

The diversity of endemic bamboo in Bali and conservation efforts

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研究資料

The diversity of endemic bamboo in Bali and conservation effortsI.B.K. ARINASA¹⁾ and Wawan SUJARWO^{1,2)}

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Abstract

The live of Balinese community can't be separated from bamboo usage. Mostly, bamboos can grow from lowland to highland. Some bamboos also grow naturally in the forest. Six bamboos were reported as endemic in Bali, such as *tiing liplip* (*Dinochloa sepang* Widjaja & Astuti), *tiing ooh* (*Bambusa ooh* Widjaja & Astuti), *buluh kedampal* (*Schizostachyum castaneum* Widjaja), *tiing bali* (*Gigantochloa baliana* Widjaja & Astuti), *tiing jajang aya* (*Gigantochloa aya* Widjaja & Astuti) and *tiing jajang taluh* (*Gigantochloa taluh* Widjaja & Astuti). All of those have been conserved in Bali Botanic Garden.

Keywords: bamboo, conservation, endemic, Bali

1. Introduction

Bamboo has been known by the people of Bali for a long time. Their lives can't be separated from the bamboo since birth until death. Many bamboos are needed both in types and quantity, so efforts were made to meet them. In Bali, some species of bamboo can grow from coastal areas to the mountainous terrain. Most bamboo species found on land owned by residents of both planted and naturally grown. In the area of protected forests also found some bamboo species grow well.

Given such an important meaning of bamboo to the lives of the Balinese for religious ceremonies, building materials, handicrafts, home furnishings, groceries and so it is no wondering that bamboo has special attention. Planting for harvesting are expected to abide by the rules (*lontar wariga*). *Lontar wariga* explains the good and bad days to plant; plant species are grown or harvested associated with astrology (astronomy). Planting a plant species segmented like bamboo, well planted on Sunday and the poor harvest on the day of planting (Bija and Arinasa, 2004).

Many traditional villages attach bamboo into *awig awig desa adat* (customary village

regulations in Bali) to remain bamboo sustainability. *Angsri* and *Candikuning* indigenous villages in Tabanan District, *Kedui* and *Penglipuran* indigenous villages in Bangli District, and *Tigawasa* traditional village in Buleleng District require communities to plant and maintain bamboo (Sumantera and Peneng, 2005). *Awig awig* violation is imposed fine sanctions, warning of customs officials and even issued as a citizen, so that all people obey. *Awig awig* can lead to sustainable environment, and plant conservation both in-situ and ex-situ are still exist.

Ex-situ bamboo conservation by "Eka Karya" Botanical Garden Bali was conducting since 1980. In 2012, Botanical Garden Bali has managed to collect a total of 60 bamboo species or 54.54% of the total bamboo found in Indonesia. Nearly 50% of the present amount is a kind of introduction (Arinasa and Widjaja, 2003). Efforts to increase the types of bamboo received great attention as a multi-purpose function. To increase bamboo collection can be done by exploration, and exchange of material in the form of donations. Exploration carried out to the rural areas and protected forests in Bali, while material exchange performed by governments and private institutions, communities, bamboo lovers, and overseas. Based on the bamboo collection activities until 2009 has been collected as many as 62 types of bamboo including six endemic bamboo in Bali, that representing 20 genera. Five types of endemic bamboo can be found in either the public or private property traditional village and one type is found in protected forest areas.

Discovering endemic bamboo in Bali is always possible to increase, because there are many types of bamboo can be found in Bali. In addition, Botanical Garden Bali has not collected yet herbarium material completely, especially in the genus of *Gigantochloa*.

Field exploration is expected to be able to increase other types of bamboo, including knowing endemic bamboo species. Widjaja (1988) mentioned 24 known endemic species of Indonesia bamboo. Along with field trips that were constantly trying to collect bamboo, Widjaja (1994) reported the number of endemic bamboo in Indonesia had reached 49 species. So far it has not been reported yet the existence of endemic bamboo in the Lesser Sunda Islands.

In Bali, bamboo collection has also been done long time ago. Unlike other places, types of bamboo in Bali are quite a lot of variations so as to determine the type requires a complete herbarium material and takes a long time. Many morphological variations shown in the genus of *Gigantochloa* thus requires further research to determine the taxonomy. Widjaja *et al.* (2004) reported five new species of bamboo are found only in Bali namely *Dinochloa sepang* Widjaja & Astuti, *Bambusa ooh* Widjaja & Astuti, *Gigantochloa aya* Widjaja & Astuti, *Gigantochloa baliana* Widjaja & Astuti and *Gigantochloa taluh* Widjaja & Astuti. In addition, Widjaja *et al.* (2005) reported there is one more endemic bamboo from Tabanan District Bali namely *Schizostachyum castaneum* Widjaja.

