

PAPER • OPEN ACCESS

EBONY (*Diospyros celebica* Bakh) CONSERVATION

To cite this article: Merryana Kiding Allo 2020 *IOP Conf. Ser.: Earth Environ. Sci.* **522** 012018

View the [article online](#) for updates and enhancements.

You may also like

- [Ebony \(*Diospyros celebica* Bakh.\) cultivation: A short review](#)
Suhartati and D Alfaizin
- [Ex situ Conservation of *Diospyros* spp. \(Ebenaceae\) in the Bogor Botanic Gardens, Indonesia](#)
I F Wanda, peniwiidyanti and A A Oksari
- [Fungal diversity inhabiting tissues of ebony \(*Diospyros celebica* Bakh.\) in urban forest](#)
Mukrimin Mukrimin, Nurul Musdalifah, Siti Halimah Larekeng et al.

ECS
The
Electrochemical
Society
Advancing solid state &
electrochemical science & technology

DISCOVER
how sustainability
intersects with
electrochemistry & solid
state science research

EBONY (*Diospyros celebica* Bakh) CONSERVATION

Merryana Kiding Allo

Institute of Research and Development of Environment and Forestry Makassar

E-mail: merrymsr@yahoo.co.id

Abstract. *Eboni (Diospyroscelebica Bakh.) is a species of Diospyros. It is one of the endemic species that distributes only in Wallacea geographical region. Ebony is lowland tree species found in both rain forest and monsoon forest in Sulawesi with various soils types including in Alluvial, Latosols, Mediterranean, and Litosols. In its natural habitat this species associates with areng (Arengapinnata), rattan and other palm trees. Ebony is well known as an outstanding tree species that produces durable, fancy wood with colorful mixed red and brownish yellow. Because of its superior quality and luxury, ebony has been utilized for high class furniture and house interior. Before trade banning ebony was an important species exported mainly to Japan. High demand in both domestic and foreign markets has led the overcutting of the ebony and put the extinction of this species. To date, only few ebony trees remaining in Sulawesi natural forest. This species is having struggle of natural regeneration. The data showed that the potential ebony trees in term of IVI decreased dramatically from 92% to 23% during 1970 to 1990. At this moment, it is hard to find the ebony trees in the conservation areas, only a few ebony at poles levels can be found in those areas. Therefore, it is important to conserve the ebony through in situ replanting programs. Before Forest Concession was handed over to private parties in the 70s, the potential of value approached 92% and after management until the 90s, IVI dropped to less than 23%. At present the existence of ebony trees in some ex-processing is only in the pillars form and in the conservation area they can still be found at poles with small diameter. In the future, ebony conservation could be implemented through.*

Introduction

The Wallacea region has a high level of biodiversity and high endemic properties. Endemic flora and fauna in the Wallacea region are different from other species in another place, caused by the formation process and geological history that are not the same as other regions in the world. The presence of these endemic species is a feature of the transition region or meeting between the types of flora and fauna from the continents of Asia and Australia, causing this region have a special attraction for the world of conservation of flora and fauna.



Tropical forests are biologically the richest ecosystem on the Earth. It is a vital role in regional hydrology, carbon storage, and global climate [1,2]. Around 13 million hectares of forest are cleared for various interests every year [3]. Deforestation and shifted from subsistence from 1960's to 1980's have an impact on changes in natural ecosystems that have been formed, affecting the level of biodiversity, especially for endemic species.

Ebony (*Diospyros celebica* Bakh.) is one of the 300 species of *Diospyros* in the world, merely found live and develop in the forest habitat in Sulawesi. Based on [4], 31 species of *Diospyros* were found growing on Sulawesi and Maluku islands and 5 species of which were endemic, i.e. *Diospyros celebica* Bakh, *Diospyros eburnea* Bakh, *Diospyros greshoffiana* Kds ex Bakh, *Diospyros polita* Bakh, and *Diospyros venenosa* Bakh. Cox (1939); Burkill (1935) and Schneider (1916) in [4], mentioned that other places of growth for *Diospyros* were in West Africa, America and Asian. Not all types of *Diospyros* can produce black heart wood. Ebony wood since the colonial era was known as Makassar ebony, striped pattern ebony and coromandel are traded to European and Asian countries. The decorative value of ebony is very high, the wood character is heavy, strong and durable so it is classified as "fancy wood" utilized for furniture, sculpture, carving, fan, decorative veneer, musical instruments, and souvenirs. In Japan ebony is used in altars and places of worship and has been the raw material for storage cabinets and chests of Japanese ancestors, known as *butsudan*.



