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Exploration of Flora Diversity and Recommending Species for Reclamation of Coal Mining with Biodiversity Concept in Besiq Bermai Forest, East Borneo

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ABSTRACT

This research was conducted to gather basic information to support recovery coal mining area with study of flora biodiversity. Plants inventory were conducted explorative in Besiq Bermai forest. Some observations were conducted on plants as integral part of the documentation process. The result showed that there are 203 numbers of plant. They consist of 51 families of flora collection to be conserved in Purwodadi Botanic Garden. There are 53 species of orchid that collected from this forest, including of rare species and endemic orchid. There are 70 numbers of 1000 specimen floras to be collected in Nursery of coal mining to be used in reclamation program. There are 20 species of flora that be conserved because it is threatened species that based on IUCN. Ten species can be chosen to become pioneer species in reclamation of coal mining area. Biodiversity concept can be used in reclamation of post mining area. Prospective conservation area that called Arboretum is provided for *in-situ* conservation program. Some practical considerations are suggested for future reclamation projects.

Keywords: *Borneo, flora, coal mining, reclamation*

INTRODUCTION

One of biodiversity hotspot centers is Borneo Island. This island saves various species of endemic, rare, and potentially plant [1, 2]. Government protects several species, they are *Coelogyne pandurata* (black orchid) and *Borasiodendron bornense*. The Shorea is rare species, local people call several species as meranti. It is including in Dipterocarp families [3]. The patterns of tree species richness that proposed as proxy for overall biodiversity and endemism within the island are described and interpreted with special reference in Dipterocarpaceae. Borneo still holds many new species and rare species, so rescue and conservation of plant are needed to Borneo.

Human activities, global environmental change, habitat loss and species extension are cause biodiversity loss [4]. Conservation is important to the long-term of plant rescue program. The purpose of conservation is to rescue the plant either *in-situ* or *ex-situ*. Hot spot biodiversity in the Sundaland and Borneo Island store at least 15,000 specimens of endemic flora [2]. Disturbances from storms, fire, logging, or mining can disrupt or destroy established forests in the forested Appalachian region. Forest clearing must be balanced with the conservation activities, so they are expected to reduce the rate of lost the plant species in Borneo. These conservation activities carry out through the inventory and collecting specimens of flora in the forest area.

The purpose of this study is to record and collect the plant diversity of the forest area, especially Besiq Bermai forest in Borneo. Besiq Bermai is natural forest with high diversity of plant. Part of this area to be mining, so rescue of plants is needed to reduce biodiversity loss. Information of the study is expected to be a reference to reclamation program of coal mining in Kalimantan. Recovery post-mining area is expected to be done through the principle of conservation by using local plant species in the region.

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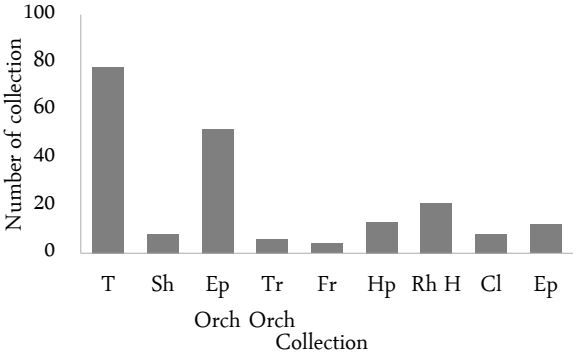

Figure 1. Comparisons species collection to *ex-situ* conservation (T: Tree, Sh: Shurb, Ep Orch: Ephipytic Orchid, Tr Orch: Terrestrial Orchid, F: Fern, HP: herba Perennial, RhH: Rhizome Herba, Cl: Climber, Ep: Ephipytic)

MATERIALS AND METHODS

The research was conducted in 2015, at Besiq Bermai forest, Kutai Barat, East Borneo. Ten plots with a size of 100 × 20 m^2 were made to the inventory of plants in the forest. All plants within a map location were field checked using inventory field check lists and more emphasis on observing actual plant material. Sample of plants available were recorded and documented. Plant inventoried including Angiosperms, Gymnosperms and Pteridophytes (Bryophytes, Lichens and Algae were excluded). Plant exploration was conducted using survey method to inventory and gather plant materials in forms of seedlings, seeds, cuttings, tubers, corms, etc. for ex-situ conservation purpose in Purwodadi Botanic Garden. In-situ conservation would be conducted in arboretum, beside that the plant specimen of forest was planted in PT. Bharintho Ekatama Nursery. Herbarium was made to identify of plants species. This herbarium was identified in Bogoriense Herbarium - Indonesian Institute of Sciences (LIPI). Diversity of plant based is classified by its plant habit and it refers to the overall shape of a plant. It includes genetic tendency of a plant to grow in a certain shape and to attain a certain mature height and spread. The list of rare species was matched in IUCN Red List Species (http://www.iucnredlist.org). The list species of selecting plant in reclamation of coal mining area were chose by biodiversity study in Besiq Bermai Forest, ethnobotany in locally people and literature survey.

