

# Indigenous Dayak Iban customary perspective on sustainable forest management, West Kalimantan, Indonesia

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**Abstract.** *Leo S, Supriatna J, Mizuno K, Margules C. 2021. Indigenous Dayak Iban customary perspective on sustainable forest management, West Kalimantan, Indonesia. Biodiversitas 23: 424-435.* Borneo is the third-largest island in the world, is rich in biodiversity and has diverse unique ecosystems. However, deforestation and land tenure conflicts continue to threaten the indigenous people who rely on forest resources for their livelihoods and well-being. This study aimed to identify the ecosystem services and the value of customary forest resources, identify local wildlife species, and document the traditional knowledge that the Iban indigenous community of West Kalimantan use to manage their customary forest. We collected relevant data using Toolkit for Ecosystem Service Site-based Assessment (TESSA), in-depth interviews, and wildlife surveys. The customary forest provides significant ecosystem services, mainly carbon sequestration (exceeds US\$ 52 million/year), water-related services (exceeds US\$ 21 million/year), and the 52 wildlife species recorded in the customary forest. Forest resources are managed successfully by the community through traditional knowledge and customary laws passed down for generations. The integration of local and expert knowledge and involvement from all related stakeholders would boost sustainable forest management and enhance the economic benefits and livelihoods of the community. Following current trends, recognizing customary forest and appropriate sustainable forest management could effectively tackle deforestation and land tenure conflicts in Borneo. Further studies should be considered to develop specific activities on managing the forest sustainably that the community can implement and evaluate.

**Keywords:** Dayak Iban, deforestation, ecosystem service, sustainable forest management, traditional knowledge

## INTRODUCTION

Borneo is the third-largest island in the world after Greenland and New Guinea. It is rich in biodiversity, with many endemic species, and has diverse unique ecosystems. Three countries occupy parts of the island, Indonesia with 73% of the land area, Malaysia with 26%, and Brunei Darussalam with 1% (Mackinnon et al. 1996; Koh et al. 2013). Kalimantan, the name of Indonesia's part of Borneo Island, is inhabited by more than 16 million people (in 2019), most from the three largest communities, Dayak, Malay, and Chinese descents. Recently, there have been significant immigrants from the Indonesian islands of Java, Madura, and Sulawesi (Mackinnon et al. 1996; Setyawan 2010; Kusnandar 2019).

Deforestation began in 1973 and continues today. It is the biggest threat to forests on Borneo, including in Kalimantan. Forest logging and conversion to plantations, infrastructure development and mining had caused the loss of around 123,491 km<sup>2</sup> of the forest area in Borneo by 2010 (Gaveau et al. 2014; Leonald and Rowland 2016; Langston et al. 2017). Deforestation also leads to land tenure conflict

between local governments, private companies, and local communities. This happens because there are often no clear boundaries between customary land, state land, and private concession land. Local governments do not recognize customary land and unilaterally permit the private sector to exploit customary land. In some cases, local communities would like to sell some of their lands to earn money for facilities and services for their villages. The local communities lack an understanding of land tenure and have a weak position to influence policies that might cause them to lose their land ownership claims (Yasmi et al. 2007; Clerc 2011; De Royer et al. 2015; Hasudungan 2018).

Land tenure conflicts between the state and indigenous peoples have occurred since the colonial era. They are still happening today in some customary forests areas that have not yet been recognized. Customary forest (*hutan adat*) is a forest area that belongs to indigenous communities who have claimed it for generations. The community has the right to use and maintain the resources within the forest to support their culture and livelihoods (De Royer et al. 2015). Indonesia tried to define and control customary forests through The Basic Agrarian Law (BAL) No. 5/1960

that applied to land, water, and air space, which can be used customarily to the extent that such use is not contrary to national interests and the state. However, the state often uses this law to exploit customary forests. Forest Law No. 41/1999 determined that the state fully controlled customary forest and changed its status to state forest. In 2012, The Alliance of Indigenous Peoples of The Archipelago (*Aliansi Masyarakat Adat Nusantara* [AMAN]) prosecuted a lawsuit in the constitutional court to return indigenous people's rights customary forests. The court decision No. 35/PUU-X/2012 stated that customary forest differed from state forest and distinguished three categories based on the tenurial land claims; state forest, private forest, and customary forest (De Royer et al. 2015; Myers et al. 2017). Since then, many indigenous communities have sought recognition from the government of their ancestral land as customary forest.

The Dayak people are the largest ethnic group in Borneo. There are 405 sub-ethnic groups, of which the Iban is the largest (Setyawan 2010; Darmadi 2017). Forest is an essential aspect of Iban communities. Forests are one of the most valuable resources of the country that have several benefits for society (Amenu 2017; Kurniadi and Koeslulata 2020). Forests provide four kinds of services; provisioning services (food, water, and timber), regulating services (climate regulation, flood control, and water quality), cultural services (recreation, aesthetic, and spiritual), and supporting services (soil formation, photosynthesis, and nutrient cycling) (Ninan 2009; Daramola et al. 2020). Each community has its customary forest protected and managed through customary laws (Wadley and Colfer 2004). It is instructive to understand how the Iban's sustainable management system has maintained their forest resources for generations. To grow food crops on nutrient-poor soils, they developed the practice of shifting cultivation that continues today (Setyawan 2010). To fulfill their meat and protein requirements, they hunt common animals as food but are prohibited from hunting sacred animals, for instance, hornbills and orangutans. This hunting activity must follow their customary laws (Wadley et al. 1997; Wadley and Colfer 2004). They also rely on their forest resources for medicine, fruit, handicraft materials, and more (Jessup and Vayda 1988; Sellato 2002). Thus, forests are essential for the Dayak Iban people's environmental, cultural, and spiritual well-being (Meijaard et al. 2013).

