Conservation Strategy of Native Seedlings in Kalimantan to Achieve Sustainable Forests in Indonesia

M Suheri1*, N F Haneda2, J Y Hwa1, S Sukeno1

1PT Korintiga Hutani Camp Pellita, Ds Nanga Mua, Kab Kotawaringin Barat 74152 Central Kalimantan, Indonesia
2Departemen of Silviculture, Faculty of Forestry and Environment, IPB University, Jalan Ulin Kampus IPB Darmaga, Bogor 16680 Indonesia

*Corresponding email: mohamad.suheri23@gmail.com

Abstract. Recently, the attention of the global community is increasing to the phenomenon of climate change. Climate change could influence the imbalance of the forest ecosystem. Likely floods, forest fires, pests, and disease outbreaks are the important factors that can decrease forest productivity as a reciprocal relationship between forest disturbance and deforestation. The development of plantation forests and natural forest nurseries is one solution to maintain forest resources by reducing deforestation rates and conserving biodiversity. In this study, to conserve native trees of Kalimantan, we explored natural seedlings in their habitats as part of sustainable forest management. The study was conducted at IUPHHK-HTI PT Korintiga Hutani (PT KTH) from 2019 to date. Seedling explorations were carried out in Bukit Panjang and Sungai Inaf Besar. The collection method used wild seedlings (soil aggregate was still compacted in the roots). Furthermore, wild seedlings were grown in a polybag (23 x 15 cm) and stored in shading areas. Then, for acclimatization, it was transplanted to a natural forest nursery. These results suggest that the nursery has collected 9 families, 10 genus, 13 species, and 9791 individuals with 2680 individuals, represent the majority of dominance. As much of 600 seedlings of Dipterocarpaceae were planted at the river border in PT KTH.

1. Introduction
The issue of climate change is currently a major concern for the world community. This phenomenon directly impacts various sectors in society, especially the forestry sector [2]. Climate change affects the balance of forest ecosystems. Disturbance as a temporary and long-term change in forest environmental conditions causes significant fluctuations through altering the physical structure and biotic activities [20]. Such as floods, forest fires, pest and disease explosions are important factors that can reduce forest productivity as a reciprocal relationship between forest disturbances and deforestation. The demand for wood, both in Indonesia and the world, is still increasing but is not matched by the carrying capacity of adequate forest resources, which is one of the triggers for deforestation. The rate of deforestation in Indonesia (average deforestation 2013-2019) is 510 273,007 ha/year and the world (average deforestation for 2015-2020) is 10 Million Ha/year) [5]. In this case, the United Nations Framework Convention on Climate Change (UNFCCC) plays an important role in providing temporary wood by reducing pressure on natural forests, increasing carbon stocks, and reducing carbon emissions. Excessive logging in tropical forests will cause a long drought phenomenon to increase seedling mortality [15]. This phenomenon can threaten the diversity of native plants in a forest ecosystem. There is a need for conservation efforts against native forest plant species in Indonesia and the world. For example, actions
were taken by plant restoration to support increasing the diversity of threatened species such as developing nature reserves, establishing plots of target conservation species both in their natural distribution (in-situ) and outside their habitat (ex-situ), propagation techniques to expand the population of the target species, protection policies (regulations), and stakeholder networks [12]. The development of plantation forests and natural forest nurseries is one of the solutions to tackle the rate of deforestation and conserve native species of natural forests [10]. In 1988 the development of industrial plantation forests in Indonesia became the main approach in the Rehabilitation program [11]. In addition to establishing Eucalyptus and Acacia plantations, to protect native species in Kalimantan, Indonesia, we are exploring natural forest seedlings to be stored in nurseries and planted in critical zones (protected areas, river borders). One of the exploration goals is to obtain genetic material to build seed sources [14]. Transplanting individuals outside their natural range is called ex-situ conservation [19]. Ex-situ conservation is an alternative to vegetation restoration [6]. This is because it ensures plant survival, increases the number of ex-situ collections and provides material for future mass reintroduction [9]. This research aims to act on the conservation of native plants of Kalimantan to reach sustainable forest development in industrial forest plantations in Central Kalimantan, Indonesia.