RESULTS AND DISCUSSION

Ex-situ conservation by collected plant

There are 203 numbers, they consist of 51 families of flora collection to be conserved by *ex-situ* program in Purwodadi Botanic Garden including 57 species of orchid collection. Borneo has high diversity. The finding of plant growth habit diversity in forest is assumed that this forest has high flora diversity. Tree, shrub, climber, epiphytic, fern, herbs, perennial, rhizome herbs are collected from the forest. Tree is the most dominant collection in there. The comparisons of collecting plant growth habit are showed in Figure 1.

Tree is dominant collection. The present of tree has high humidity in the forest. Many epiphytic plants live in tree. East Borneo has many Dipeterocarpaceae that grow well such as *Hopea dyeri*, *Hopea pachycarpa*, *Dipterocarpus caudiferus*, *Shorea ovalis*, *Shorea agami*, and *Shorea peltata*. The Sapotaceae species is representated by *Palaquium gutta* and *Madhuca kingiana*. Anacardiaceae is representated by *Melanochyla caesia*, *Campnosperma auriculatum*, and *Buchanania arborescens*. Moraceae is representated by *Ficus crassiramea*, *Ficus deltoidea* (Figure 2e), and *Ficus callosa*. Myrtaceae is representated by *Syzygium cymosum* and *Syzygium castaneum*. Annonaceae is representated by *Polyalthia lateriflora*, *Fissistigma manubriatum*, and *Xylopia malayana*. Lauraceae is representated by *Cinnamomum javanicum*, *Cryptocarya pulchrinervia*, *Litsea firma*, *Beilschmedia rivularis*, and *Actinodaphne diversifolia*. Polygalaceae is representated by *Xanthophyllum flavescens* and *Xanthophyllum schizocarpium*. Clusiaceae is represented by *Garcinia graminea*, *Gordonia borneensis*, and *Calophyllum macrocarpum*. Other species are *Ixora caudata* (Figure 2a), *Nephellium* sp. (Figure 2b), *Triadica cochinchinensis*, *Gonystylus velutinus*, *Fordia splendidissima*, *Aglaia palembanica*, *Santiria tomentosa*, *Nephelium lappaceum*, *Eusideroxylon zwageri* (Figure 2c), *Eurycoma longifolia*, *Irvingia malayana*, *Antidesma bunius* (Figure 2d), *Canthium glabra* (Figure 2k) *Elatiospermum tapos*, (Figure 2l) and *Durio oxleanus*.

Epiphytic non-orchid plant is dominated by Apocynaceae like *Dischidia benghalensis*, *Dischidia sagittata*, *Dischidia latifolia*, and *Dischidia major*. The caracteristics of *Dischidia* are climbing, fleshy epiphytic herb like *Dischidia benghalensis* with 30 – 100 cm long, a smooth stem and pendulous roots emerging from nodes. Leaves have very short stalks, smooth and occur in widely spaced pairs. They are light green or yellowish-green and various shapes in the same plant, where it has been recorded in Myanmar, Cambodia, Thailand, Vietnam, Malaysia (Peninsular) and Indonesia (Sumatra, Java) [5]. *Aschynanthus parvifolius* is found with limitted distribution, it has beautiful flower like a lip. *Piper porphyrophyllum* and *Piper caninum* are found in many spots of the forest and grow well in tree host. Compounding

