The potential, utilization and management of forest biodiversity for the livelihood of local communities in Ratah Watershed, East Kalimantan Province, Indonesia

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Abstract. Forest biodiversity is crucial for the survival of local communities in Mahakam Ulu District, East Kalimantan Province, Indonesia, especially for the Punan Dayak, Bahau Bateq Hwang Lung Gelawang, and Bakumpai Dayak tribes who live in the Ratah Watershed area. For generations, local communities in the Ratah Watershed have had local wisdom to protect the resources in the forest around them. Unfortunately, various problems threaten the existence of forest biodiversity in the Ratah Watershed. The purpose of this study is to show the identification results of the potential, utilization, and management of biodiversity according to local communities in Mahakam Ulu District, East Kalimantan Province, and the threats faced. The data was obtained through interviews with key informants, FGDs, participatory mapping, and field observations with the people of Nyari Bungan Village, Long Gelawang Village, Danum Paroy Village, and Muara Ratah Village. The result of the study indicated that local communities in the Ratah Watershed find it more inconvenient to utilize forest resources because of the diminishing potential for biodiversity. The low level of welfare, unclear village boundaries, overlapping village areas with private companies (timber companies, oil palm) are the main problems. Conservation of biodiversity from forests in the Ratah Watershed requires the cooperation of various parties, especially in increasing community capacity in managing forest resources for better environment.

1. Introduction

Indonesia is one of the countries with the highest biodiversity in the world. Located on the equator and has more than 17,000 islands originating from the continents of Asia and Australia reached 95,000 km2 of coastline, Indonesia's tropical forests have very varied biodiversity from west to east [1]. Indonesia even has species richness with a sufficiently high percentage of endemic species. Indonesia has 20,000 species of flowering plants of which 40% are endemic plants, Orchidaceae which achieve 4,000 species, Dipterocarpaceae has 386 species, 4000 species of ferns, 1200 species of bamboo, and 350 species of rattan [2].

The existence of biodiversity is very crucial for the livelihoods of people around the world. 20% of the world's population of about 350 million of the world's poorest people depend on forests for their survival, about 60 million indigenous peoples and other communities living near forests depend on
subsistence on forests, and 1.6 billion rural people on to some extent depending on the forest [3]. The local community in East Kalimantan, especially the Dayak ethnicity, is one of the local communities in Indonesia where some generations have used biodiversity to fulfill their daily lives. Local people in Setulang Village, Malinau District, obtained wood, animals, fish, craft materials, and medicinal plants from the forest [4]. Meanwhile, a study in Gunung Beratus Protected Forest, Wehea Protected Forest, Menamang Kiri Village, and Menamang Kanan Village showed that of 44 medicinal plant species from 30 families which are used for women’s health [5].

Although biodiversity is very crucial to many people, its existence faces many threats. For Indonesia, the biggest threat to biodiversity is the reduction of tropical rain forests, and currently, only a lot of degraded forests are left. The most causes are logging, forest fires, and deforestation [6]. Although Indonesia has established a task force to control forest and land fires and implemented a selective logging system, the impacts of several species produced and fires are unavoidable [7,8].

The loss of biodiversity is very influential on local communities that are very dependent on the availability of forest resources. Research on the use of forest resources by local communities has done many, to helping local communities not get too negative impacts is also significant to act biodiversity conservation efforts. This paper presents the potential, utilization, and management of biodiversity according to local communities in Mahakam Ulu Regency, East Kalimantan Province. In this study, we also collect information related to the challenges faced by local communities in efforts to conserve biodiversity, including the parties who support these efforts.

2. Materials and methodology

2.1. Research site
This research was conducted from July – September 2019 in Nyaribungan Village, Long Gelawang Village, Danum Paroy Village, and Muara Ratah Village, which are located in Laham Sub District, Mahakam Ulu District, East Kalimantan Province, Indonesia, as shown in Figure 1.

![Figure 1. Map of study location in Mahakam Ulu District, East Kalimantan Province, Indonesia](image)

2.2. Data collection
Data collection in this study was carried out through meetings in the form of Focus Group Discussions (FGDs), in-depth interviews with several key informants (village heads, traditional leaders, community leaders, elders, etc.), field observations, and through secondary data search (reports, publications, and others). FGDs were carried out in each village by collecting 20-25 people representing groupings in
the community (occupation, gender, and age) to find out the potential, use of biodiversity in each land, and the challenges faced in efforts to conserve forest resources in each village. Interviews were conducted to clarify the information obtained during the FGD, while field observations were carried out to find out directly about community activities related to the data obtained.