Most of the Iban populations in Borneo are located in the area covered by what is known as the Heart of Borneo (HoB) project. HoB is one of several forest management activities in Kalimantan and is a tri-national transboundary conservation initiative led by The World Wide Fund for Nature (WWF). It covers a vast landscape in Central Borneo that overlaps three countries, Indonesia, Malaysia, and Brunei Darussalam. The HoB initiative is ambiguous in the sense that its borders are not fixed, its land and resource management strategies are not clearly defined, its projects are not predetermined, and its policies regarding who benefits from it are not obvious. HoB is also ambitious, and its actors must negotiate on different levels: geographic, political, economic, institutional, and ecological. These factors provide both opportunities and

weaknesses for conservation and local and indigenous communities. Most of the forested landscape in the Kapuas Hulu Regency has been an integral part of this initiative, including the customary forest areas (WWF 2017). As a result, the HoB work plans have connected with customary forest management. The initiative focused on three strategies; (1) enlarging and restoring connectivity between protected area networks and larger landscape forest ecosystems; (2) increasing sustainable production and consumption of key commodities; and (3) empowering local communities and indigenous people to have a stronger role in the stewardship of natural resources and sustainable development of the island (WWF 2018).

The benefits of customary forests to the community and the environment are supposed to be shared (Ninan 2009; Peh et al. 2013). One approach to achieving this is to build on traditional management practices (Hauhs and Lange 2000). The Iban people's traditional knowledge and customary laws could form the basis of a strategy to provide for the sustainability of the forests implemented through local government policies. This study aimed to identify the ecosystem services and the value of customary forest resources, identify the local wildlife species, document the Iban traditional knowledge used to manage their customary forest, and use the results to recommend an action plan or strategy to maintain the customary forest and its resources. Implementing that action plan should benefit the indigenous community by enhancing their livelihoods and may also prove appropriate for application in other customary forests.

## MATERIALS AND METHODS

### Study area

The study was carried out in Sungai Utik Sub-village and its customary forest, located in the Kapuas Hulu Regency, West Kalimantan, Indonesia (Figure 1). The Kapuas Hulu Regency was declared a conservation regency through the Kapuas Hulu Local Regulation No. 20/2015. The forests in Kapuas Hulu, which cover over 57% of the regency, play an important hydrological role as a water reservoir and water source for many rivers in Borneo, including the Kapuas River, the longest and largest river on the island of Borneo. The Kapuas Hulu landscape also hosts two large national parks, Betung Kerihun National Park and Danau Sentarum National Park, both of which have unique and diverse ecosystems ranging from highland forest to lowland peat-swamp forest (Lusiana et al. 2008; Leonald and Rowland 2016). Sungai Utik Customary Forest is located between these two national parks and connects the two. The 9,480 hectares (ha) customary forest in Sungai Utik is managed under customary laws by the Dayak Iban indigenous community.

Conservation and development outcomes occur due to human decisions and the governance arrangements that guide change. However, much conservation science is not rooted in a deep understanding of how social-ecological systems work and what determines the people's behavior whose decisions shape the future of landscapes.

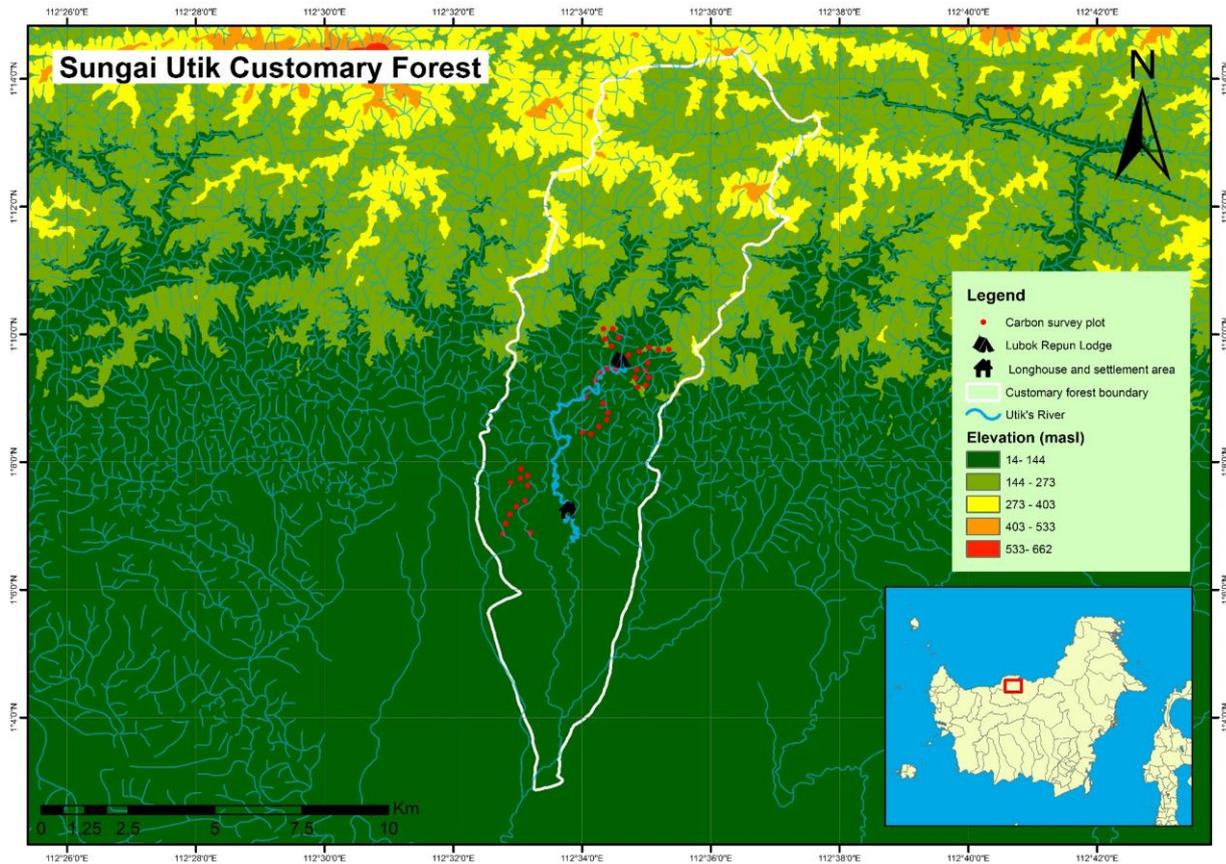


Figure 1. Area of the Dayak Iban customary forest at Sungai Utik Sub-village, Kapuas Hulu, West Kalimantan, Indonesia (BRWA 2021)

Thus, in socio-ecological and anthropological contexts, it is important to gain the community's trust who are the subjects of study to ensure that the information obtained from interviews and discussions is accurate and unbiased. Therefore, the first author (SL) stayed in the community for over two months (13 December 2020-20 February 2021) to engage with and learn from them about their culture and traditions and shape hypotheses about how decision making on forest management might be influenced (Margules et al. 2020).