2. Methods

Exploration method was used to determine the endemic species of bamboo in Bali (Rugayah

et al. 2004). Exploration into the rural areas and protected forests in Bali conducted since 1989 until now. The types of bamboo that has not been collected yet by "Eka Karya" Bali Botanic Garden will be collected and conserved. The collection was conducted by splitting rhizome or seedling and then planted in XLD compartment which is a special area for the Poaceae family (Grasses). Herbarium of flowering bamboo was collected. Ecological and distribution data were also recorded. Herbarium was identified in Herbarium Bogoriense and "Eka Karya" Bali Botanic Garden.

3. Results and Discussions

3.1. The types of endemic bamboo in Bali.

Bamboo exploration was commencing since 1989 to present to various rural areas and protected forests in Bali, recorded as 6 six types of bamboo are endemic (Table 1.)

Table 1. Endemic Bambos of Bali

No	Name		Origin	Altitude (m asl.)	Abundance
	Scientific	Vernacular			
1	<i>Schizostachyum castaneum</i> Widjaja	Buluh Kedampal	Angkah, Tabanan District	300	Rare
2	<i>Bambusa ooh</i> Widjaja & Astuti	Tiing Ooh	Rendang, Karangasem District	800	Rare
3	<i>Dinochloa sepang</i> Widjaja & Astuti	Tiing ludlud, tiing liplip, tiing alas, tiing-tiing	Sepang, Buleleng District	600-1200	Rare
4	<i>Gigantochloa aya</i> Widjaja & Astuti	Tiing jajang aya	Penglipuran, Bangli District	700	Medium
5	<i>Gigantochloa taluh</i> Widjaja & Astuti	Tiing jajang taluh	Penglipuran, Bangli District	700	Medium
6	<i>Gigantochloa baliana</i> Widjaja & Astuti	Tiing betung bali	Sidetapa, Pedawa, Cempaga, Tigawasa, Buleleng District	600	Rare

In Buleleng district, located in the northern part of the island of Bali, has two endemic species of bamboo namely bamboo *liplip* (*Dinochloa sepang* Widjaja & Astuti), Fig. 1 and bamboo *bali* (*Gigantochloa baliana* Widjaja & Astuti), Fig. 2. *Dinochloa sepang* is a *liana* bamboo, culm can reach 30 m in length and 3 cm in diameter, is the only endemic species of bamboo are found growing naturally in Sepang protected forest areas. *Gigantochloa baliana* is simpodial where rods can reach 10 m with a culm diameter up to 6 cm, distributed throughout villages of Sidetapa, Cempaga, Pedawa, and Tigawasa in Buleleng District. The name for *Dinochloa sepang* was taken from place of origin where the bamboo is obtained, while the name for *Gigantochloa baliana* was taken from the name of the concerned area.

In Bangli district, there are two types of bamboo that is endemic namely *Jajang aya* (*Gigantochloa aya* Widjaja & Astuti), Fig. 3 and *Jajang taluh* (*Gigantochloa taluh* Widjaja & Astuti), Fig. 4. Both types grow well in the village's indigenous forest. *Gigantochloa aya* is

a simpodial bamboo with dense clumps, erect culm up to 15 m in height, 40 - 45 cm internodes, 8 - 10 cm in diameter, and green. *Gigantochloa taluh* is also simpodial bamboo with rather dense clump, erect culm up to 10 m in height, 27.5 - 40 internodes cm with culm diameter up to 3.8 cm. The scientific name for these two bamboos was taken from the name of the region.

In Karangasem district, located at the eastern of the Bali Island has endemic species of bamboo namely *Bambusa ooh*. *B. ooh* (Fig. 5) is a simpodial bamboo with rather dense clumps, erect culm can reach a height of 16 m, green, 25 - 75 cm internodes, culm diameter can reach 10 cm, a thin culm is no more than 1 cm, green. The scientific name was also taken from the name of the region.