2.3. Data analysis
The data and information obtained were analyzed descriptively to provide an overview of the condition of the village community and the environment in which they live. Descriptive analysis was chosen because it is considered to be able to describe systematically and accurately, facts and characteristics of a particular population or field. To facilitate the analysis, the data obtained is reduced and then compiled in the form of tables or matrices.

3. Results

3.1. Socio-economic, potential and utilization of forest resources by local communities in the Ratah Watershed
Laham Sub-district is one of the sub-districts in the south of Mahakam Ulu District, East Kalimantan Province. Laham Sub-district has an area of ± 901.80 km² which is divided into 5 villages namely Nyaribungan, Long Gelawang, Danum Paroy, Laham, and Muara Ratah [9]. These villages, except Laham Village, are generally located along the Ratah River (a tributary of the Mahakam River). Most of the population in Laham Sub-district is still dominated by local ethnic groups (Dayak) and the rest are immigrants from other areas, namely Java, Banjar, Kutai, Bugis, Lombok, and Sasak. The original Dayak ethnicity in Laham Sub-district can only be found in Long Gelawang Village which is characterized by the presence of the Bahau Saq Hwang Lung Gelawang Dayak ethnicity, while the other 3 Dayak ethnic groups are displacements from Central Kalimantan Province (Table 1).

| Table 1. Social, economic, and community conditions in Nyaribungan Village, Long Gelawang Village, Danum Paroy Village, and Muara Ratah Village |
| Condition | Village |
| --- | --- | --- | --- |
| Total land area | Nyaribungan | Long Gelawang | Danum Paroy | Muara Ratah |
| ± 168.44 km² | ±137.32 km² | ± 45.77 km² | ±197.75 km² |
| Total population | 218 people | 525 people | 687 people | 229 people |
| Ethnicity | Dayak Punan | Dayak Bahau Saq, Hwang Lung Gelawang | Dayak Punan, Dayak Murung, | Dayak Bakumpai, Dayak Baha Dayak Siang, |
| Dayak Murung, | Gelawang | Dayak Murung, | | Dayak Murung, |
| Dayak Siang, | Dayak Bakumpai, | Dayak Siang, | Timor, | Java, |
| Dayak Ot Danum | Kutai, Jawa, | Banjar, | | Banjar |
| Community activities | farmer, lumberjack, casual laborers, fishermen, animal hunter | farmer, lumberjack, fishermen, animal hunter | farmer, lumberjack, fishermen, rubber farmer | farmer, lumberjack, rubber farmer |

Until today local communities in Ratah Watershed still have a high dependence on forest resources. Most of the forest resources are collected by the local community to meet their daily need eg to build houses, boats, food, traditional medicines, handicraft materials, and even for completing traditional ceremonies.
Table 2. The potential and use of flora by local communities in the Ratah Watershed