Figure 1. (A) The morphology of ebony tree in Gowa (B) fruit is located in the armpit of the leaf (C) Fruit form of ebony (D) Stem of ebony with 110 cm diameter

According to [5], ebony wood has been traded since 1969/1970 in the form of 2,439.431 tons of logs and the highest peak production for export in 1986/87 was 22,363.44 tons (including old stocks except the left cut down). Along with the increasing price and to meet market demand, the price of ebony in 2011 reached Rp. 37 million per cubic meter (Jacki, personal comm. 2011). [6] mentioned that in Palu, ebony prices ranged from Rp. 7 million to Rp. 10 million/m³, while in Malaysia from Rp. 20 million to 25 million/m³. In rupiahs, the value is very tempting, causing the ebony trees to be exploited both legally and illegally. The pressure to ebony population in nature population still continues, causing this species vulnerability. The problem at this time is that trade was still permitted with the pretext to increase the country's foreign exchange through non-oil and gas exports with the ebony traded is from ex old logging. Many rules were made to limit logging of ebony trees, among others is SK Menteri Kehutanan Nu.950/IV-TPHH/90 which states that if logging continues, it is possible that the ebony tree will be extinct considering the harvest cycle reaches hundreds of years.

[7] reported the detection results of satellite image analysis of ebony stand potential in Central Sulawesi in the coverage area of 4,920,541 ha consisted of 2,546,550 ha of land containing ebony trees which spread over a land area of 336,883 ha (8.5%). In detail 177,000 ha are found in a natural forest with the composition of the presence of ebony trees around 10-20%, 143,038 hectares are found in a rare forest with a composition of 20-30% ebony trees and 16,845 ha in the yard/moorings with a composition of <10% ebony. The high level of exploitation and the low growth rate have caused ebony to become one of the rare trees planned to be included in CITES Appendix III and the base of ebony conservation [8]. Species *D. celebica* (ebony) is included in Vulnerable category (VU A1 cd), which means at a high risk for extinction (vulnerable to exploitation).

Conservation efforts

1. Regulations

Several regulations at the level of the Ministry have been issued since ebony management was expanded, as illustrated in Table 1.

Table 1. Regulation made by the government to limit ebony exploitation

Regulation	Issues
Government Regulation No. 21 in 1970	granting of forest concession rights and forest harvesting right
Agricultural Ministry Degree Nu.54/Kpts/Um-2/1972	felling ebony trees above 60 centimeters
Forestry Ministry Decree Nu.31/KPTS-IV/86	concerning the control of ebony (including the prohibition of the new logging)
Ministerial decree Nu.261/Kpts-IV/1990	protected tree species
Instruction of the Minister of Forestry Nu.239/Menhut-II/1996	Collection, Decrease and Sale of ex-HPH ebony and former community logging in Central Sulawesi, that PT. INHUTANI II as executor and export ban on ebony wood inter-insular in logs [9].
S.K. Gub. Sulawesi Tengah Nu. 188.44/3932/Dinhut/1989	Designation of Pangi Binangganature reserve in Sulawesi Tengah province as a protected area for ebony

The potential of ebony stands in Pangi Binanggan quite high, reaching 1.5 trees/ha with an estimated volume of ± 2.35 m³ per ha. As for the types of plants that live in association with ebony in the area, they include kayu malam (*D. macrophylla*), kenari (*Canarium odoratum*), binuang (*Octomeles sumatrana*), angga (*Gluta elegans*), medang (*Dehaasia paniciflora*), Andolia doromoga (*Cananga odorata*), Aga (*Ficus variegata*) dan Siuri (*Koordeosiodendron pinnatum*).

As an illustration, the following Tables shows ebony wood trade (in volume) associated with several policy products through exports and inter-insular in 1969/70 to 1981/82 and 1985 to 1999. The trade of ebony wood in inter-insular during Pelita I-Pelita III is described at Table 2. There has been a decline in the trade figures from Pelita I to Pelita II, then trade has increased in Pelita III.