Tabanan district has one endemic bamboo species namely *buluh kedampal* (*Schizostachyum castaneum* Widjaja), Fig. 6. This bamboo is simpodial with dense clumps, erect culm can reach 15 m in length, 45 - 70 cm internodes, 4.5 - 6 cm in diameter. Thin-walled bamboo



Fig.1. *Dinochloa sepang* Widjaja & Astuti

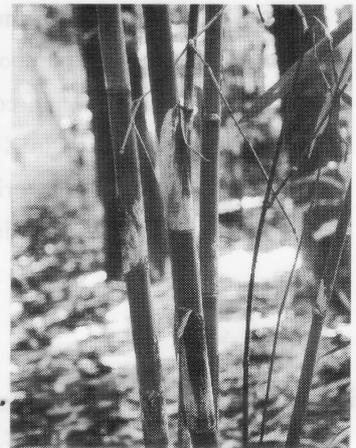


Fig.2. *Gigantochloa baliana* Widjaja & Astuti



Fig.3. *Gigantochloa aya* Widjaja & Astuti



Fig.4. *Gigantochloa taluh* Widjaja & Astuti



Fig.5. *Bambusa ooh* Widjaja & Astuti



Fig.6. *Schizostachyum castaneum* Widjaja

is no more than 0.5 cm with white stripe around the bottom of the internodes (Widjaja 2001).

Scientific naming of six endemic bamboos in Bali was proposed by Elizabeth Widjaja and Inggit Puji Astuti as bamboo descriptor (Widjaja *et al.* 2004). Elizabeth Widjaja is bamboo taxonomist at Research Center for Biology, the Indonesian Institute of Sciences (LIPI). Description of endemic bamboo in Bali is more detail presented in Table 2.

Table 2. Description of endemic bamboo in Bali

Name	Morphological properties					Distribution
	Clumps	Shoots	Culms	Culm sheath	Leaves	
<i>S. castaneum</i> Widjaja	Sympodial, densely, erect with dropping or pendulous tip.	Green, covered by brown to densely. yellowish orange,	Length to 15 m, green with white substance surround under the node, internodes 45-70 cm long, 4.5-6 cm in diameter, wall 4-5 mm thick.	Rather dropping, erect blade, triangular and rather convex on the base. Auricles small to 2 mm. Ligula short to 1 mm with short bristles to 1 mm.	The normally leaves 15.5-24 x 3-4.5 cm, hairy adaxially, auricles short to 1 mm, out curve.	Tabanan and Karangasem District, Bali Province
<i>B. ooh</i> Widjaja & Astuti	Sympodial, rather densely, erect with pendulous tip.	Green, covered by brown hair.	Green, erect, 16 m height, internode 25-75 cm long, 10 cm in diameter, wall 1 cm thick.	Rather dropping, triangular and erect blade, whole covered by densely brown hair, obtuse auricles to 8 mm with bristles to 8 mm	Leaf blade lanceolate, 12-30 x 2.5x 4 cm covered by brown hair, auricle obtuse 1 mm, bristles 4 mm	Karangasem District, Bali Province
<i>D. sepang</i> Widjaja & Astuti	Climbing, infrequently, its tip can be dropping to the earth.	Purple green covered by white wax. On the base of culm sheath covered by densely white yellowish hair.	Length of culm up to 30 m, culm tip dropping can to reach to earth. Internodes 15-23 cm, thick wall, 3 cm in diameter. Culms zig zag, usually solid, rarely hollow. Upper of node covered by densely white brownish hair.	Consisting of two parts, the hard, expandable rugose base (lampang), hairy and the smooth upper part. Covered by white wax, appressed brown hairy on the base. Obtuse spreading to deflexed leaf blade.	Leaf blade lanceolate, 15.5-27.1 x 1.7-5.5 cm, both surface (below and upper) covered by thin white hair.	Sepang protected forest, Buleleng District, Bali Province.