| Utilization category          | Village          |
|------------------------------|------------------|
|                              | Nyaribungan      | Long Gelawang | Danum Paroy | Muara Ratah |
| For house materials          | Eusideroxylon zwageri, Shorea spp. | Eusideroxylon zwageri, Shorea spp., Duabanga maluccana, Anthocepalus macrophyllus, Pentaspadon motleyi, Dryobalanops aromatica, Shorea spp., Elmerillia mollis, Dipterocarpus spp., Shorea laevis, Dyera costulata | Eusideroxylon zwageri, Shorea spp. | Eusideroxylon zwageri, Shorea spp., Koompassia exelsa, Dryobalanops aromatica |
| For boats materials          | Pentaspadon motleyi, Elmerillia mollis | Pentaspadon motleyi, Elmerillia mollis, Shorea spp., Dimocarpus longan, Lansium domesticum, Nepheleium spp., Artocarpus integer, Baccuarea spp., Durio oxleyanus, Durio kutejensis, Layang, Durio oxleyanus, Artocarpus integer, Lansium domesticum, Dimocarpus longan, | Pentaspadon motleyi, Elmerillia mollis | Pentaspadon motleyi, Elmerillia mollis |
| For food material (fruit and vegetables) | Koompassia exelsa, Oncosperma tigillarium, Durio spp | Durio kutejensis, Layang, Durio oxleyanus, Artocarpus integer, Lansium domesticum, Mangifera rambutan, Cocos nucifera, Nepheleium lappaceum, Dimocarpus longan, Linsertium domesticum, Mangifera torquenda, Cocos nucifera, Nepheleium lappaceum, Artocarpus odoratissimus, Durio dulcis, Durio oxleyanus, Artocarpus herophyllea, Musa balbisiana, Theobroma cacao | Durio spp., Durio kutejensis, Nepheleium lappaceum, Dimocarpus longan, Linsertium domesticum, Mangifera torquenda, Cocos nucifera, Nepheleium lappaceum, Artocarpus odoratissimus, Durio dulcis, Durio oxleyanus, Artocarpus herophyllea, Musa balbisiana, Theobroma cacao |
| For traditional medicine     | Arcangelisia flava, Eurycoma longifolia, Tinospora cordifolia, Lavanga sarmentosa, Arcangelisia flava, Eurycoma longifolia, | Arcangelisia flava, Eurycoma longifolia, | Tristaniopsis merguensis, Arcangelisia flava, Eurycoma longifolia, Lavanga sarmentosa, Bauhinia sp., Gynura procumbens | Arcangelisia flava, Eurycoma longifolia, Lavanga sarmentosa, Bauhinia sp., Gynura procumbens |
| For craft materials          | Licuala valida, Calamus spp. | Licuala valida, Calamus spp. | Licuala valida, Calamus spp., Pandanus cf. kaida, Bambusa spp. | Licuala valida, Calamus spp., Pandanus cf. kaida, Bambusa spp., Calamus spp. |
| For traditional ceremonial equipment | Euphorbia tirucalli, Ficus benjamina, Lea simplicifolis, Saccharum officinarum | Macaranga spp., Saccharum officinarum, Euphorbia tirucalli, Ficus benjamina, Lea simplicifolis, Saccharum officinarum | Euphorbia tirucalli, Ficus benjamina, Lea simplicifolis, Saccharum officinarum | Euphorbia tirucalli, Ficus benjamina, Lea simplicifolis, Saccharum officinarum |
| For sale                     | Eusideroxylon zwageri, Shorea spp. | Eusideroxylon zwageri, Shorea spp., Eusideroxylon zwageri, Shorea spp. | Eusideroxylon zwageri, Shorea spp. | Eusideroxylon zwageri, Shorea spp. |
Paraserianthes falcataria, Hevea brasiliensis, Theobroma cacao, Cocos nucifera,

Because not all needs can be obtained from the forest, some of the results from the use of forest resources are also sold by local communities in Ratah Watershed for cash. Most of their cash comes from selling Eusideroxylon zwageri, Shorea spp, Paraserianthes falcataria and others. In addition, they also sell prey such as Manis javanica, Cervus timorensis, Tragulus napu, Sus scrofa, fish, and others to get cash.

Table 3. The potential and utilization of fauna by local communities in the Ratah Watershed