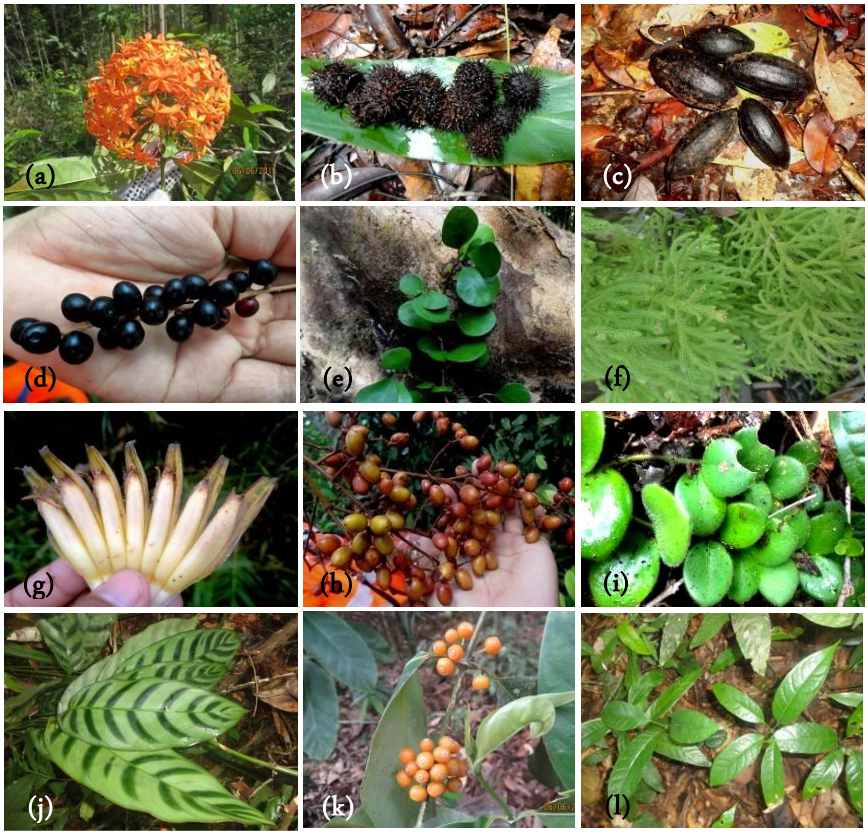

Figure 2. Flora diversity. *Ixora caudate* (a), *Nephellium* sp. (b), *Eusideroxylon zwageri* (c), *Antidesma bunius* fruit (d), *Ficus deltoidea* (e), *Selaginella plana* (f), *Musa borneensis* flower (g), *Eurycoma longifolia* fruit (h), *Aschynanthus parvifolius* (i), *Calathea zebrina* (j), *Canthium glabra* (k), and *Elatiospermum tapos* (l)

flavanoids with high content in *P. porphyrophyllum* can probably be used as a chemical marker for this *Piper* [6]. *Scindapsus pictus* species is potential of ornamental plant and require regular pruning to retain the commercially desirable leaf form of the juvenile. This habitat is drier to face per humid lowland shady peat forest, than in lowland mixed dipterocarp forest [7]. Fern is represented by *Blechnum orientale*, *Asplenium nidus*, *Diplazium cordifolium*, *Coniogramme intermedia*, and *Selaginella plana* (Figure 2f). They are dominated by fern in forest. We find *Platycerium coronarium* in Borneo forest in high population. *P. coronarium* is an epiphytic fern, bears a gigantic morphology and native in tropical areas of South America, Africa, Southeast Asia, Australia, and New Guinea. They are on the upper branches of the tallest trees in the forest. Due to having some uniquely-shaped fronds, they are famous for ornamental purposes.

Perennial herb is represented by *Phrynium pubinerve* and *Calathea zebrina* (Figure 2j). The distribution of *P. pubinerve* in India, Myanmar, Indo-China, Malaysia, Indonesia, Philippines, and Papua New Guinea [8]. *P. pubinerve* is found in Borneo forest with high population and fruits blooming. The other of finding herb species are *Mapania cuspidata*, *Freycinetia* sp., *Alocasia princeps*, and *Homalomena pendula*. Climber plant is represented by *Smilax leucophylla*, *Smilax gigantea*, *Smilax modesta*, and *Smilax zeylanica*. Distributions of *Smilax* are in Peninsular Malaysia, Sumatra, Java, Borneo and the Philippines till New Guinea and northern Australia. They have potential in traditional medicine, roots and leaves that used for treating cancer [9]. Smilax in East Borneo is found in many populations of forest. Rhizome herb is represented by Zingiberaceae family. *Alpinia pubiflora*, *Alpinia aquatica*, *Alpinia capitellata*, *Alpinia beamanii*, *Zingiber aromaticum*, *Zingiber zerumbet*, *Amomum blumeanum*, and *Plagiostachys bracteolata* are found in the forest and they grow well in lower land and wet soil. Zingiberaceae is called ginger and it is important natural resources that provide many useful products for food, spices, medicines, dyes, perfume and aesthetics [10]. Sixteen until twenty percent of Paninsular ginger are edible and can consumed fresh, cooked, picked, or boiled [11].