Table 2. Inter-insular trade in ebony logs from Sulawesi Tengah from Pelita I, Pelita II and Pelita III

Pelita	Years	Trading volume	
		Ton	Equality in m ³ in logs*)
I	1969/1970	3.171,260	2.439,431
	1970/1971	3.146,272	2.420,209
	1971/1972	8.012,545	6.136,496
	1972/1973	12.626,181	9.712,447
	1973/1974	18.926,606	14.558,928
	Total	45.882,864	35.291,511
II	1974/1975	3.959,382	3.045,678
	1975/1976	7.439,626	5.722,789
	1976/1977	3.456,356	2.658,735
	1977/1978	3.455,546	2.658,112
	1978/1979	3.051,386	2.347,221
	Total	21.362,296	16.432,535
III	1979/1980	3.629,116	2.791,628
	1980/1981	2.452,606	1.886,620
	1981/1982	1.373,487	1.056,528
	1982/1983	22.529,750	17.330,577
	1983/1984	4.743,776	3.649,058
	Total	34.728,735	26.714,411
Total		101.973,895	78.441,457

Sources : [10]

Remarks : *) Data compiled from tons of logs m³ to logs, every round m³ ebony is equivalent to 1.3 tons, assuming the moisture content 20% and ebony type 1.1.

In Pelita I the ebony wood logging decreased as stipulated by Government Regulation and in Pelita II, ebony trade has further decreased but then increased in Pelita III. [5] explained that early harvesting rights were conducted in 1970 by government regulation. Some assumed that the decline in the volume of ebony trade during Pelita II was likely due to management restrictions on tree harvesting, where harvesting could only be done for the trees with <60 cm in diameter. The increase in the total volume of trade happened in Pelita III, because there were no regulations and the range of management areas has certainly increased. The volume of trade declined in Pelita III during 1981 and 1982 and again increased in 1983 with the volume of 22,529.750 tons, in line with the high market demand. There is a possibility that increasing trade volume is due to the issuance of a regulation concerning the collection process of harvesting from old logging, without checking whether the rules were actually implemented or not, as there was no follow up (See Figure 2).

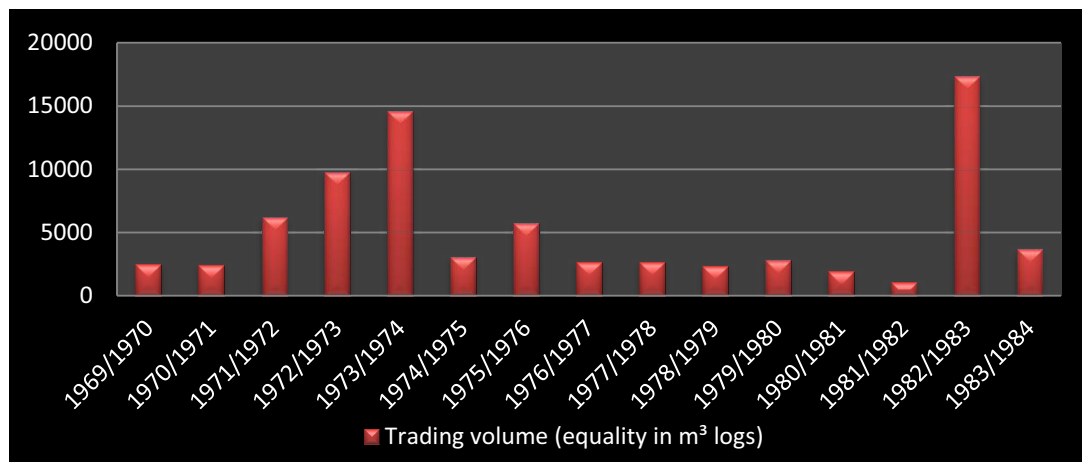


Figure 2. Inter-insular trading of ebony wood (in volume) for 14 years (1970-1984)

Similar case is seen in Table 3, where the regulation appeared in 1986 regarding the collection of old logging, without sufficient data of the total old felling stock will be traded. As a consequence, the regulation was alleged as one of the causes why the volume of ebony trade in 1987 increased to around 400% from the previous year.