| Utilization category          | Nyaribungan         | Long Gelawang | Danum Paroy          | Muara Ratah          |
|------------------------------|---------------------|---------------|----------------------|----------------------|
| For food material            | Cervus timorensis,  | Cervus timorensis,  | Cervus timorensis,  | Cervus timorensis,  |
|                             | Tragulus napu,      | Tragulus napu,  | Tragulus napu,       | Tragulus napu,       |
|                             | Sus scrofa,         | Sus scrofa,    | Sus scrofa,          | Sus scrofa,          |
|                             | Malayopython        | Malayopython   | Malayopython         | Malayopython         |
|                             | reticulatus         | reticulatus    | reticulatus          | reticulatus          |
|                             | Leptobarbus hoenvenii, | Paradox      | Hystrix brachyura,  | Helarctos malayanus, |
|                             | Pangasius pangasias, | hermaphroditus, | Muniaicus muntjak    | Lophura bulveri      |
|                             | Osphronemus goramy, | Hystrix brachyura, | Muntiacus muntjak    | Pangasius pangasias, |
|                             | Barbonymus gonionotus, | Neofelis nebulosa, | Helarctos malayanus, | Pangasius pangasias, |
|                             | Cyprinus carpio,    | Bos javanicus lowi, | Orlitia borneensis, | Osphronemus goramy,  |
|                             | Channa gachua,      | Helarctos malayanus, | Amyda cartilaginea, | Barbonymus gonionotus, |
|                             | Bagrus nemurus,     | Leptobarbus hoenvenii, | Leptobarbus hoenvenii, | Cyprinus carpio,     |
|                             |                     | Pangasius pangasius, | Pangasius pangasius, | Channa gachua,       |
|                             |                     | Osphronemus goramy, | Osphronemus goramy,  | Bagrus nemurus,      |
|                             |                     | Barbonymus gonionotus, | Barbonymus gonionotus, |                     |
|                             |                     | Cyprinus carpio, | Cyprinus carpio,     |                     |
|                             |                     | Channa gachua, | Channa gachua,       |                     |
|                             |                     | Bagrus nemurus, | Bagrus nemurus,      |                     |
|                             |                     | Polyleptodon    |                      |                     |
|                             |                     | schleimacheris, |                      |                     |
|                             |                     | Malayopython    |                      |                     |
|                             |                     | reticulatus     |                      |                     |
|                             |                     | Orlitia borneensis, |                      |                     |
|                             |                     | Lophura bulveri |                      |                     |
|                             |                     | Manis javanica  |                      |                     |
| For traditional medicine    | Buceros rhinoceros, | Buceros rhinoceros |                      |                     |
|                             | Neofelis nebulosa, |                      |                      |                     |
|                             | Helarctos malayanus, |                      |                      |                     |
|                             | Polyleptodon schleimacheris, |                      |                      |                     |
|                             | Sus scrofa,         |                      |                      |                     |
| For sale                    | Manis javanica,     |                      |                      |                      |
|                             | Cervus timorensis,  |                      |                      |                      |
|                             | Tragulus napu,      |                      |                      |                      |
|                             | Osphronemus goramy, |                      |                      |                      |
|                             | Barbonymus gonionotus, |                      |                      |                     |
| For traditional ceremonial equipment |                      |                      |                      |                     |
|                             |                      |                      |                      |                     |

5
3.2. Management of forest resources by local communities in the Ratah Watershed

In utilizing forest resources, local communities in Ratah Watershed divide their territory based on several landscapes, namely villages, ex-villages, rice fields, gardens, and forests. The division of the landscape is very important in the habitual patterns of those who move frequently. Local people in the Ratah Watershed often move their settlements for finding more outlying land. The village they left later became fruit gardens, while the former fields would become *Paraserianthes falcataria* gardens, *Calamus* spp gardens, *Theobroma cacao*, or *Hevea brasiliensis* gardens.

Table 4. Landscape-based forest resource management by local communities in Ratah Watershed

| Stakeholders category | Village | Village | Village | Village |
|-----------------------|---------|---------|---------|---------|
|                       | Nyaribungan | Long Gelawang | Danum Paroy | Muara Ratah |
| Village               | settlement, latest grave location | settlement, latest grave location | settlement, latest grave location | settlement, latest grave location |
| Ex-village            | fruit garden (*lembo*), ex-grave location (*kolowong*), long house (*lamin/betang*), artifact namely washing stone (*sembaling*) | long house (*aya*), fruit garden (*lembo/lepuun*), ex-grave location (*kale menaq*) | artifact namely house pole (*torah*), ex-grave location (*kelovong*), fruit garden (*kelokaq*) | ex-grave location, fruit garden (*lauun*) |
| Rice field            | rice, vegetables, fruits | *Paraserianthes falcataria*, *Calamus* spp (*way*), *Theobroma cacao*, *Hevea brasiliensis* | *Calamus* spp | *rice, vegetables, fruits*, *Calamus* spp (*uwe*) |
| Garden                | *Paraserianthes falcataria*, *Calamus* spp (*woy*), *Theobroma cacao*, *Hevea brasiliensis* | *rice, vegetables, fruits* | *rice, vegetables, fruits* | *rice, vegetables, fruits* |
| Forest                | customary forest (*tana adat*), protected forest (*tanaad pera ay*), waterfalls namely *ongkong* (*jantur*), Ongkong, swallow’s nest caves, hunting location namely salt water (*sopan*) | customary forest (*tu’an adat*), protected forest (*tanaad pera ay*), waterfalls (*ben*) | hunting location (*ngaran*), waterfalls namely *cay*, hunting location namely salt water (*sopan*) | customary forest (*petak adat*), swamp (*rapaq*), forest, hunting location namely salt water (*sopan*), *Calamus* spp forest, location of the honey tree |