2. Method

2.1 Study area
The research location is in the PT Korintiga Hutani Industrial Plantation Forest, Central Kalimantan, Indonesia. PT KTH is a company that provides the source of raw material for pulpwod through industrial planting management. PT KTH has 4 camp units consisting of Pellita Camp Unit, Indokayu Camp Unit, Talawe Camp Unit, and Tiger Camp Unit with 438 ha, 3,786 ha, 345 ha, and 23 ha, respectively. The forest is divided into 6 blocks with a total area of 94,384 ha.

The construction of a semi-permanent nursery specifically for native plants is carried out in PT Korintiga Hutani (S 02005'16.60'' E 111071'10.00'') with a size of 210 m² with an estimated capacity to accommodate approximately 3000 seedlings. However, currently, there is an expansion of the natural forest nursery area so that more plants are collected (Figure 1.)

![Figure 1. Map of research location](image)

2.2 Collection sample native seedlings
Natural forest seedlings were collected from two protected areas, namely Bukit Panjang and Sungai Inaf Besar in the PT Korintiga Hutani area. The seed collection method uses the natural sapling technique. The technique of taking natural saplings from their natural habitat without damaging the soil aggregates is to plunge a shovel into the soil (± 20 cm) forming a circle around the natural tillers to be taken. The soil outside the circle is loosened to make it easier to take rounds. The distance between the plant’s stem and the shovel is about 5 cm (forming a circle radius of ± 5 cm). The soil chosen is compact and dense because it will be easier to get a round of not crushed. This technique applies to plant heights of 2–29
cm and 30 cm [3]. The seedlings were put in polybags (23 x 15 cm) then collected and stored in a shading area. Finally, the transportation of natural saplings from the forest to the nursery for the acclimatization process uses a lid for 1 month (routine watering every morning and evening). Covering natural seedlings aims to reduce evaporation [17].

2.3 Data analysis

The data on the diversity of natural seedlings collected for each genus, family, and individual are shown in the Table 3.

3. Result and discussion

3.1 Description of the location for collecting natural seedlings

The conservation zone of Bukit Panjang and the Sungai Inaf Besar is a tropical rain forest ecosystem with rainfall data in 2020 of 4634 mm, with the lowest temperature (23.90ºC) occurring in January and the highest of 30.60ºC occurring in October with an average humidity of 67.30-77.85 % (Appendix 1, 2, and 3).

3.2 Identify the kind of seedlings collected

Identification of seedlings collected from conservation areas was carried out using the help of local people and an online guidebook on plant identity (http://www.theplantlist.org/). Seedlings are stored by-line for each type, relative, and family for easy documentation. Several kinds of wild seedlings that have been identified with local names and scientific names are presented in Table 1.

| No | Local Name | Family | Genus/Species | Reintroduction | Update Stock |
|----|------------|-------|---------------|----------------|--------------|
| 1  | Meranti A  | Dipterocarpaceae | Shorea sp1 | 25  | 40 |
| 2  | Meranti B  | Dipterocarpaceae | Shorea sp2 | 150 | 1150 |
| 3  | Meranti C  | Dipterocarpaceae | Shorea sp3 | 475 | 1400 |
| 4  | Pelanju    | Anacardiaceae    | Pentaclethron molleyi Hook.f. | 300 | 1150 |
| 5  | Idat       | Hypericaceae     | Cretonymum sp | 150 | 1151 |
| 6  | Jabon putih| Rubiaceae        | Neolamarckia cadamba ( Roxb.) Bosser | 470 | 2468 |
| 7  | Durian     | Malvaceae        | Durio sp | 200 | 905 |
| 8  | Gaharu     | Thymelaeaceae    | Aquilaria malaccensis Lam. | 45 | 182 |
| 9  | Rambutan   | Sapindaceae      | Nepheilium sp | 25 | 220 |
| 10 | Cempedak   | Moraceae         | Artocarpus sp | 35 | 89 |
| 11 | Balsa      | Malvaceae        | Ochroma sp | 20 | 218 |
| 12 | Sungkai    | Lamiaceae        | Peronema sp | 150 | 673 |
| 13 | Kuwesi     | Anacardiaceae    | Mangivera sp | 30 | 55 |