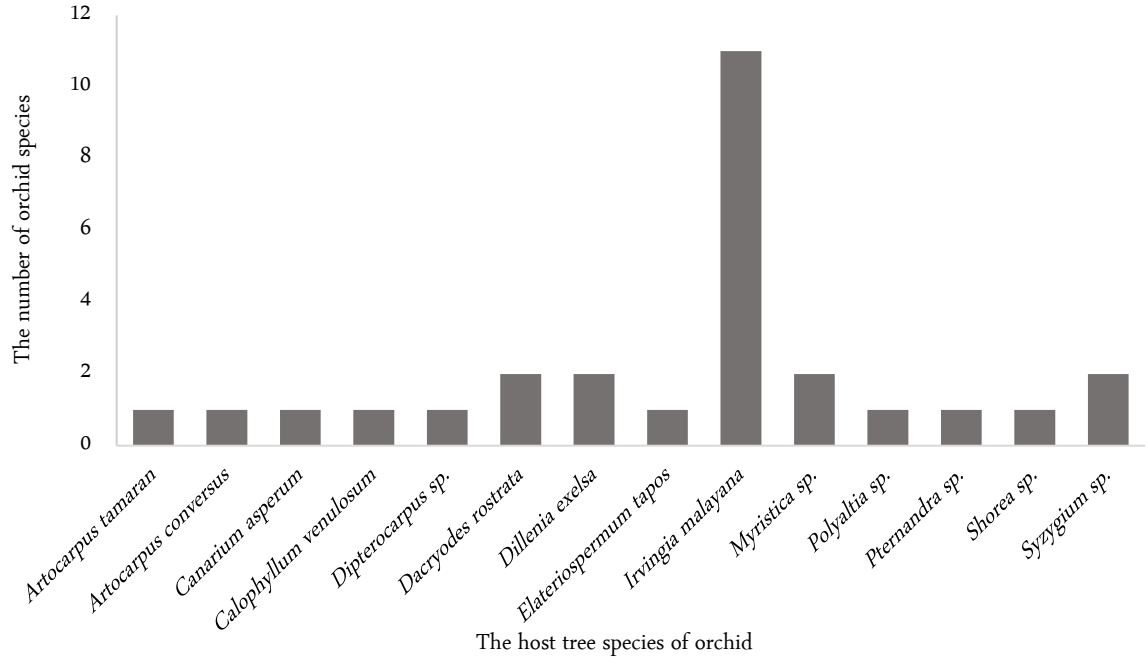

Figure 3. The host tree species of eyphytic orchid

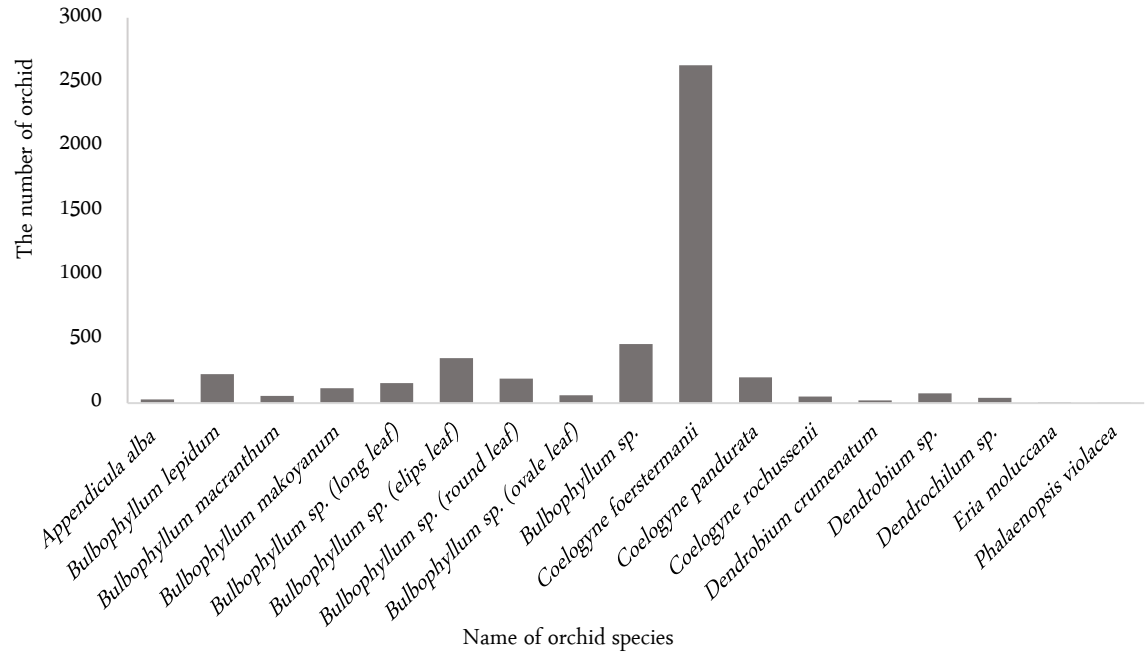

Figure 4. The number of population orchid species in forest

Orchid inventory

Borneo has many various indigenous orchid species. Inventory of Siregar has found 27 species terrestrial orchid and 169 species live as epiphytes in the forest at West Borneo [12]. In Besiq Bermai Forest East Borneo we can divide orchids into two types, they are terrestrial orchids and epiphytic orchid. Epiphytic orchid is more diverse than terrestrial orchid. Humidity average is high (more than 80%), it supports to epiphytic orchid growth. Orchid is important plant to be conserved because of the decreasing quantity species. The largest host tree of epiphytic orchid is *Irvingia malayana*, this species has bark that is suitable for epiphytic orchid. The other of host trees species of epiphytic orchid are *Artocarpus*

