Bio-prospecting bamboo collection in purwodadi botanic gardens

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Abstract. The utilization of biodiversity can be classified according to several categories, including consumptive values, productive values, existence values, ecological values. Indonesia has a high diversity of bamboo. Bamboo is one of the plants that has an important role in Indonesia and other tropical countries. Almost every part of a bamboo plant has certain uses. This research was conducted in order to analyze the value of uses (bioprospect) of bamboo collections at Purwodadi Botanical Gardens. The study was conducted in January-February 2019. The research method was carried out by conducting semi-structured interviews with surrounding communities and identifying bamboo data in the collection as well as in the Registration Unit of Purwodadi Botanical Gardens. The results showed that there were 39 types of bamboo belonging to ten (10) genera in the Purwodadi Botanical Garden. The ten genera of bamboo include: (1) Bambusa, (2) Dendrocalamus, (3) Dinochloa, (4) Fimbribambusa, (5) Gigantochloa, (6) Neololeba, (7) Scizostachyum, (8) Thyrsostachys, (9) Phylostachys, and (10) Pinga. Bamboo bioprospection analysis is done by Index of Cultural Significance (ICS) or cultural importance index. The highest cultural importance index (ICS) value of bamboo in Purwodadi Botanical Garden, indicated by Bambu Betung (Dendrocalamus asper) with an index value of 194 and smallest 107 by Bambusa balcoa

1. Introduction
Indonesia is one country that is rich in plant biodiversity, one of which is bamboo. There are 161 types of bamboo in Indonesia, of which this amount is 11.5\% of the world's bamboo [1]. The geographical distribution of bamboo is influenced by human activities [2], because bamboo is a plant species that has many benefits for human life [3]. Bamboo is a plant that has a fairly high interaction with the people of Indonesia, because bamboo has many benefits. Most people still use bamboo as the main material for the needs of the board. Some of the advantages of bamboo include strong, straight, flat, easily formed, easily split, and easily transported [4]. Some local names of Indonesian bamboo include betung bamboo, yellow bamboo, black bamboo, spotted bamboo, ater bamboo, loleba bamboo, Bali
bamboo, Japanese bamboo, apus bamboo. Generally, bamboo plants grow in clumps, especially bamboo species in Indonesia, although some of them grow solitary or as shrubs [5]. Bamboo is a type of grass that is broad, classified in the family Poaceae, which consists of 70 genera [4]. Bamboo is a plant that has an important role for the economic life of the Indonesian people [6], because it is known to have good properties including sturdy, straight, easily formed and easily distributed. Bamboo also plays a role in preserving the environment, because its roots are strong and can prevent erosion, so bamboo is often used for soil and water conservation needs. One of the ecological functions of bamboo plays a role in soil and water conservation, especially springs. Bamboo can maintain the hydrological function of the infiltration area and the spring discharge continuously, through its root and litter functions. Bambu and Ficus are spring-specific plants [7]. Research conducted around springs in Malang and Batu, bamboo is often found in the spring area. Bamboo also plays a role in regulating root mechanics in the soil. Bamboo root has the ability to prevent erosion, with its root holding power towards the soil, especially the physical properties of the soil. Bamboo leaves have a high of silicate content, so the decomposition of bamboo leaves is slow. The slow decomposition of bamboo litter makes bamboo litter last longer above the soil surface [8]. Plant litter at the soil surface reduces soil from surface erosion. Plant litter plays a role in land cover by reducing the rate of run off on sloped soils and increasing soil porosity and permeability. Litter also plays a role in supplying soil organic matter [9]. Bamboo litter that stays longer at the soil surface will better protect the soil from surface erosion.

It is estimated that there are 1200 - 1300 species of bamboo in the world. Based on data in the field and in the laboratory, bamboo in Indonesia is known to consist of 143 species and in Java there are only an estimated 60 species [10]. Bamboo clumps (Bambusoideae) have long been used in everyday life by the people of Indonesia. Since long time ago, bamboo was considered by Indonesian people as a versatile plant. Bamboo is consumed as a vegetable, used as a household appliance, a musical instrument, to building materials [11]. A good understanding of the benefits of bamboo is fundamental to conservation and sustainable use. The value of benefits can help to determine the species that must be conserved [12]. However, the expected use is to meet the conservation principles. Although the availability of bamboo in nature is abundant, continuous use that is not based on conservation principles, is feared to reduce the number of individuals and the number of types of bamboo available in nature.

Bamboo is a plant with economic value, its use is very wide, both in daily needs and other products. Although this function is generally known, bioprospection efforts can continue, especially if it is associated with efforts to conserve species in a particular conservation area. All parts of bamboo plants can be used from roots to leaves [13]. Purwodadi Botanical Garden is a dry lowland plant conservation agency. This botanical garden has quite a large collection of bamboo, originating from Java but some from outside Java. The bamboo collection in the Botanical Gardens of Purwodadi reaches 39 species belonging to 12 genera. Not much information about the value of the benefits of each Bamboo species in this Botanical Garden. This study aims to examine the value of benefits from existing bamboo species, which can then be taken into consideration and input for the Botanical Gardens in carrying out conservation activities such as propagation for bamboo which has the highest benefit value.