3.3 Maintenance of natural saplings in the nursery

3.3.1 Watering and weeding

Seedlings were transferred to acclimatization for one month. Furthermore, seedlings are monitored every morning and evening to maintain the moisture condition of the soil aggregate. Indicators of a successful acclimatization process were marked by the growth of new shoots and growing into young leaves. The success of the survival of natural seedlings is thought to be influenced by biotic factors such as minimizing root damage, soil compaction of each plant, and abiotic factors such as variability of environmental conditions. The survival and growth of forest plant seedlings are influenced by habitat heterogeneity, environmental variability, and species density [8]. In addition, the age of seedlings at transplanting has an important effect on good work in acclimatization [18]. Except in very rainy weather, seedlings watered in the morning and evening. The maintenance and management of the nursery are to produce sufficient quantities of high-quality seedlings to satisfy the needs of the user [4]. The results showed that natural seedlings from the conservation area to the post-acclimatization process were 88% successful (Table 2.)
Table 2. Condition and survival rate of natural forest seedlings after acclimatization in natural forest nursery PT KTH

| No | Genus/Species                  | Collection from Forest | Pasca Acclimatization | Survival rate (%) |
|----|--------------------------------|------------------------|-----------------------|-------------------|
| 1  | Shorea sp                      | 3500                   | 3330                  | 95                |
| 2  | Pentaspadon motleyi Hook.f.    | 1700                   | 1450                  | 85                |
| 3  | Cratoxylum sp                  | 1400                   | 1301                  | 93                |
| 4  | Neolamarckia cadamba (Roxb.) Bosser | 3250               | 2933                  | 90                |
| 5  | Durio sp                       | 1200                   | 1105                  | 92                |
| 6  | Aquilaria malaccensis Lam.     | 267                    | 227                   | 85                |
| 7  | Nephelium sp                   | 270                    | 245                   | 91                |
| 8  | Artocarpus sp                  | 135                    | 124                   | 92                |
| 9  | Ochroma sp                     | 267                    | 238                   | 89                |
| 10 | Peronema sp                    | 1100                   | 823                   | 75                |
| 11 | Mangivera sp                   | 102                    | 85                    | 83                |

Average 88

3.3.2 Plant health monitoring
This study reported that for monitoring seedlings as shown in Table 3. However, the majority of pests on seedlings are sap-sucking, Lepidoptera larvae, and grasshoppers

Table 3 Monitoring pests & diseases on natural forest seedlings in PT KTH

| No | Genus/Species                  | Describe Pest | Describe Disease |
|----|--------------------------------|---------------|------------------|
| 1  | Shorea sp                      | Larva lepidopt| Necrosis         |
| 2  | Pentaspadon motleyi Hook.f.    | Sap sucking   |                  |
| 3  | Cratoxylum sp                  |               |                  |
| 4  | Neolamarckia cadamba (Roxb.) Bosser | Larva lepidopt | Necrosis         |
| 5  | Durio sp                       |               |                  |
| 6  | Aquilaria malaccensis Lam.     |               |                  |
| 7  | Nephelium sp                   |               |                  |
| 8  | Artocarpus sp                  |               | dieback          |
| 9  | Ochroma sp                     |               |                  |
| 10 | Peronema sp                    |               |                  |
| 11 | Mangivera sp                   |               | Larva lepidopt   |

3.4 Reintroduction of natural seedlings in critical areas (river borders, other conservation areas).
In 2021, we have planted 2075 natural seedlings in river border locations and the PT Korintiga Hutani conservation area as many as 5 points consisting of Bukit Panjang, Kelalai River, Umpang River, Inap Besar River, and Sumber Jaya River. This is performed the distribution of natural forest seedlings is more representative. the factors, such as canopy density, species density, individual density, altitude, slope, soil organic matter, and total soil nitrogen have a significant impact on the regeneration of natural seedlings in the forest [7]. Reintroduction in the area that has low regenerative species is one of the best conservation efforts to prevent population decline and their rarity [13]. Although the current data is still scanty, at least we are committed to carrying out ex-situ conservation activities and replanting natural saplings to conservation areas and river borders.