During that period, SL was involved in the community's daily activities, observing and offering to help with their work, for instance, harvesting crops, following traditional rituals, gathering wood, and documenting traditional marriages. In return, the community offered their help to conduct fieldwork on the carbon stock survey and the biodiversity survey and to be willing respondents in this study. The community expects this study to help develop their customary forest management and improve their well-being from their forest resources. These reciprocal activities helped SL to build an emotional bond with the community.

Fieldwork and data collection were conducted between 13 December 2020 and 5 January 2021. During this time, we distributed questionnaires and conducted interviews, measured the carbon stock following the method of Peh et al. (2017), and conducted biodiversity surveys of the customary forest.

**Procedures**

This study was carried out using the Toolkit for Ecosystem Service Site-based Assessment (TESSA). TESSA was developed to provide a rapid assessment method and measurement of ecosystem services that could be applied in various ecosystems, including highland forest ecosystems (Peh et al. 2013; Peh et al. 2017). We selected a contribution to global climate regulation through carbon sequestration, water-related services, cultivated goods, harvested wild goods, and cultural services as the essential services to measure (Table 1). Each selected service has a measurement method in the guidelines provided by TESSA (Peh et al. 2017). In addition, we conducted a rapid assessment of wildlife species and interviewed three elders to define more precisely the Iban traditional knowledge.

Table 1. Measurement methods for ecosystem services

Selected services	Measurement methods
Global climate regulation	Direct measurement of biomass carbon stock and carbon sequestration
Water-related services	Questionnaire and direct measurement of water discharge and pH
Cultivated goods	Questionnaire
Harvested wild goods	Questionnaire
Cultural services	In-depth interview

### *Global climate regulation*

Above Ground Biomass (AGB) was determined using a formula from Pearson et al. (2005) for moist tropical forest ecosystems, shown below.

$$AGB = \exp(-2.289 + 2.649 \times \ln(D) - 0.021 \times \ln(D)^2)$$

Carbon stock = 50% x AGB

D = diameter breast high (cm)

To measure annual carbon sequestration, the estimated carbon stock was multiplied by the sequestration constant 3.67 (Tooichi 2018). We measured the diameter of 1,332 trees (ranging from 10 cm to 150 cm) from 42 plots of size 5 m x 100 m to determine AGB and approximate the total carbon stock of the customary forest area.

### *Water-related services*

We measured water discharge and water pH from three different locations in Sungai Utik. The discharge measurement was conducted using a small plastic ball, transect roll, and stopwatch to determine the river's surface current, depth, and width. To determine the quality of the river, we also asked questions of 37 of the 86 respondents and measured the water acidity using a pH indicator. The questions were related to water usage, maintenance cost, water quality, and flood control (see Peh et al. 2017).

### *Cultivated and harvested wild goods*

In Sungai Utik Sub-village there are 86 households in 46 clusters. A household is an economic unit composed of people living in the same dwelling space, eating meals together and generating at least one income together. Each household acknowledges the authority of a woman or man who is the head of the household. A cluster is a group of households with kinship relations living in the same dwelling space (Beaman and Dillon 2012). In Sungai Utik, there are 28 clusters in the longhouse and 18 in single houses. We asked the same 37 respondents as above to provide all information on the ecosystem services' quality and provisioning. The respondents were selected considering their ability to speak Indonesian to avoid misunderstandings between interviewers and respondents. The questions were related to planted crops, estimated production cost, livestock, harvested wild goods, and estimated revenue from those goods (see Peh et al. 2017).

### *Cultural services*

Information about traditional knowledge on managing their customary forest and other cultural services was collected through in-depth interviews (Lucas 2014). Three respondents from this small community were selected for their reputable positions, i.e., the elder, community leader, and longhouse leader, to gather all the topics listed above (Dworkin 2012). Before we interviewed the respondents, free, prior, and Informed Consent (FPIC) was reached.

### *Wildlife assessment*

We conducted a rapid assessment of the wildlife species found in the customary forest following the method of

Oliver and Beattie (1993). We spent five days conducting surveys in the forest, cultivated lands, and surrounding the settlements. We took notes and photos of species encountered as well as signs voices and descriptions by local people, of birds, primates, amphibians, and reptiles. We also extracted data from a previous survey in Betung Kerihun National Park (ITTO PD 617/11 2015).

### **Data analysis**

Data were interpreted and described qualitatively (Jamshed 2014). Economic valuations were carried out by converting the measured ecosystem services of carbon, water, cultivated goods, and harvested wild goods, to monetary values according to market values minus the cost of producing them. The local market value means the price for each product, determined by the community before it is sold to the customer. An economic valuation can be an indicator of economic benefits and the beneficiaries, which can help highlight the dependence of particular groups in society on ecosystem services and lead to conservation-related outcomes that might have public support (Birch et al. 2014; Peh et al. 2017). According to The International Union for Conservation of Nature, each encountered species from the wildlife assessment was allocated a conservation status level (IUCN 2021).

## **RESULTS AND DISCUSSION**

### **Results**

We estimated the value of the ecosystem services, global climate regulation (carbon stock and sequestration), water-related services (water discharge and quality), cultivated goods, and harvested wild goods. All values were converted into US Dollars (rate: USD 1 = IDR 14,300). The ecosystem services and their values are shown in Table 2. The cultural services and traditional knowledge are described narratively. We also added the estimated number of plants and animals found in the Betung Kerihun Landscape and listed the wildlife species found in the Sungai Utik Customary Forest.