Table 1. Diversity of orchid species

No.	Species	Type	No.	Species	Type
1.	*Acriopsis indica*	Ep	28.	*Eria moluccana*	Ep
2.	*Appendicula alba*	Ep	29.	*Eria bicristata*	Ep
3.	*Appendicula* sp.	Ep	30.	*Grammatophyllum speciosum*	Ep
4.	*Bulbophyllum macranthum*	Ep	31.	*Grosourdya* sp.	Ep
5.	*Bulbophyllum lepidum*	Ep	32.	*Kingidium deliciosum*	Ep
6.	*Bulbophyllum beccarii*	Ep	33.	*Liparis condylobulbon*	Ep
7.	*Bulbophyllum absconditum*	Ep	34.	*Malleola insectifera*	Ep
8.	*Bulbophyllum ovalifolium*	Ep	35.	*Oberonia* sp.	Ep
9.	*Bulbophyllum makoyanum*	Ep	36.	*Pomatocalpa spicata*	Ep
10.	*Bulbophyllum* sp.	Ep	37.	*Phalaenopsis violacea*	Ep
11.	*Bulbophyllum* sp 1.	Ep	38.	*Pteroceras emarginata*	Ep
12.	*Bulbophyllum* sp 2.	Ep	39.	*Sarcanthus subulatus*	Ep
13.	*Bulbophyllum* sp 3.	Ep	40.	*Thecostele alata*	Ep
14.	*Coelogyne foerstermanii*	Ep	41.	*Trichoglottis* sp.	Ep
15.	*Coelogyne pandurata*	Ep	42.	*Thrixspermum* sp.	Ep
16.	*Coelogyne rochussenii*	Ep	43.	*Trichotosia velutina*	Ep
17.	*Cymbidium aloifolium*	Ep	44.	*Trichotosia ferox*	Ep
18.	*Cymbidium bicolor*	Ep	45.	*Abdominia* sp.	Tr
19.	*Cadetia* sp.	Ep	46.	*Apostasia* sp.	Tr
20.	*Dendrobium leonis*	Ep	47.	*Bromheadia finlaysoniana*,	Tr
21.	*Dendrobium crumenatum*	Ep	48.	*Dipodium paludosum*	Tr
22.	*Dendrobium* sp.	Ep	49.	*Dipodium* sp.	Tr
23.	*Dendrobium* sp 1.	Ep	50.	*Goodyera* sp.	Tr
24.	*Dendrobium* sp 2.	Ep	51.	*Malaxis blumei*	Tr
25.	*Dendrobium* sp 3.	Ep	52.	*Vanilla aphylla*	Tr
26.	*Dendrobium* sp 4.	Ep	53.	*Vanilla albida*	Tr
27.	*Dendrochilum* sp.	Ep			

Note: Ep: Ephipytic Orchid; Tr: Terrestrial Orchid

tamaran, *Dillenia excelsa*, *Calophyllum venulosum*, and *Dacryodes rostrata*. We safe 53 orchid collections from this forest (Figure 3 and Table 1).

Several orchids are found and collected in Borneo. They are rare species like *Coelogyne pandurata* that is endemic orchid, although they are found in Crocker Range National Park, Sabah Malaysia [13]. It is called black orchid. *C. pandurata* (Figure 5d) is exploited by people because it is potentially high economic value, it has often been excessively exploited but not widely cultivated. Illegal collection and forest fires are currently at risk of extensive black orchid loss. According to survey by Padmanaba in Malinau watershed, East Kalimantan, Indonesia, this orchid is risk to be loss in forest [14]. The other endemic species of orchid is *Bulbophyllum beccarii* (Figure 5a). This species includes in Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) checklist [15]. This orchid is only found in one location and more open forest. The two other orchid species of government protecting are *Phalaenopsis violaceae* and *Grammatophyllum speciosum* (Figure 5i). The other orchid species are found in abundance of forest, they are *Coelogyne rochussenii, Coelogyne forstermanii, Bulbophyllum lepidum*, and *Eria moluccana*. Several of collecting epiphytic orchids are *Pteroceras emarginatum*, *Apendicula alba* (Figure 5b), *Cymbidium bicolor*, *Dendrobium leonis* (Figure 5e), *Bulbophyllum macranthum* and *Bulbophylum medusae* (Figure 5g).

The largest population of orchid (Figure 4) are dom-

inated by *C. forstermanii* is very adaptable in the forest, even this orchid can live in fallen tree. Epiphytic orchid needs host tree of their life. The suitable tree of epiphytic orchid in forest is *Irvingia malayana*. There are 11 species of epiphytic orchid that live in *I. malayana*. This tree has suitable bark for root of epiphytic orchid, so many species can live there.