3.5 Monitoring and survival percentage after reintroduction
Apart from reintroduction, monitoring is carried out to determine the success of the planting. Overall, the results of monitoring on replanting at critical points of the PT KTH reached 91% across the group.
This is caused by the performance of the seeds to be planted that were in the post-acclimatization stress minimization stage and the planting location tends to be in its natural habitat. This is by the selection of seeds in forest rehabilitation activities that must be adjusted to the objectives and suitability of the ecosystem [1]. In addition, planting threatened species to increase biodiversity is one of the references in the reforestation of damaged forest areas [16].

4. Conclusions
Ex-situ conservation of native Kalimantan species at PT Korintiga Hutani has been carried out by exploration and collection with natural seedlings in the conservation areas of the Inaf Besar River and Bukit Panjang. The results of the identification of documented collections in natural forest nurseries consist of 9 families, 10 genera, 13 species, and 9791 individuals with the dominant Dipterocarpaceae collection group (2680 individuals). Replanting efforts have been carried out in conservation areas and river borders as many as 2075 individuals at 5 points consisting of Bukit Panjang, Sungai Kelalai, Sungai Umpang, Sungai Inap Besar, and Sumber Jaya.

References
[1] Al-Ghamdi AA, Tadesse Y, Adgaba N 2020 Saudi Journal of Biological Science 27 pp 3385-3389
[2] Anggraini N and Trisaksi B 2011 Jurnal Penginderaan Jauh 8 pp 11-20
[3] Aprianti F 2013 Teknik Pemanfaatan Anakan Alam Puspa (Schima wallichii (DC) Korth) di Hutan Pendidikan Gunung Walat (HPGW), Sukabumi Skripsi Departemen Silvikultur IPB Bogor
[4] Briggs C, Breiner JM, Graham RC 2012 Soil Science 177 pp 263-268
[5] FAO and UNEP 2020 The States of World’s Forests: Biodiversity, and People Rome
[6] Hawkins B, Sharrock S, Havens K 2008 Plant and Climate Change: Which Future? Botanic Gardens Conservation International Richmond UK
[7] Liu H, Chen Q, Chen Y, Xu Z, Dai Y, Liu Y, Jiang Y, Peng X, Li H, Wang J, Liu H 2020 Global Ecology and Conservation 24 e01370
[8] Magee L, Wolf A, Howe R, Schubbe J, Hagenow K, Turner B 2021 Forest Ecology and Management 480 118722
[9] Mounce R, Smith P, Brockington S 2017 Nature Plants 3 pp 795-802
[10] Myint Y Y, Sasaki N, Datta A, Tsusaka T W 2021 Cleaner Environmental System 2 100029
[11] Nawir AA, Murniati, Rumboko L 2008 Rehabilitasi Hutan di Indonesia CIFOR Bogor
[12] Novriyanti E and Susilo A 2020 IOP Conf. Series: Earth and Environmental Science 533 012006
[13] Pamoengkas P, Rachmat HH, Nurkaeni W, Susilowati A 2021 IOP Conf. Series: Earth and Environmental Science 713 012032
[14] Prasetyawati CA 2015 Info Teknis Eboni 12 pp 39-49
[15] Qie L, Telford EM, Massam MR, Tangki H, Nilus R, Hector A, Ewers RM 2019 Environmental Research Letters 14 pp 045012
[16] Shaw T E 2019 Plant Diversity 41 84-93
[17] Suhartati and Alfaizin D 2020 IOP Conf. Series: Earth and Environmental Science 533 012036
[18] Susilowati A, Rachmat HH, Hidayat A, Elfati D, Yulita KS, Ginting IM 2021 IOP Conf. Series: Earth and Environmental Science 782 042028
[19] Wang S, Xiao Z, Yang T, Jiang M, Wei X 2021 Global Ecology and Conservation 26 e01490
[20] Wu SH, Chao CT, Huang BH, Luo MX, Duan XG, Liao PC 2020 Global Ecology and Conservation 24 e01311