### **Measured ecosystem services**

Our results suggested that the customary forest has an enormous value (Table 2). It is estimated to absorb more than 12 million tonnes CO<sub>2</sub> eq annually. If we then calculate the average price on the voluntary carbon market (Donofrio et al. 2020), the value exceeds USD 52 million. The forest is dominated by dense trees of the Dipterocarpaceae family and on average is estimated to contain 348.3 tonnes of CO<sub>2</sub>/ha. That amount makes it one of the highest carbon stock areas in Borneo (Mackinnon et al. 1996).

This forest is also a large water catchment area that provides unlimited and primary clean water supplies to the community. Sungai Utik is a rocky shallow freshwater stream that discharges into the Kapuas River. Some small intrusions from peatland make the water slightly acidic (pH 6); however, the community can still use this water for their daily needs, watering their cultivated lands, and for

ecotourism purposes. The water is carried from the river to the longhouse through pipes and each cluster only needs to pay USD 0.14/month for pipe maintenance. We estimated the total value for water-related services would reach more than USD 21.5 million per year. Respondents also explained that the river provides essential food sources and helps to reduce the impact of flooding. This demonstrates the enormous value of the Sungai Utik River to the community.

The Dayak Iban rely more on cultivated goods than harvested wild goods. Therefore, we estimated the net annual return from cultivated and harvested wild goods, which are most of the goods needed to meet the community's daily needs. The community grows rice as the staple food, glutinous rice commonly used for ceremonies, rituals, and making rice wine, and other vegetables. The total return from cultivated goods is estimated to be USD 2,265/household annually. The community also collects forest products, for instance, ferns for daily vegetable intake, wild pigs, and fishes for food, *senggang* to make handicrafts, and firewood. The total return from harvested wild goods is estimated to be USD 282/household annually. This return is relatively small because the people only harvest forest resources for personal use.

### Cultural services and traditional knowledge

#### Cultural services

Some forest resources have inspired the Iban community culture, arts, and traditional handicrafts. For

example, tattoo art patterns have been inspired by species such as *Bunga Terong* (eggplant flowers) and *Ukir Degok*, which distinguish the Iban people from other sub-ethnic groups. Like tattoos, designs in woven fabric and wicker crafts are also inspired by forest species, representing the relationship between the community and forest as the primary living resource.

The Iban people practice rituals to interact with their ancestral spirits. The rituals are integrated into daily activities, for instance, opening up new land for cultivation, planting, harvesting, and other ceremonies. A ritual can mean many things; it can feed nature, ask permission and protection from the ancestors and *Betara* (the term for God in Iban tradition), and celebrate the harvest at *Gawai Dayak*, a local term for feast or festival (Nyauak and Dunn 1906).

The community passes on cultural and spiritual messages and the importance of protecting nature to the next generation through traditional schools. The school teaches children the farming process, how to recognize the forest's natural resources, and how to get to know their own culture by being involved in activities such as singing, dancing, weaving, and practicing rituals. Children also learn the history of the Iban community through stories passed down for generations.

**Table 2.** Estimated ecosystem services in Sungai Utik Customary Forest, Kapuas Hulu, West Kalimantan, Indonesia

Ecosystem Services	Estimated amount	Market value (USD)	Source	Total estimated value (USD)
Carbon stock and sequestration	Stock 3,301,907.17 tonnes; Sequestration 12,117,999.31 tonnes CO <sub>2</sub> eq/year	\$4.3/ton CO <sub>2</sub> eq	Donofrio et al. 2020	\$52,107,397.03/year
Water discharge	269,296,380.31 m <sup>3</sup> /year	\$0.08/m <sup>3</sup>	Kapuas Hulu Regent Regulation No. 71/2018	\$21,543,710.42/year
Water pH	6	-	Direct measurement	-
Cultivated goods*	Rice 2,241 kg/household/year Glutinous rice 1,100 kg/household/year Sweet potato 250 kg/household/year Corn 132 kg/household/year Cucumber 67 kg/household/year	\$0.97/kg \$1.4/kg \$0.35/kg \$0.35/kg \$0.35/kg	Local market	\$2,265.18/household/year
Harvested wild goods*	Ferns 312 kg/household/year Wild pig 95 kg/household/year Senggang, a local ginger ( <i>Hornstedtia reticulata</i> ) 40 kg/household/year Firewood 15 kg/household/year Fishes 12 kg/household/year	\$0.7/kg \$2.45/kg \$10.5/kg \$0.35/kg \$4.2/kg	Local market	\$281.79/household/year

Note: \*) refers to the top five most widely used items

### Customary law on forest management

Community management divides the land into sacred forests, protected forests, production forests (*Damun*), old and used longhouse areas (*Tembawang*), and cultivated land. The sacred forest is a cemetery where burial sites are marked with a jar. The sacred forest and *Tembawang* are believed to be where ancestral spirits lie and it is prohibited to cut down trees in those areas. However, foraging and hunting are still allowed. To meet the need for wood, trees are cut in the *Damun* area. Nevertheless, there are regulations on cutting trees. Every kinship cluster is only allowed to cut a maximum of 15 trees annually and must plant two trees for every tree cut down to ensure sustainability for future generations. In addition, the wood can only be used for personal needs, such as building a house, making tools, or firewood, and cannot be sold to people outside the community.

The customary sanction implemented for every transgression is a customary fine that can be converted into a monetary value. The customary fines from the lowest to the highest are *mungkul* (IDR 10,000), *kuna* (IDR 50,000), *alas* (IDR 500,000), and *tajau legiau* (>IDR 100,000,000) for incidents resulting in the loss of human life. In addition, sanctions are also implemented for violations related to forest resource usage, for instance, cutting trees in customary forests that belong to other communities and poaching sacred animals (orangutan, hornbills, and other specific species).