Terrestrial orchid is rarely found in forest. We only collect 9 species, they are *Vanilla aphylla* (Figure 5h), *Vanilla albida*, *Bromheadia finlaysoniana* (Figure 5c), *Goodyera* sp., *Malaxis blumei*, *Dipodium* sp. (Figure 5f) and *Abdominia* sp. The acidity of soil (pH) is 5 – 6. The most terrestrial orchids need mycorrhizas to grow [16], so it is difficult to conserve this with *ex-situ* conservation. To experience a greater extinction risk as a result of the multiplicity of threatening processes particularly under current climatic change, terrestrial orchids represent a lifeform class [17]. Land clearing for farming, plantations and mining have caused loss of plants biodiversity, both the species level and genetic level. In-situ conservation is more possible to conserve the terrestrial orchid.

The red-List species based on IUCN

Endangered species are the most important for the species to get conservation. Based on IUCN redlist species, there are 20 species that need attention in conservation programs (Table 1). *Shorea smithiana*, *Hopea pachycarpa*, and *Shorea lamellata* (*meranti putih*) are threatened by exploitation rates. It is the major source of light red *meranti* timber for north-east Borneo. This species is also native in Indonesia and Malaysia [18] *Shorea* spp. is threatened by species, because of illegal logging and an irregular flowering period. The dispersal of the mostly winged fruits of dipterocarps is generally considered to be poor. Seed dispersal of all Dipterocarpaceae species in Borneo is predominantly local, with 90% of seed dispersing 10 m, although maximum dispersal distances has varied widely among species [19]. By reducing the extent and intensity of interspecific mast fruiting, the selective logging of dipterocarps is also likely to decrease their reproductive success. It has been suggested to be a reproductive strategy that has evolved to satiate seed predators. Logging has led to recruitment failure of dipterocarps within a national park in Borneo, which is surrounded by logged forest now, and logging has also exacerbated local *El Nino* events [20].

The threatening species in Meliaceae family is least concerned such as *Aglaia forbesii*, *Aglaia crassinervia*, *Aglaia elliptica*, and *Aglaia palembanica*. The genus *Aglaia* (Meliaceae) comprises around 100 species that mainly distributed in the tropical rain forests of Southeast Asia. Sixty species can be found in Borneo, and 12 species are endemic [21]. *Aglaia* spp. should be conserved. Several native species in Southeast Asia are like *A. forbesii* and *A. crassinervia*. They are from Brunei Darussalam, India (Nicobar Island), Indonesia (Kalimantan, Sumatera), Malaysia (Peninsular Malaysia, Sabah, Sarawak), Myanmar, Philippines, and Thailand [22]. Aglaia is potential plant to medicine. Several researches show that flavaglines and triterpenoids produce from the leaves [23]. *Aglaia palembanica* is found in primary and secondary, moist, lowland forest as a tree. It is near threatened [24]. Burceraceae is also important family in Borneo forest, such as *Dacryodes rostrata, Santiria apiculata*, and *Santiria apiculata*. They are lower risk species. *Dacryodes rostrata* is top ten most abundant species in Borneo forest, but after it is burned, one of this species is not abundance [25]. This species is dificult to recovery in forest. The seeds of *D. rostrata* have nutritional and antioxidant properties of peels [26], so this species must be conserved to reveal the species potential. Myristicaceae known as good timber quality like *Knema conferta* and *Myristica maxima* has timber potential. *Nephelium lappaceum* is provide of food to wild animal. It has edible fruit, so it must be conserved.

Locally species collection from forest for nursery in coal mining area and in-situ conservation program

Plant conservation program of coal mining area also carry out in-situ. Seventy species with 1006 plant specimens are collected from forest. This plant will be maintained in the nursery of PT. Bharinto Ekatama Coal Mining Nursery (Figure 6). In their natural habitat, growing plants are enables plants to live and adapt well in the planting comparison of another location with different environmental factors. The plant will be introduced into the post-mining land so that the land reclamation plant species is more variable. This nursery has good program for reclamation post-mining, the concept is recommended by Purwodadi Botanic Garden researchers to use local tree as material for reclamation plant that can be implemented well. In nursery, plant collection can grow well. Several collection plants in supporting reclamation are *S. lamellata*, *Shorea parvistipulata*, *S. leavis*, *I. malayana*, *Alangium javanicum*, *N. lappaceum*, *Artocarpus sericicarpus*, Symplocos fasciculata, *G. velutinus*, *Syzygium hemsleyanum*, *Durio dulcis*, *Elateriospermum tapos*, *Sindora wallichii*, *Palaquium gutta*, *Dacryodes rostrata*, *Pometia pinnata*, *Phyllanthus*

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7.	*Bulbophyllum absconditum*	Ep	34.	*Malleola insectifera*	Ep
8.	*Bulbophyllum ovalifolium*	Ep	35.	*Oberonia* sp.	Ep
9.	*Bulbophyllum makoyanum*	Ep	36.	*Pomatocalpa spicata*	Ep
10.	*Bulbophyllum* sp.	Ep	37.	*Phalaenopsis violacea*	Ep
11.	*Bulbophyllum* sp 1.	Ep	38.	*Pteroceras emarginata*	Ep
12.	*Bulbophyllum* sp 2.	Ep	39.	*Sarcanthus subulatus*	Ep
13.	*Bulbophyllum* sp 3.	Ep	40.	*Thecostele alata*	Ep
14.	*Coelogyne foerstermanii*	Ep	41.	*Trichoglottis* sp.	Ep
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Note: Ep: Ephipytic Orchid; Tr: Terrestrial Orchid

emblica, *Dillenia excelsa*, and *Castanopsis motleyana*.

