The same concept of agroforestry initiated if Bario is currently being replicated in Lubok Antu Communal Forest. Currently, the first project that was approved with funding under this agroforestry is being implemented in the Lubok Antu Communal Forest focusing on infrastructure, as well as to facilitate investors to come in. If this project is successful, then the project will be expanded and implemented throughout the state.

"The beauty of Mount Pueh from Sebako Hydro Dam's viewpoint."