### Maintaining the customary forest

The customary forest that belongs to The Iban community in Sungai Utik Sub-village is the first customary forest area in the Kapuas Hulu Regency to receive recognition from The Indonesia Government through The Ministry of Environment and Forestry Decree No. SK.3238/MENLHK-PSKL/PKTHA/PSL.1/5/2020, issued in May 2020. The process to achieve recognition began in 1997 and involved numerous NGOs and contributions from the community itself throughout the process. Boundaries of customary community forests are recognizable natural boundaries such as rivers and hills that have been determined long ago among the communities. Boundaries have to be identified and agreed upon between communities and their coordinates have to be plotted to be officially registered in a government document. The customary forest has two essential functions, protection and production, implemented following customary laws.

The above decree nominated a forest area of  $\pm 9,480$  ha divided into three zones, protected forest ( $\pm 3,862$  ha), limited production forest ( $\pm 5,518$  ha), and other land-use areas, most settlements ( $\pm 100$  ha). Government recognition provides the community with rights and claims on using and maintaining the natural resources within the customary forest, which is expected to be done sustainably.

The community grows food on a shifting cultivation rotation. This system has been implemented ever since the community settled in the area, to maintain soil fertility. The process of clearing land for cultivation must follow customary law. The trees and shrubs in a particular area of

land to be cleared for planting will be burned. The burn process must be monitored and controlled to ensure that the fire does not infringe on other sites. The ash from the burn becomes fertilizer for the cultivated plants. Every cluster and household will plant rice and glutinous rice as their primary plants and various others such as cassava, eggplant, corn, cucumber, and other vegetables. When fertility decreases, the process shifts to another area. After a few years of abandonment (commonly about 5-10 years), the rotation returns to a previous site once trees and shrubs have had time to grow back.

Other than wood, the forest provides resources such as rattan, *resam*, *bemban*, *biro* leaves, *purun*, *pandan*, and others that will be used to make tools or products, for instance, mats, hats, bracelets, dyes, baskets, and many more. In addition, to meet their protein needs, the community sometimes hunts selected animals such as wild pigs, fish, and deer and keeps livestock, such as chickens and pigs, which are commonly used in rituals.

The Iban community in Sungai Utik adheres to the moral that "*The forest is our father, the land is our mother, and the water is our blood*". The forest is our father, which means the forest is the primary livelihood resource, the land is our mother, which means the ground is where all cultivated plants grow. Water is our blood means that the water resource is essential to support life; there is no life without water.

### Biodiversity and wildlife assessment

The customary forest in Sungai Utik is both a buffer zone for and a potential corridor linking, Betung Kerihun National Park and Danau Sentarum National Park. From the field survey results and the database provided by ITTO PD 617/11 (2015), we have estimated the biodiversity to be composed of 1217 plants, 303 birds, and other taxa, including mammals and amphibians, reptiles, and fishes (Figure 2).

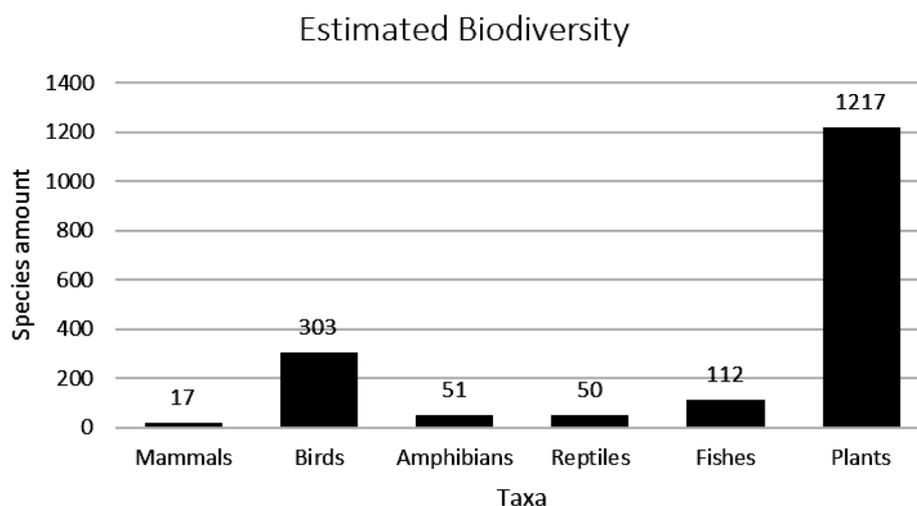
Our rapid assessment recorded 52 conspicuous wildlife species in Sungai Utik, from direct observation and community interviews (Table 3). These 52 species are known to inhabit the customary forest and would provide a specific wildlife tourist attraction. We referred to The International Union for Conservation of Nature's Red List of Threatened Species (IUCN Red List) database to determine the conservation status of each species (IUCN 2021).

The survey identified 1 critically endangered species, 4 endangered species, 4 near threatened species, and 12 vulnerable species. Another 29 were of least concern, and 2 were not assessed. Helmeted Hornbill, Wrinkled Hornbill, White-crowned Hornbill, Abbott's grey Gibbon, and Bornean Clouded Leopard are all endangered or critically endangered species found in the Sungai Utik customary forest and would be strong tourist attractions. More extensive surveys and assessments are needed for accurate estimates of all species living in the customary forest. However, this species assessment would help design a landscape conservation action plan in the future.