Bharinto Ekatama Nursery has biodiversity concept for reclamation program. Several choosing plants are *Shorea balangeran*, *Eusideroxylon zwageri*, *Anthcepahalus macrophyllus*, *S. lamellata*, and *Duabanga mollucana*. Orchids are also concerved in nursery, they are *C. forstermanii*, *C. rochussenii*, *C. pandurata*, and *G. speciosum*. The functions of forest would require uniformity of plant growth habit there. Not only trees can occur but also shrubs, herbs, epiphytes, climber, and ground cover plant in forest succession. Naturally, a relatively stable plant community has a dominant plant population which suite to the environment. Dominating tolerant species of the site and the climax species will reproduce successfully under their own shade. These species will maintain the community under the current climatic conditions. Intolerant trees cannot reproduce. Forbs, grasses, and shrubs dominate the site and seedlings can grow in initial, continued pioneer tree species (intolerant), seral tree species, and climax tree species (very tolerant) [27]

Species conservation in situ requires protected networks areas in selection of high conservation interest [28]. *In-situ* conservation program is provided by arboretum. Arboretum is the natural forests. It is released and used from mining as a conservation area. Arboretum is one of the solutions to reduce against loss biodiversity because in the arboretum, plant and animal can live in their habitat. Arboretum also provides seeds of growing plants naturally. Arboretum provides food and

Table 2. Redlist Species Based on IUCN

No.	*Species*	*Family*	*Red List Status*
1.	*Shorea smithiana* Symington	Dipterocarpaceae	Critically Endangered
2.	*Shorea lamellata* Foxw.	Dipterocarpaceae	Critically Endangered
3.	*Shorea peltata* Symington	Dipterocarpaceae	Critically Endangered
4.	*Shorea agami* P.S.Ashton	Dipterocarpaceae	Endangered
5.	*Hopea pachycarpa* (F.Heim) Symington	Dipterocarpaceae	Vulnerable
6.	*Aglaia crassinervia* Kurz ex Hiern	Meliaceae	Lower Risk/near threatened
7.	*Aglaia elliptica* (C.DC.) Blume	Meliaceae	Lower Risk/least concern
8.	*Aglaia forbesii* King	Meliaceae	Lower Risk/near threatened
9.	*Aglaia palembanica* Miq.	Meliaceae	Lower Risk/near threatened
10.	*Alangium javanicum* (Blume) Wangerin	Cornaceae	Lower Risk/least concern
11.	*Dacryodes costata* (A.W.Benn.) H.J.Lam	Burseraceae	Lower Risk/least concern
12.	*Knema conferta* (King) Warb	Myristicaceae	Lower Risk/least concern
13.	*Koompassia malaccensis* Benth	Leguminosae	Lower Risk/conservation dependent
14.	*Magnolia acuminata* (L.)L	Magnoliaceae	Least Concern
15.	*Myristica maxima* Warb	Myristicaceae	Lower Risk/least concern
16.	*Nephelium lappaceum* L	Sapindaceae	Lower Risk/least concern
17.	*Santiria tomentosa* Blume	Burseraceae	Lower Risk/least concern
18.	*Santiria apiculata* A.W.Benn	Burseraceae	Lower Risk/least concern
19.	*Shorea laevis* Ridl.	Dipterocarpaceae	Lower Risk/least concern
20.	*Vatica rassak* Blume	Dipterocarpaceae	Lower Risk/least concern

Table 3. Selected species in reclamation of coal mining area with biodiversity concept