Table 3. Trading of ebony in period 1985 until 1999

Years	Trading Volume		
	Sawn timber (m³)	Equality in m³ in logs*)	Equality in ton of logs*)
1985	1.916,48	4.791,20	6.228,56
1986	1.623,83	4.059,57	5.227,45
1987	6.881,06	17.202,65	22.363,44
1988	2.351,68	5.879,20	7.642,96
1989	1.035,26	2.588,15	3.364,59
1990	549,18	1.372,95	1.784,84
1991	477,97	1.194,93	1.553,40
1992	373,48	933,70	1.213,81
1993	266,58	666,45	866,38
1994	253,52	883,83	1.148,97
1995	513,57	1.283,93	1.669,10
1996	677,08	1.692,70	2.200,51
1997	960,42	2.401,05	3.121,37
1998	909,90	2.274,75	2.957,18
1999	874,17	2.185,43	2.841,05
Total	19.767,19	49.417,98	64.243,37

Remarks: *) Data compiled from m³ sawn timber to m³ of logs and ton of logs every m³ ebony round is equivalent to 1.3 tons, assuming the moisture content 20%

2. Genetic Conservation Gardens

Conservation efforts as genetic sources in the form of in-situ and ex-situ developments on several distributions areas of ebony have been carried out. As stated in [11], genetic variation of one plant species is needed so the plant would be able to adapt to changing environmental conditions to maintain its existence. Some efforts to conserve with the appointment and construction of conservation gardens were illustrated in Table 4.

Table 4. Several locations for protection and conservation of ebony in Sulawesi and their condition

Type of garden	Location	Description
Seeds stand	Maleali Central Sulawesi	Ebony trees that live in the area are estimated no more than 50, with estimation of seedling production of 500,000. The current condition is damaged, some parts have been planted with cocoa trees
Seeds stand	Sausu	Ebony conservation area is approximately 57 ha. Some parts have been planted with cocoa trees
The genetic conservation garden	Pangi Binangga Nature Reserve	The potential of ebony stands is quite high, reaching 1.5 trees/ha with an estimated volume of $\pm 2.35 \text{ m}^3$ per ha.
The genetic conservation garden	Bantimurung Bulusaraung National Park	Ebony planting was carried out in 2011 on an area of 5 ha originating from 6 provenances. The 2011 activity was a collaboration between the Forestry Research and Development Agency and ITTO

3. The Condition of natural regeneration of ebony

Ebony trees in natural forests grow in groups, forming dense stands with thick canopy, inhibiting the growth of other vegetation beneath it. Ebony grows well in the range of the A–C climate types. Height of tree from 20 to 42 m (in Tasiu, Sulawesi Barat province), tree diameter reached 80–170 cm. Flowering season of this species occurs in March, bear fruit in July and reached fruit maturity from November to March the following year with the diameter of fruits 4–6 cm. Flowering generally takes place in the top of canopy with canopy diameter of old trees generally reaches 15–22 m. Ebony has fleshy, thick-skinned, and heavy fruit, therefore fruits always fall down under the tree. Since they are fleshy fruits, several animals such as rangkong birds, monkeys, and weasels will consume those fruits leading to the rare existence of natural seedlings in the forest.