Name	Morphological properties					Distribution
	Clumps	Shoots	Culms	Culm sheath	Leaves	
<i>G. aya</i> Widjaja & Astuti	Sympodial, densely, erect with dropping or pendulus tip.	Green with appressed brown to black hairy.	Green bluish, and erect. Height of culm up to 15 m, internodes 40-45 cm, 8-10 cm in diameter.	Erect. Persistent, erect, auricles 3 mm line shape. Leaf blade triangular, top acute and wavy margins.	21-35x3.2- 6 cm with white hair beneath and glabrous upper shape, obtuse auricles, 3 mm, ligule 4 mm	Penglipuran traditionally bamboo forest, Bangli District, Bali Province.
<i>G. baliana</i> Widjaja & Astuti	Sympodial, densely, erect with dropping or pendulus tip.	Green, covered with dark brown hair, spreading	Height to 10 m. The young culm is green bluish. Internodes 27.5-49 cm covered by brown hair, more than 3.8 cm in diameter.	Persistent, auricles line shape to 2 mm, ligule 2 mm with velutine bristles. Erect leaf blade, triangular with narrow shape in the base.	21-40.3 x 2.5- 7.5 cm with white hair beneath and glabrous upper shape.	Bamboo forest community of Sidetapa, Pedawa, Cempaga, Tigawasa Villages, Buleleng District, Bali Province.
<i>G. taluh</i> Widjaja & Astuti	Sympodial, densely, erect with dropping or pendulus tip.	Green, covered with dark brown to black hair,	Height to 10 m, green when young and white when dry. Internodes 27.5-40 cm, and 1.8- 3.8 cm in diameter	Caducous, obtuse auricles to line shape, glabrous. Ligule irregularly with hairy bristles. Leaf blade deflexed but erect when young, lanceolatus.	22-40.3 x 2.5- 7.5 cm, hairy beneath but upper side glabrous, obtuse auricles and glabrous. Petiole covered by persistent brown hair.	Penglipuran traditionally bamboo forest, Bangli District, Bali Province.

The origin place of six endemic bamboos in Bali was found is presented in Fig.1.

3.2. Conservation efforts

The six endemic bamboos in Bali have been planted in XI.D compartment of Botanical Garden Bali. As plant collection, six endemic bamboos have been given registered number each specimen. For instance, *Dinochloa sepang* has

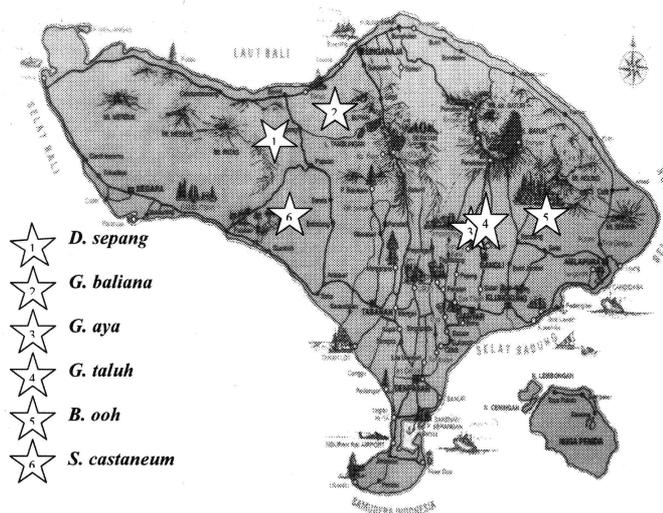


Figure 1. Distribution of six endemic bamboos in Bali

registered number of XLD.290, planted on June 14, 2007 with the specimen as many as three clumps. *Gigantochloa baliana* has registered number of XLD.228, planted on November 30, 2004 with the specimen as many as one clump. *Gigantochloa aya* has registered number of XLD.294, planted on June 14, 2007 with the specimen as many as eight clumps. *Gigantochloa taluh* has registered number of XLD.151, planted on December 4, 2001 with the specimen as many as five clumps. *Bambusa ooh* has registered number of XLD.226, planted on November 30, 2004 with the specimen as many as four clumps. *Schizostachyum castaneum* has registered number of XLD, planted on January 5, 1995 with the specimen as many as two clumps.

Propagation and cultivation of six endemic bamboos in Bali received attention from the research staff of "Eka Karya" Bali Botanic Garden to ensure the existence from extinction threats.

4. Conclusions

1. Six endemic bamboo in Bali are *Dinochloa sepang* Widjaja & Astuti, *Bambusa ooh* Widjaja & Astuti, *Gigantochloa aya* Widjaja & Astuti, *Gigantochloa baliana* Widjaja & Astuti, *Gigantochloa taluh* Widjaja & Astuti and *Schizostachyum castaneum* Widjaja.
2. All of those have been conserved in "Eka Karya" Bali Botanic Garden.

5. Suggestion

Genus of *Gigantochloa* has many variations in Bali. Completing herbarium collection is needed to support the correct taxonomic position.

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