No.	*Spesies/Family*	*Explanation*
1.	*Shorea balangeran* (Dipterocarpaceae)	Rare species: critically endangered, pioneer species, high quality timber, pioneer species, can grow on peatlands, endemic species, can propagated by vegetative
2.	*Duabanga moluccana* (Rubiaceae)	Fast growth, locally plant, adaptable to poor soils, can grow on peatlands, export quality timber, easily propagated by seeds
3.	*Ficus variegata* (Moraceae)	Adaptable to poor soils, adaptable to poor soils, Strong roots to soil ecological function, providing animal feed, believed to be related to the conservation of springs
4.	*Dillenia excelsa* (Dilleniaceae)	Locally plant, easily propagated by seeds, edible fruit, ecological functions for animals in the wild
5.	*Anthocepahalus macrophyllus* (Rubiaceae)	Fast growth in full light intensity, strong quality wood in class II or III, adaptable to poor soils
6.	*Eusideroxylon zwageri* (Simaroubaceae)	Rare species: vulnerable, commercial timber, endemic plant from Borneo
7.	*Cananga odorata* (Annonaceae)	Native plants Indonesia, easily propagated vegetative and generative, main source of the world's major essential oils.
8.	*Michelia champaca* (Annonaceae)	Locally plant, the root can improve soil fertility and increasespH, high quality timber, flower a source of essential oils.
9.	*Shorea lamellata* (Dipterocarpaceae)	Rare species: critically endangered, high quality timber, very adaptable in peatlands.
10.	*Syzygium* spp. *(Jambu-jambu)* (Myrtaceae)	Locally plant it is called *jambu-jambu*, adaptable in peatlands, ecological functions for animals in the wild

shelter for wild animals in the forest. Leaving the forest land in the middle of the mining is one of the efforts in forest conservation. The feasibility of an arboretum can be determined from a high diversity index, the availability of water in the region, availability of feed for animals, and free of activity and human disturbance. If an arboretum does not meet the eligibility for supporting ecological functions then sieving method by adding a local plant species. It will be applied.

The concept of reclamation on diversity is one way to reduce the loss of diversity. The using of local species for revegetation can maintain diversity at the genetic level. The selection of appropriate species for revegetation will support the process of forest succession. According to Hendrychova, he reclaimed that human intervention are often characterized by lower biodiversity and inhabited by alien or aggressive species, its different with spontaneous succession supports generally the rare dispersion and native species [29]. Pioneer species can be used by locally plant, so biodiversity study of locally plant in clearing land of coal mining is important. The selection of tree in revegetation should be considered. Presence of indigenous species, endurance of natural disturbances and self-sustainability are several indicators to measure the success of restoration (The Society for Ecological Restoration International).

Macaranga gigantea is dominant plant in post mining land in Borneo, especially in Bharinto Ekatama Besiq forest. *M. gigantea* species is pioneer tree species [30]. Ten species of tree are recommended in revegetation program (Table 3). These species represent a combination of various functions in the forest ecology. One of the conditions of succession on reclaiming mine sites is two types plants of trees early successional species for wildlife and soil stability, and commercially valuable crop trees [31] *S. balangeran*, *Eusyderoxylon zwageri*, and *S. lamellata* are rare species based on IUCN Redlist, so these species must be concereved. *E. zwageri* is locally plant with high quality timber. This species has potential to develop a drill-borer [32]. In the observation of flowering dipterocarps, this species has irregular flowering like *S. balangeran*. Seed dispersal of *Shorea* spp. can be aided by natural predators [33] but in Besiq, there is little predators so this species must be conserved.

Anthocepahalus macrophyllus and *D. mollucana* are pioneer species and lightweight hardwood. These species are also expected to become more important for woods industries and supplies for plywood [34, 35]. These plants species have a fast growth. *Ficus variegata* can be considered as a plant that related to the springs conservation. This species is also found in lowland and around spring like Moyo and Bawean Island [36]. This species also provide food for wild animal. *F. variegata* is adaptable to poor soils, even they are growing on the stones. *D. excelsa* and *Syzygium* spp. are easy to be propagated. This species is also locally plant in forest. *D. excelsa* is edible fruit. This species has medical purposes and pharmacological properties [37]. *Syzygium* spp. is also edible fruit and this provide food to wild animal. *Syzygium polyanthum* and *Syzygium lineatum* species have been tested well as a pioneer plant in post-mining land in East Borneo [38].

Michelia champaca and *Cananga odorata* are locally plants in Indonesia. These spesies have economic value. *M. champaca* has high quality timber. This species can absorb air pollutants highly. Flower *C. odorata* has a high selling price. *C. odorata* has essential oil and antioxidant activity [39]. There still need to be conserved for many species, so that the returning species of the forest needs to be done to conserve plant. Types of shrubs, epiphytes, herbaceous, ground cover, climbers, and woody climber need to be reintroduced in the forest.

CONCLUSION

Concervation of plant diversity was done with ex-situ in Purwodadi Botanic Garden and in-situ in nursery of Bharionto Ekatama. There are 203 numbers, they consist of 51 families of flora collection to Purwodadi Botanic Garden, and 70 numbers of 1000 specimen floras are collected in nursery of coal mining. The planning of *in-situ* conservation was done by arboretum. Twenty species of floras are conserved because this is rare species based on IUCN Redlist species and 10 species can be chose to pioneer species in reclamation of coal mining area. Biodiversity concept and used locally plant is used to reclamation concept.

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