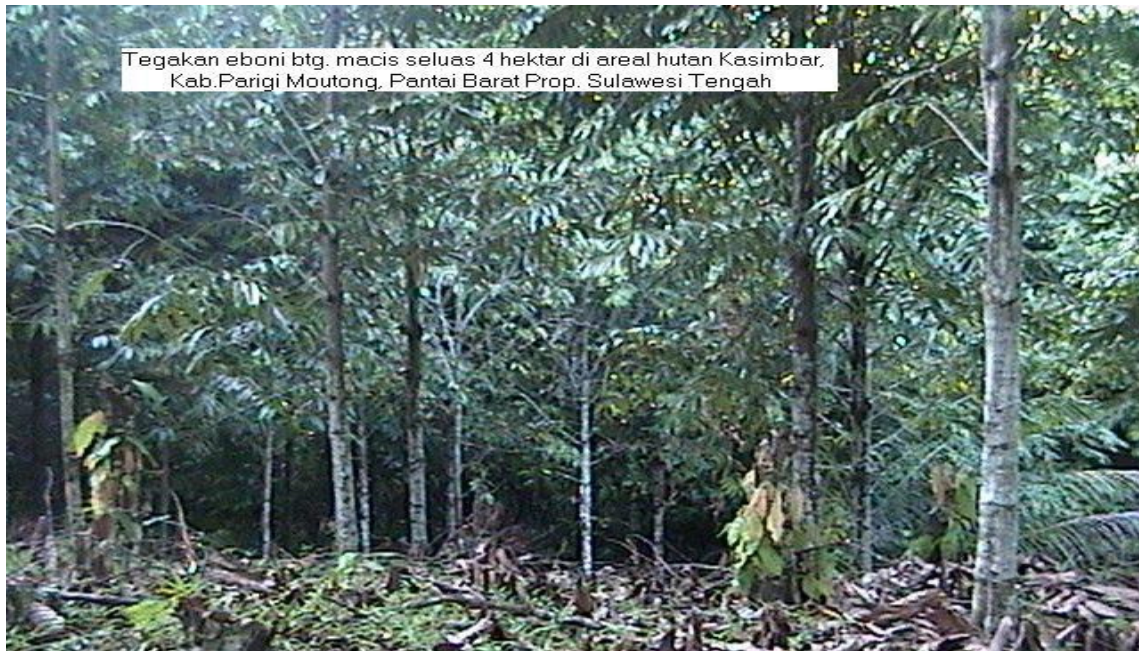


Figure3. Ebony stand of wood pattern like a matchstick in Kasimbar forest area, West coast in Sulawesi Tengah Province.

Santoso and Retno (2003) in [11] mentioned that ebony trees in their habitat start producing fruit at the age of 5 years, but high-quality seeds should come from trees age of 20 years old. Only around 80% of trees flowering if ebony in the second canopy; bearing flower 6 pieces per branch with approximately fruit production per tree is 204 fruits. One fruit generally contains 4-6 seeds, roughly in a flowering time, 1.200 seeds per tree can be obtained.

[12] reported that the number of natural ebony seedlings during the peak season of ripe fruit is very abundant, but these numbers decrease up to 80-90% due to the competition with others in terms of growing space, nutrient and light. In Maleali seed garden during fruiting times, the seedlings are very abundant and reached 4000 individuals at a radius of 5m x 5m (25m²) from the parent tree. However, the seeds that have germinated will die soon if they are not immediately removed to nursery.

The potential of ebony stands is quite high, reaching up to 1.5 trees/ha with a volume of ± 2.35 m³ per ha in Central Sulawesi Pangi Binangga nature preserve. Several species found grows in association with ebony include kayu malam (*D. macrophylla*), kenari (*Canarium odoratum*), binuang (*Octomeles sumatrana*), angga (*Gluta elegans*), medang (*Dehaasia paniciflora*), Andolia doromoga (*Cananga odorata*), Aga (*Ficus variegata*) dan Siuri (*Koordeosiodendron pinnatum*). In the Bendungan forest area, Tinombo district, with the severe exploitation during the past years, ebony stand is an uneconomical stand with a small diameter and rotten core (difficult in progress).

In the Uekuli forest, Poso district in Sulawesi Tengah there are 13 types of plants that live in association with ebony groups. As a general illustration, in the field the presence of ebony at the seedling level is dominant among existing species (IVI reaches 92.18%). Regeneration at sapling

level regeneration began to decrease by 175 trees/ha and then at the pole level it became less than 58 trees/ha, while trees with amount of 39 were leftover trees from the logging of HPH in the past. Ebony has been traded since 1969/1970 in the form of logs of 2,439.431 tons and the peak ebony timber production for export occurred in the year 1986/1987 with 22,363.44 tons (including stock felling of the old logging) along with the increasing selling prices and to meet the demands of foreign markets. It is assumed that when the peak of the ebony trade was reached in 1986/1987, an estimated 779 trees with more than 60 cm diameter were cut down. But the mistakes of the past should certainly not be repeated. This is because based on the potential natural regeneration of ebony, number of trees in seed stands can be the basis to stimulate enthusiasm to preserve ebony in the future, considering that seeds stand can produce thousands of seeds per year (Table 5) and can spread the natural growing locations for ebony (Figure 5). Natural ebony growing in Sulawesi is quite potential to produce seeds when protected by strict regulations.