**Table 3.** Wildlife species encountered in Sungai Utik Customary Forest, Kapuas Hulu, West Kalimantan, Indonesia

Species	Common Name	IUCN Conservation Status
<b>Mammals</b>		
<i>Macaca fascicularis</i>	Long-tailed Macaque	VU
<i>Macaca nemestrina</i>	Pig-tailed Macaque	VU
<i>Presbytis rubicunda</i>	Maroon leaf monkey	VU
<i>Rusa unicolor</i>	Sambar deer	VU
<i>Neofelis diardi borneensis</i>	Bornean clouded leopard	EN
<i>Hylobates abbotti</i>	Abbott's grey gibbon	EN
<i>Sus barbatus</i>	Bearded pig	VU
<i>Tragulus napu</i>	Greater mousedeer	LC
<i>Helarctos malayanus</i>	Malayan sun bear	VU
<b>Birds</b>		
<i>Haliastur indus</i>	Brahminy kite	LC
<i>Pelargopsis capensis</i>	Stork-billed kingfisher	LC
<i>Alcedo meninting</i>	Blue-eared kingfisher	LC
<i>Anorrhinus galeritus</i>	Bushy-crested hornbill	NT
<i>Anthracoceros albirostris</i>	Oriental pied hornbill	LC
<i>Anthracoceros malayanus</i>	Black hornbill	VU
<i>Berenicornis comatus</i>	White-crowned hornbill	EN
<i>Buceros rhinoceros</i>	Rhinoceros hornbill	VU
<i>Rhabdotorrhinus corrugatus</i>	Wrinkled hornbill	EN
<i>Rhinoplax vigil</i>	Helmeted hornbill	CR
<i>Rhyticeros undulatus</i>	Wreathed hornbill	VU
<i>Prinia flaviventris</i>	Yellow-bellied prinia	LC
<i>Corvus enca</i>	Slender-billed crow	LC
<i>Dicrurus paradiseus</i>	Greater racquet-tailed drongo	LC
<i>Lonchura fuscans</i>	Dusky munia	LC
<i>Eurylaimus ochromalus</i>	Black-and-yellow broadbill	NT
<i>Hirundo tahitica</i>	Pacific swallow	LC
<i>Lichmera limbata</i>	Indonesian honeyeater	LC
<i>Terpsiphone paradisi</i>	Indian paradise-flycatcher	LC
<i>Copsychus malabaricus</i>	White-rumped shama	LC
<i>Copsychus saularis</i>	Oriental magpie-robin	LC
<i>Cinnyris jugularis</i>	Olive-backed sunbird	LC
<i>Passer montanus</i>	Eurasian tree sparrow	LC
<i>Argusianus argus</i>	Great argus	VU
<i>Pityriasis gymnocephala</i>	Bornean bristlehead	NT
<i>Pycnonotus goiavier</i>	Yellow-vented bulbul	LC
<i>Hemipus hirundinaceus</i>	Black-winged flycatcher-shrike	LC
<b>Amphibians</b>		
<i>Phrynoidis asper</i>	Asian giant toad	LC
<i>Fejervarya limnocharis</i>	Grass frog	LC
<i>Limnonectes ibanorum</i>	Rough-backed river frog	LC
<i>Limnonectes malesianus</i>	Malesian frog	NT
<i>Leptobranchella hamidi</i>	White-bellied slender litter frog	LC
<i>Chalcorana raniceps</i>	White-lipped frog	LC
<i>Meristogenys jerboa</i>	Gunther's borneo frog	VU
<i>Pulchrana picturata</i>	Spotted stream frog	LC
<i>Pulchrana signata</i>	Variable-backed frog	LC
<i>Polypedates leucomystax</i>	Four-lined tree frog	LC
<b>Reptiles</b>		
<i>Boiga cynodon</i>	Dog-toothed cat snake	LC
<i>Dendrelaphis pictus</i>	Painted bronzeback	N/A
<i>Bungarus flaviceps</i>	Red-headed krait	LC
<i>Ophiophagus hannah</i>	King cobra	VU
<i>Dogania subplana</i>	Malayan soft-shelled turtle	LC
<i>Varanus rudicollis</i>	Roughneck monitor	N/A

Note: IUCN Conservation status: LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered, CR: Critically Endangered, N/A: Not Assessed



**Figure 2.** The estimated biodiversity and species composition in Betung Kerihun National Park and the Sungai Utik Customary Forest, Kapuas Hulu, West Kalimantan, Indonesia (ITTO PD 617/11 2015)

## Discussion

### *Measured ecosystem services*

A pristine forest with an intact ecosystem and high biodiversity could mitigate climate change by absorbing large amounts of CO<sub>2</sub> from the atmosphere and releasing O<sub>2</sub> back to support life on earth. Such incentives may help ensure the sustainability of the provisioning of ecosystem services (Deal et al. 2012; Grêt-Regamey et al. 2013). The pristine customary forest plays the crucial role of retaining carbon. It has a complex ecosystem structure, high density of big trees, humidity, and a high regeneration rate. These characteristics make tropical rainforests the highest carbon-absorbing ecosystems on land (Mackinnon et al. 1996; Saner et al. 2012). In addition, the Sungai Utik River provides a clean water source for the community as it meets the pH standard for clean water (pH scale 6-9) (Arcipowski et al. 2017). This pristine river also plays a role in flood control and is the habitat for some protein resources, such as frogs and fishes (Grizzetti et al. 2016).

The Iban community has implemented community-supported agriculture (CSA) through traditional knowledge and shifting cultivation methods. The CSA concept refers to communities that grow their food to meet the community's needs. This also strengthens the bonds among community members (Liu et al. 2017). CSA has been proven to give numerous benefits to both communities and ecosystems. For instance, community members work together to cultivate the land and share the harvest, so no one is disadvantaged if some members' crops fail. In addition, the cultivated goods have a higher value than harvested wild goods. Currently, the community depends on crops as the primary food source. Harvested wild goods are used as supplementary resources to meet protein needs, fuel, and materials to make handicrafts.

### *Cultural services and traditional knowledge*

The Iban people have developed and implemented sustainable forest management through their traditions, knowledge, culture, and livelihoods since the era of their

ancestors without affecting the capacity of forest ecosystems to provide goods and services for future generations (Parrotta et al. 2016; Yuliani et al. 2018).

In the current period, the development of modern societies has some significant challenges for indigenous communities who still rely on and utilize forest resources. Technological enhancement, the abandonment of marginal lands, forest degradation, and inappropriate policies could erase traditional knowledge and cultural value and contribute to the over-exploitation of natural resources. Currently, the local indigenous community faces the challenges of land encroachment and degradation and outside parties who want to exploit the natural resources of the customary forest. These challenges lead to socio-economic pressures, rising excessive exploitation of the customary forest, and an imbalance of economic and political power, disadvantaging the indigenous communities. Therefore, the preservation and protection of traditional knowledge and the natural resource base must be prioritized if their natural resources continue to be used to meet their needs (Parrotta and Agnoletti 2007).