3.3. Conservation of forest resource biodiversity in the Ratah Watershed

The local community in the Ratah Watershed is strict in applying local knowledge and traditional wisdom handed down from their ancestors. This condition can appear from their activities such as in traditional medicinal, wood, rattan, game animals, and others collect in forest management with the
existence of customary forests, protected forests, fruit gardens, and others. The customary institutions and the village government of each village support the conservation efforts of local communities by issuing village regulations on river protection, hunting activities, launching timber, and others supported by the district government by issuing the Mahakam Ulu District Regulation. Some timber, mining, and oil palm plantation companies in the Ratah Watershed (PT Ratah Timber, PT Seroja Universum Narwastu, PT Kaltim Artha Pusaka Eksplorasi, PT Tata Buana Kharisma, PT Marsam Citra Adiperkasa, and PT Kaltim Bumi Palma follow government regulations by implementing protection rivers, springs, and protected areas according to the provisions of the HCVF, while WWF-Landscape Mahakam Kayan Indonesia helps the community by conserving the area and protecting endangered flora and fauna.

Table 5. The role of stakeholders in forest resources conservation in the Ratah Watershed

| Stakeholders          | Village                        |
|-----------------------|--------------------------------|
|                       | Nyaribungan                    | Long Gelawang                  | Danum Paroy                  | Muara Ratah                   |
| Villagers             | local knowledge and           | local knowledge and           | local knowledge and         | local knowledge and           |
|                       | traditional wisdom such as    | traditional wisdom such as    | traditional wisdom such as   | traditional wisdom such as    |
|                       | in rotational cultivation     | in activities of fruit        | in activities of rotational | in activities of fruit        |
|                       | activities and use of forest  | garden (lepuraan), to        | cultivation (Umoq) and       | gardens, customary forests,   |
|                       | medicinal plants, forest      | protected forest (tanaaq       | forest protection and        | fruit gardens, customary      |
|                       | utilization, and             | pera'auq), and rotational      | utilization for traditional | forests, ratten gardens, and  |
|                       | management (collection of     | cultivation                  | medicines, handicrafts from  | rotational cultivation        |
|                       | rattan, agathis boonensis     |                              | rattan, wood for             |                              |
|                       | resin, and forest honey)      |                              | house material,              |                              |
| Traditional           | customary regulations         | customary regulations        | customary regulations        | Custodial regulations         |
| Government            | related to forest             | related to the protection of  | related to the preservation  | governing customary           |
|                       | conservation                 | protected plants and          | of natural resources         | forests (petak adat), rattan  |
|                       |                               | animals where if             |                               | harvesting (uwe), forest      |
|                       |                               | there is a violation will    |                               | resources such as rattan,     |
|                       |                               | be subject to a fine old urn  |                               | honey, hunting                |
|                       |                               | (antang).                    |                               |                              |
| Private companies     | village regulations           | village regulations           | village regulations          | village regulations           |
|                       | governing the prohibition     | governing the prohibition of  | governing the protection of  | governing the use of          |
|                       | of poisoning rivers,          | illegal logging and killing   | natural resources            | natural resources             |
|                       | prohibition of hunting in     | of protected animals          |                               |                              |
|                       | certain areas, and permits    |                               |                               |                              |
|                       | to enter certain areas        |                               |                               |                              |
| Non-Government        | protect rivers, springs, and  | protect rivers, springs,      | protect rivers, springs, and  | protect rivers, springs, and  |
| Organization (NGO)    | forests according to the      | forests according to the      | forests according to the     | forests according to the      |
|                       | rules of High Conservation    | rules of High Conservation    | rules of High Conservation   | rules of High Conservation    |
|                       | Value Forest (HCVP)           | Value Forest (HCVP)           | Value Forest (HCVP)          | Value Forest (HCVP)           |
|                       | conserving areas and          | conserving areas and          | conserving areas and         | conserving areas and          |
|                       | protecting endangered         | protecting endangered         | protecting endangered        | protecting endangered         |
|                       | animals and plants            | animals and plants            | animals and plants           | animals and plants            |

3.4. Future challenges in the conservation of forest resources biodiversity in the Ratah Watershed
The low level of welfare of local communities is the first problem to conserve forest resources in the Ratah Watershed. The high price of necessities due to inconvenient access to and from the village adds to the pressure on forest resources because they are the mainstay for finding cash. The unclear
boundaries between villages in the Ratah Watershed are also a problem that is solved. The lack of clear boundaries causes many conflicts to occur, both conflicts between village communities and conflicts between village communities and existing companies (enrichment, mining, and oil palm).