Table 5. Composition of natural regeneration of seedlings, saplings, poles, and trees under ebony trees in the fruiting season at several locations (on September 2004)

Nu.Plot	Location	Thepotency of sapling, pole, and tree in(20x20)m ²			Thepotency of seedlings in (2x2)m ²			Estimateseedlingsnumber
I.1	MaliliKab. LuwuTimur	4	4	6	15	55	15	85
I.2		4	2	3	15	43	15	73
I.3		4	4	6	11	23	11	45
II.1	Pituriawa, Kab.Sidrap	4	4	6	201	80	40	321
II.2		3	3	5	121	65	21	206
II.3		6	3	6	120	75	38	233
III.1	Palado, Kab. Mamuju	7	3	-	35	19	5	59
III.2		5	-	-	212	13	17	242
III.3		3	6	-	25	3	9	37
IV.1	C A Karaenta, Kab.Maros	2	3	3	38	29	15	82
IV.2		3	1	2	82	43	8	133
IV.3		2	-	2	90	9	2	101

Sources:[13]

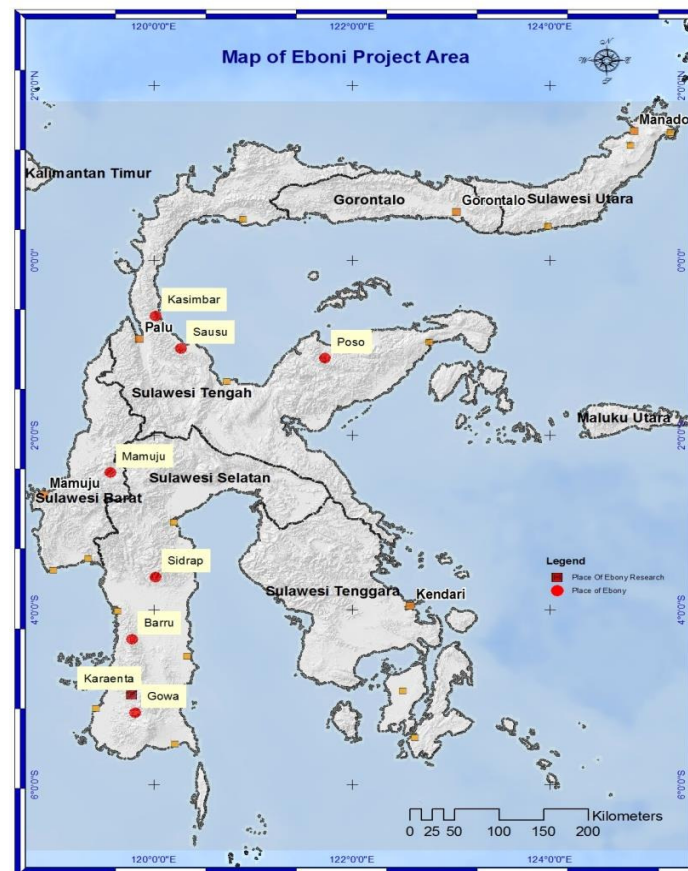


Figure 4. Map of habitat spread of ebony in Sulawesi

What is the actual number of ebony populations in nature today? There are no definite data yet, but the association with other vegetation types in Central Sulawesi region has 17 species which are dominated by species of Keli and ebony in each 1ha plot. [15] described that ebony seedlings in the nature preserve of Kalaena had a sacrifice index of around 0.0073, with associated vegetation of *Vitex quinata* and *Colona secabra* in the area. The natural regeneration conditions of ebony in the natural reserve of Kalaena shows IVI at the tree, pole, sapling and seedling levels were 23.01%, 1.97%, the 12.90%, and 66.57%, respectively. Based on IVI of seedling, it can be assumed that natural regeneration of ebony is still dominant among the associated species in nature reserves. Ebony regeneration in nature is still quite promising with the help of human intervention considering the dormancy period of ebony seedlings is very short, i.e. around 2 weeks.

Outlook

Efforts to conserve genetic resources in form of in-situ and ex-situ development have been carried out in Sulawesi. However, no further efforts are conducted in handling ebony and its habitat. The attention of policymakers is urgently needed to optimize conditions for the development and cultivation of ebony plants before it is too late to take appropriate actions. Ebony cultivation and

potential development can be implemented based on sufficient, complete, and up to date data on remaining natural ebony forest distributions including their stand characteristics and natural regeneration potential in various geographical areas in Sulawesi. The potential of seed stands should be identified and preserved as a source of seeds for plantation programs. For this reason, central and local government attention is needed by issuing strict regulations in protecting ebony areas in nature from the encroachment. It is hoped that full government support, research and development results could be implemented on a large scale to save ebony existence as priceless species in Sulawesi.