Generally, most local peoples and indigenous communities in Borneo perceive that the forest and its services are essential for their health (temperature regulator, food, water, and medicines) and spiritual and cultural well-being. Borneo's land-use change and deforestation issues have happened due to policies that allow private companies to invest in and exploit forest resources. National and local governments have simplified all regulations to attract investments from private companies and boost their income. This approach has also provoked land tenure conflict among local people, private companies, and local governments. High revenue is not the only benefit of forest resources.

Integrating local traditional knowledge and expert knowledge of ecosystem services (Figure 3) and resource management would secure local participation and ensure more opportunities to achieve higher returns at lower investment costs. This integration would also enhance the

social-ecological resilience of the community and its environment. The value of traditional ecological knowledge lies in the adaptive capacity of indigenous communities to conserve biodiversity and ecosystems while improving livelihoods and adapting to disturbance. Therefore, the indigenous communities, experts, and external stakeholders should design appropriate policies and action plans to conserve the ecosystems and achieve ecological resilience through socio-ecological landscape conservation (Ruiz-Mallén and Corbera 2013).

#### *Biodiversity and wildlife assessment*

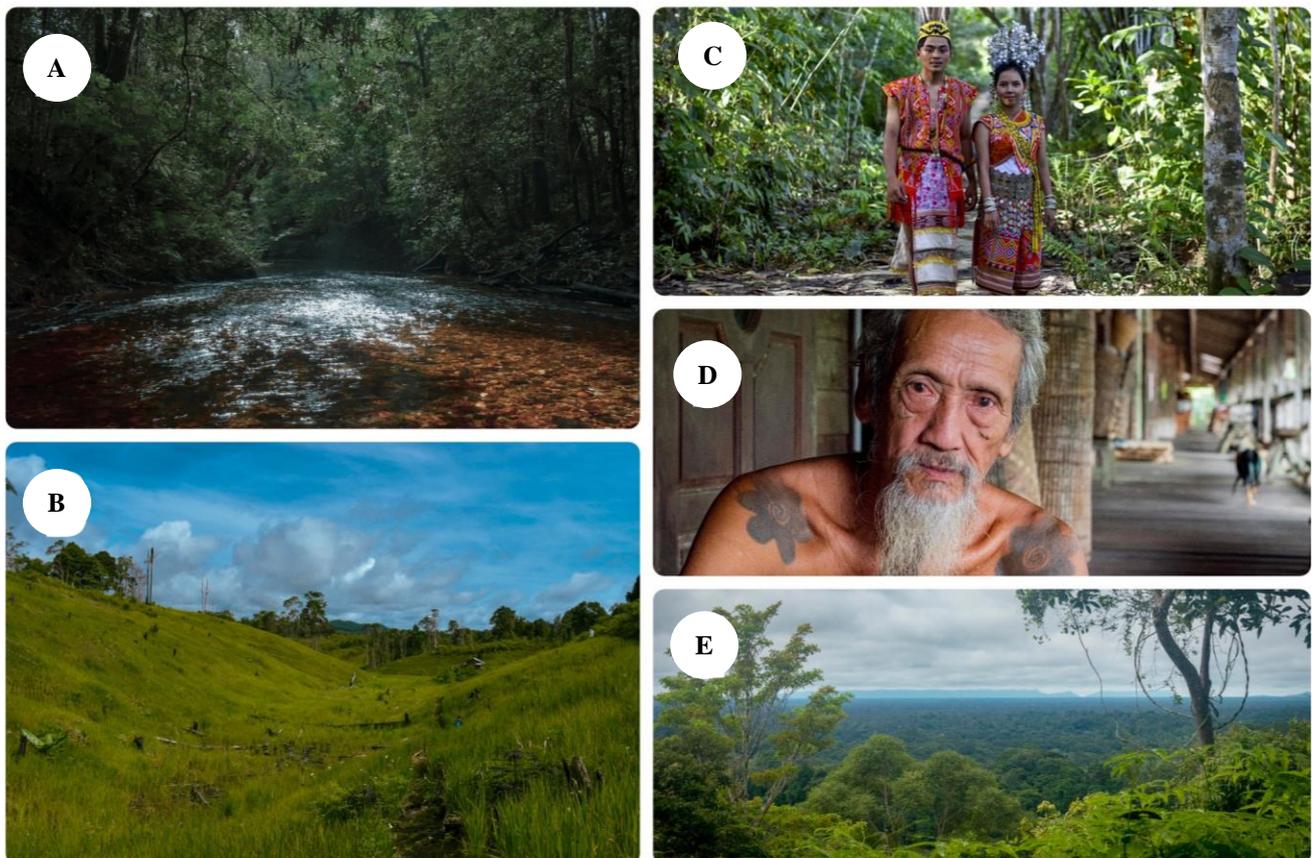
Some wildlife species have played significant roles in the customary forest landscape. Those species, for instance, hornbills and gibbons, are known as landscape species. They have a wide distribution, utilize a diversity of habitats, and often have significant impacts on the structure and function of natural ecosystems (McConkey 2018). Hornbills and gibbons are seed dispersers and could act as indicators of forest ecosystem health (Lindenmayer et al. 2000; Lindenmayer and Westgate 2020). Recently, some studies have revealed that tropical forests in unprotected areas have the highest risk of degradation. Most of that risks are caused by climate change and human encroachment (Rowland et al. 2019). The Helmeted Hornbill and Abbott's Grey Gibbon are also charismatic

species promoting conservation efforts and providing ecotourism opportunities (Walpole and Leader-Williams 2002).