**Table 6.** Challenges in conserving forest resource biodiversity in Ratah Watershed by problem category

| Problem category | Nyaribungan | Long Gelawang | Danum Paroy | Muara Ratah |
|------------------|-------------|---------------|-------------|-------------|
| Population welfare level is low | people livelihoods still depend on the results of the field crops and the use of forest resources | people livelihoods still depend on the results of the field crops and the use of forest resources | people livelihoods still depend on the results of the field crops and the use of forest resources | people livelihoods still depend on the results of the field crops and the use of forest resources |
| Boundaries between villages are not clear | boundary conflict with Long Gelawang village due to palm oil company | boundary conflict with Long Nyaribungan village due to palm oil company | conflict with Muara Ratah peoples due to the resettlement program for the Danum Paroy village community in the Muara Ratah village area | conflict with Danum Paroy peoples due to the resettlement program for the Danum Parody village community in the Muara Ratah village area |
| Conflict of the utilization of natural resources with private companies (timber, oil palm plantation, and mining) | overlapping areas with timber companies causing conflicts between villages and changes in village boundaries | overlapping areas with timber and coal mining companies causing conflicts between villages and changes in village boundaries | overlapping areas with oil palm plantations and coal mining companies causing conflicts between villages and changes in village boundaries | overlapping areas with timber companies causing conflicts between villages and changes in village boundaries |

4. **Discussion**

The variety of flora and fauna from the forest and their use by local communities in the Ratah Watershed of Mahakam Ulu District indicate they are very close to forest resources (Table 2 and Table 3). The conditions are similar to those shown by the Dayak community in Kayan Mentarang National Park utilizes 139 to 214 types of forest products for food, medicine, building materials, cash income, ceremonies, and culture [10].

The pattern of utilization of forest resources based on landscape categories by local communities in the Ratah Watershed is also general in the other Duyak community. The Dayak Bahau Umaq Telivaq
peoples in Matalibaq Village, Mahakam Ulu District, divides its territory into a village (tana’ uma’), ex-rice field fruit garden (tana’ lepu’un lumaq), ex-village fruit garden (tana’ lepu’un uma’), forbidden forest (tana’ bio), reserve forest (tana’ kaso/kasog), cemetery (tana’ patai/bilah), forest for obtaining forest products (tana’ berahan/belahan), forest for house raw materials (tana’ mawaaq), customary land boundary (aang/haang tana’), reserve forest (tana’ peraaq), forest for taking medicinal herbs (tana’ pukung), and land along rivers within the customary area (tana’ lirung) [11]. While study in Setulang Village of Malinau District shows that the forest resources of Dayak Kenyah Oma’ Longh divided into rice field (umo’) and ex-rice village (jakau), forbidden forest (tane’ olen), reserve forest (unung mp’) [4].

Although there are many opinions against that shifting cultivation is one of the causes of deforestation [12,13], but the data in Mahakam Ulu District shows this. Data from the Mahakam Ulu District Government states that the forest cover area of Mahakam Ulu Regency in 2000 was 1,844,742, but in 2013 there were 1,794,502 hectares or decreased by 94,240 hectares (5%) in 13 years. More further stated that during 2009-2013 there were 14,289 hectares of forest clearing for oil palm plantations, 7,901 hectares due to shifting cultivation and community rubber plantations, 3,463 hectares caused by unsustainable timber practices, illegal logging or forest encroachment, 392 hectares in agricultural fields mining, and 200 hectares 2009-2013 in the forest plantation sector [14]. Shifting cultivation is the local wisdom of the Dayak community that has an inheritance from generation to generation. Shifting cultivation is one of the ways for the Dayak people to survive. The implementation of shifting cultivation is generally done by following local knowledge or customary rules in the community, so carried out with care. There is some local knowledge for the Dayak community to practice shifting cultivation that is must understand astrology, the succession rate of cultivation, and the cycle of field activities [15].