Acknowledgments

The author is grateful to those who have contributed data and information during this ebony researches and field works in Provinces of South Sulawesi, Central Sulawesi, and West Sulawesi.

REFERENCES

- [1] Laurance, W.F. (1999) Reflections on the tropical deforestation crisis. *Biol. Conserv.* 91, 109–117
- [2] Fearnside, P.M. (1997) Environmental services as a strategy for sustainable development in rural Amazonia. *Ecol. Econ.* 20, 53–70
- [3] FAO (2005) Global Forest Resources Assessment. UN Food and Agriculture Organisation
- [4] Sunaryo. 2002. Morfologi Sel-Sel Serat pada Kayu Eboni (*Diospyros celebica* Bakh.). *Berita Biologi* Vol. 6 No.2. Pusat Penelitian Biologi-LIPI. Bogor. Indonesia (p 255-258)
- [5] Sanusi, D. 2002. Kajian Produksi, Perdagangan, Industri dan teknologi Eboni. Manajemen Eboni (*Diospyros celebica* Bakh.) dalam Mendukung Keunggulan Industri Menuju Otonomisasi dan Era Pasar Bebas. *Berita Biologi* Vol.6 no.2 (*Edisi Khusus*) Pusat Penelitian Biologi-LIPI Bogor, Indonesia. (p191-206).
- [6] Sunarno. 1996. Degradasi potensi kayu eboni (*Diospyros celebica* Bakh.) di Sulawesi tengah dan faktor-faktor yang mempengaruhinya. Info teknis ‘Eboni’ Balai Penelitian Kehutanan Ujung Pandang.
- [7] Allo, M.K. 2002. Eboni dan Habitatnya. *Berita Biologi* Vol. 6. No.2 (*Edisi Khusus*) (p259-265) Pusat penelitian Biologi –LIPI, Bogor Indonesia
- [8] IUCN. 2011. IUCN red list of threatened species. Version 2011.2. <www.iucnredlist.org>. Diakses tgl.25 Pebruari 2012.
- [9] Samedi dan I. Kurniawati. 2002. Kajian Konservasi Eboni (*Diospyros celebica* Bakh.) *Berita Biologi* Vol. 6. No.2 (*Edisi Khusus*) (p231-237). Pusat penelitian Biologi –LIPI, Bogor Indonesia
- [10] PERSAKI. 1985. Eboni dan Prospek Pengusahaannya. Persaki Sulawesi Tengah.
- [11] Wydiatmoko, AYPBC dan Prastyono. 2018. Konservasi Sumber Daya Genetik Eboni. In: Nurkin, B.; M. K. Allo; and A.N. Gintings (Eds). *Eboni Sulawesi* (p75-113). Unhas Press, Makassar. ISBN 978-797-530-182-0
- [12] Suhartati and Paembonan, S.A. 2018. Budidaya untuk Pengembangan Hutan Tanaman Eboni. *Buku Eboni Sulawesi*. (p 51-71) Unhas Press, Makassar.
- [13] Allo M. K. 2011. The Establishment of Plant Genetic Conservation Gardens of *Diospyros celebica* Bakh. and Local Stakeholders Capacity Building Through Awareness Raising and Technical Workshop. ITTO Project PD 539/09 REV.1(F). Promoting Conservation of Selected Tree Species Currently Threatened by Habitat Disturbance and Population Depletion. In Corporation with Center for Conservation and Rehabilitation Research and Development Forestry Research and Development Agency. Ministry of Forestry, Bogor-Indonesia

- [14] Allo, M. K. 2018. Penyebaran, Morfologi, dan habitat Eboni Sulawesi. *Buku Eboni Sulawesi*. (p 7-25). Unhas Press, Makassar.
- [15] Allo, M. K. dan K. Sallata. 1991. Asosiasi Jenis Vegetasi di Cagar Alam Kalaena. *Jurnal Penelitian Kehutanan* Vol. V No.2. (p1-24). Balai Penelitian Kehutanan. Ujung Pandang.