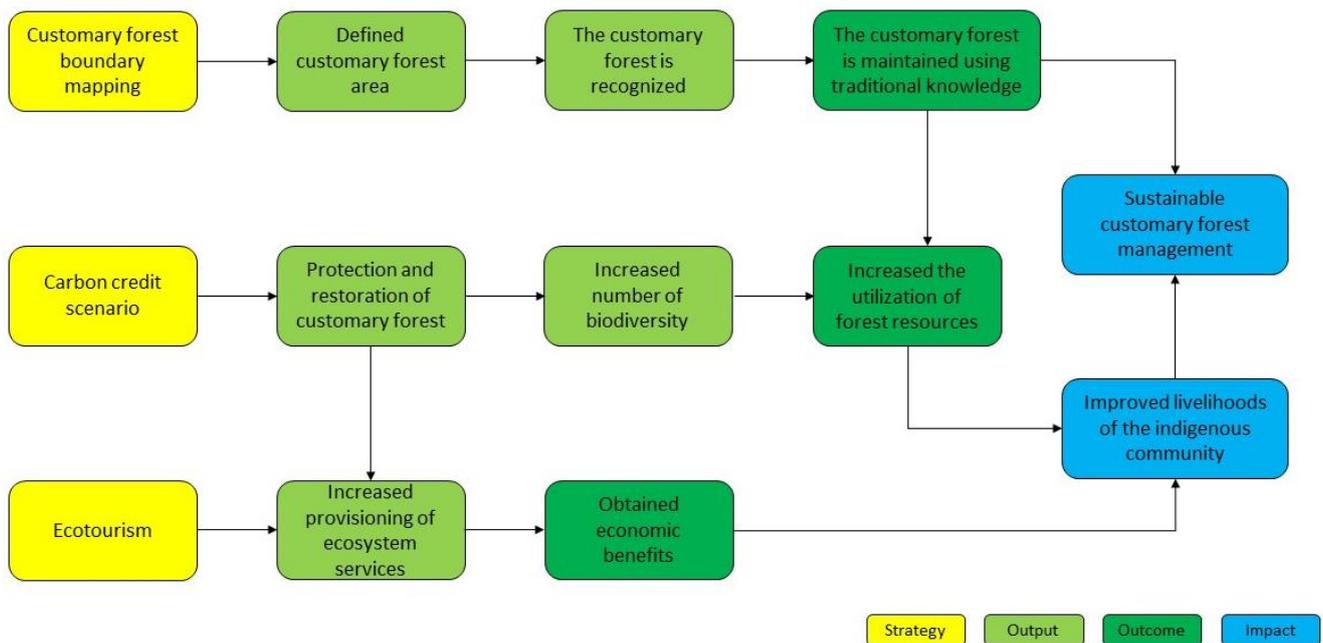
Providing ecosystem services in the customary forest has significant values and benefits if managed sustainably by the indigenous community. Therefore, the community has specific roles in maintaining, protecting, and conserving the forest to ensure the biodiversity and other ecosystem services are sustained for the next generations of the Iban indigenous community.

#### *Recommendation*

A carbon credit scheme and an ecotourism program are two activities that come from the community and could be adopted to develop the potential of customary forests to enhance economic benefits (Figure 4). Water-related services also have high values to be considered through water credit. In fact, only the community utilizes the river as their primary water source. Following the evidence, water credit seems not applicable in Sungai Utik but could be integrated into a carbon credit scheme (Lopa et al. 2012). These programs would involve the Iban community collaborating with governments and related stakeholders to maintain the customary forest and share the benefits of forest products and services.



**Figure 3.** The Sungai Utik Customary Forest, Kapuas Hulu, West Kalimantan, Indonesia. A. Sungai Utik River, providing water-related services, B. Cultivated land in shifting cultivation system, C. The Iban traditional costume, D. Apai Janggut, Tuai Rumah, the leader of Sungai Utik Longhouse, E. A landscape view of Sungai Utik Customary Forest. Photographed by Sandy Leo



**Figure 4.** Programs and activities to achieve sustainable forest management

A carbon credit scheme seems appropriate given the large amounts of carbon stored in the forest. Conditions that would improve the chances of success are enhancing communal and customary forest management, improving equity and poverty reduction, reducing social unrest and conflict, and encouraging sustainable forest management. To achieve these conditions, the community should manage their customary land through their customary law. The government should recognize community rights and help the community to achieve benefits from such a carbon credit scheme. More effective targeting of payments could reduce costs and ensure that more benefits reach the poor. Since the forest has clear boundaries and tenure claims, it will drive the program to achieve effectiveness, efficiency, and equity for the Iban community (Barbier and Tesfaw 2012).

Ecotourism is another obvious program to develop. The Sungai Utik customary forest is in the heart of Borneo, a place of mystery and adventure to outsiders. The opportunity to experience traditional community activities and see charismatic wildlife species safely and securely should appeal to tourists. The tourism sector has great potential for contributing financial benefits and helping to create growth and development, job opportunities, earnings for the community, and revenue for the government (Kaffashi et al. 2015). Implementing ecotourism could generate funds and public support that benefit the Iban community (Asriyani and Verheijen 2020). It also will enhance the conservation of the numerous species that inhabit the customary forest (Walpole and Leader-Williams 2002). Ecotourism also helps promote the Iban culture and their traditional knowledge of living respectfully with nature.

Such activities could have both positive and negative impacts on community members. In other communities,

rapid economic growth and high income are predicted to diminish the connections between community members if they cannot be appropriately managed. Therefore, before implementing carbon credit schemes or ecotourism programs, potential impacts need to be understood. For example, potential social conflicts should be identified, the agents and causes of deforestation should be understood, property rights should be clarified, free, prior, and informed consent among stakeholders must be obtained, a fair and transparent mechanism of benefits sharing should be developed, and monitoring and evaluation of the social aspects of project interventions should be established (de la Fuente and Hajjar 2013).

The recognition of indigenous peoples and their rights to their ancestral land would secure their access to forest resources and reduce any conflicts that may occur in the future. Strengthening the community capacity to manage the forest should incorporate the current carbon-based and ecotourism-based forest management (Dhiaulhaq et al. 2017). Implementing such programs should include specific activities that could be evaluated to provide feedback to the community. This evaluation could positively affect the indigenous people and the environment as an adaptation process for managing the customary forest (Meijaard et al. 2021). If sustainable forest management can be implemented on a broad scale, it will ensure the conservation of the West Kalimantan landscape and wider Borneo.

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