Forest resources cannot be a part of the life of the Dayak community. Therefore, local communities in the Ratah Watershed include these efforts in the customary rules of each village (see Table 5). The activities to protect forest resources in the Ratah Watershed receive support from the Mahakam Ulu District Dayak Customary Council through the Book of Mahakam Ulu Dayak Customary. This book contains rules for the protection of natural resources for the Dayak Bahau Saq, Dayak Siang Murung, Uut Danum, Bekumpai and Punan Kuhi Dayak customary laws. Efforts to save forest resources in the Ratah Watershed also got assistance from the Mahakam Ulu District Government through the Mahakam Ulu District Regional Regulation Number 7 of 2018 concerning Recognition, Protection, Empowerment of Indigenous Law Communities and Customary Institutions. In this regional regulation, the local government is obliged to protect and preserve cultural sites, customs, local wisdom, and foster indigenous peoples, through policies that do not conflict with the interests of indigenous peoples and human rights.

The support of traditional institutions and the government in saving forest resources in the Ratah Watershed is indeed needed but the threats also come with the activities of private companies (timber companies, mining, and oil palm plantations) operating in the area. Although the government has required private companies to apply the High Conservation Value Forest (HCVF) concept to minimize the existing ecological and social impacts, its implementation needs to be monitored by the government. Especially considering the development model of Mahakam Ulu Regency is to spur economic growth by inviting large-scale investors (forest plantations, plantations, and mining) that are environmentally friendly (East Kalimantan Green) [16]. The concept of HCVF conduct by the Forest Management Council (Forest Stewardship Council/FSC) in sustainable forest management [17], and in the oil palm plantation is used by Indonesian Sustainable Palm Oil (ISPO) to obtain sustainable management certification [18].

The presence of private companies in the Ratah Watershed does help spur the local economy in Mahakam Ulu District but it can trigger new conflicts (Table 6). The study of land tenure conflicts in Long Bagun Sub-district, Mahakam Ulu District stated that conflicts between communities in Long Melaham, Mamahak Besar, Ujoh Bilang, Long Bagun Ilir, and Long Bagun Ulu villages were caused by the presence of oil palm plantation companies, and coal mining in their area [19]. Unclear village
boundaries are indeed the main cause of conflicts between local communities and private companies (timber, oil palm plantations, and mining) and this is homework for local governments to resolve immediately. The ambiguity of village boundaries also makes it difficult for the community to arrange village spatial plans so that they can utilize forest resources optimally and sustainably.

One of the solutions that the government can offer to resolve conflicts in the Ratah Watershed is to run the Social Forestry program. The Social Forestry Program is a program of the Indonesian Ministry of Environment and Forestry to increase local communities’ access to forest resources utility by Village Forests (Hutan Desa), Community Forests (Hutan Kemasyarakatan), Community Plantation Forests (Hutan Tanaman Rakyat), Community Forests, Customary Forests (Hutan Adat), and Forestry Partnerships (Kemitraan Kehutanan) program. Since 2018 PT Ratah Timber has been running the Forestry Partnership program with the Forest Farmers Group (Kelompok Tani Hutan) Hunge Palau, in Mamahak Teboq Village, Long Hubung District, through a reforestation program on non-productive land (burnt in 1997) covering an area of 96 hectares [20].

Efforts to utilize forest resources in the Ratah Watershed are crucial because the lives of local communities in Nyaribungan Village, Long Gelawang Village, Danum Paroy Village, and Muara Ratah Village are highly dependent on the presence of forest resources. For local people in the Ratah Watershed, saving forest resources means saving their lives. This condition shows that the main challenge faced in conserving forest resources in the Ratah Watershed is meeting the needs of local communities living in the vicinity. For this reason, improving the welfare of local communities in the Ratah Watershed needs to be done immediately. Local communities in the Ratah Watershed need to improve their human resource capacity to manage forests sustainably and avoid conflicts. And to minimize the impact of conflicts that occur, it is natural for the government to involve the community in decision making. The local community of Ratah Watershed's involvement in conserve forest resources can minimize damage to biodiversity. Biodiversity conservation efforts will be much more successful if they have local community support, especially in accepting, planning, and improving initiatives [21,22].

5. Conclusion

Forest resources are a part of the life of the Dayak community in the Ratah Watershed, Mahakam Ulu District, East Kalimantan Province. Therefore, efforts to conserve forest resources, including its biodiversity, in the Ratah Watershed are very urgent. For generations, local communities in the Ratah Watershed have had local wisdom to protect the resources in their surrounding forest. But the cause of damage to forest resources in the Ratah Watershed is not only by local community activities but also by the private sector (timber, mining, and oil palm). Therefore, the Dayak community in the Ratah Watershed needs support from various parties (government, private companies, NGOs, and other parties) to maintain their forest resources.

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