2. Methods
The study was conducted at the Purwodadi Botanical Garden from 11 January to 8 February 2019. Interviews were conducted semi-structurally to respondents, consisting of indigenous people around the Purwodadi Botanical Gardens, as well as Purwodadi Botanical Garden officers who were also the surrounding indigenous people. In addition, a literature study was conducted to support the data needed.
Table 1. The value of the use quality of a plant species according to the ethnobotany category

| No | Usage Description                                                                 | Use Value |
|----|------------------------------------------------------------------------------------|-----------|
| 1  | Staple food                                                                        | 5         |
| 2  | Plant foods (secondary foods); tubers; fruit                                        | 4         |
|    | Other food ingredients used                                                        |           |
| 3  | Add flavor, aroma of spices and other flavor enhancers; foodstuffs; animal feed and animal food | 3         |
|    | Main Material                                                                      |           |
| 4  | Wood building materials, container materials, fuel wood; fiber and clothing materials; traditional crafts or technology; wood as a construction material | 4         |
|    | Secondary material                                                                 |           |
| 5  | Producing useful ingredients for treatment; coloring, decoration and cosmetics; deodorant, cleaning agent; adhesives, ropes, waterproof materials, mat and mat materials, sanitary napkins; mixture as a useful ingredient. | 3         |
|    | Medicinal ingredients                                                              |           |
| 6  | Medicinal ingredients for human diseases; medicinal ingredients for animal diseases | 3         |
| 7  | *Medicine miscellaneous or unspecified*                                             | 2         |
|    | Ritual or spiritual                                                                |           |
| 8  | Birth rituals; initiation, courage, heroism in inter-tribal warfare, medical rituals; hunting ritual, fishing and agricultural activities; the main pana material for rituals | 2         |
| 9  | Species are specifically taboo or only used for traditional / healing rituals       | 2         |
| 10 | As a talisman, a sign of love (symbol), permanan, rain repellent ritual materials etc. | 2         |
|    | Mythology                                                                          |           |
| 11 | Plant species have a spiritual or mythic role; supernatural, or magical or religious myths; historical myths; village symbol; environmental indicator of a person's name, village: valuable plants have value | 2         |
| 12 | Plants whose specific purpose is unknown but that has a beautiful picture or have similarities with other plant species | 2         |
| 13 | Plants that have value, but are not used specifically or have exceptions. Plants are worthless or worthless or unknown to anyone | 1         |

Table 2. A category that describes the intensity of use (intensity of use) useful plant species

| No | Description                                                                 | Intensity Value |
|----|------------------------------------------------------------------------------|-----------------|
| 1  | Very high intensity of use; namely plant species which in daily life, are used regularly almost every day to meet their needs | 5               |
| 2  | The intensity of its use is high; including plant species in daily life, used regularly daily, seasonally or periodically | 4               |
Medium intensity; the use of plant species on a regular basis but at certain times, such as seasonal uses. Usually species are mixed, extracted, or the produce is excessively tradable.

Low intensity of use; includes species that are rarely used and have no influence on people's daily lives

Very rarely the intensity of its use: includes plant species that are very minimal or very rarely used in daily life.

Table 3. A category that describes the level of exclusivity or level of liking

| No | Description                                                                 | Exclusive value |
|----|-----------------------------------------------------------------------------|-----------------|
| 1  | Most preferred and is the main choice and is a plant species that is the main component and is very instrumental in its culture. These species have the most preferred use or also for species that have a use value not replaced by other species. | 2               |
| 2  | Includes useful species that are preferred but there are other species if they are not present. | 1               |
| 3  | Includes plant species that are only secondary resources, their exclusivity or low favorite value. | 0,5             |

Analysis of the value of the benefits of bamboo in the Purwodadi Botanical Garden is done with the Index of Cultural Significance (ICS) or index of cultural importance. The cultural importance index (ICS) is the result of a quantitative ethnobotany analysis showing the importance of each type of useful plant based on community needs [13]. The calculation of the cultural importance index (ICS) uses the formula [14] as follows:

\[ ICS = \sum q \times i \times e \]  

ICS = Index of Cultural Significance
q = quality value, calculated by giving or assessing the quality of a type;
i = intensity value, that is to describe the intensity of utilization of plant species
e = exclusivity value

3. Results and Discussion

From the results of practice in the field, in the Botanical Gardens Purwodadi found 40 species of bamboo collections. In this bamboo collection classified into 12 genera, namely: 1) Bambusa, 2). Dendrocalamus, 3) Dinnochloa, (Figure 2) 4) Fimbribambusa, 5) Gigantochloa, 6) Melocanna, 7) Neololeba, 8). Scizostachyum, 9) Thyrsostachys, 10) Pyylostachys, 11) Nasus and 12) Pinga. For species Meloccana and Nastus are not found because they are dead. The following is a list of bamboo collections at the Purwodadi Botanical Gardens and ICS value (Table 4 and 5).

Table 4. Bamboo species ini Purwodadi Botanic Gardens

| No | Bamboo name            | Local name           |
|----|------------------------|----------------------|
| 1  | Bambusa multiplex      | bambu cendani        |
| 2  | Dendrocalamus giganteus| bambu sembilang      |
| 3  | Bambusa maculata       | bambu tutul           |
| 4  | Bambusa blumeana       | bambu gesing/duri    |
| 5  | Gigantochloa ater      | bambu jawa/nongko jajar |
6 Bambusa vulgaris bambu ampel
7 Schizostachyum silicatum bambu suling
8 Bambusa balcooa -
9 Bambusa tulda -
10 Gigantochloa robusta Bamboo mayan
11 Gigantochloa atroviolacea bambu wulung
12 Phyllostachys aurea -
13 Gigantochloa apus bambu tali/apus
14 Schizostachyum iraten pering wuluh
15 Gigantochloa nigrociliata -
16 Gigantochloa sp jajang suwat
17 Gigantochloa kuring buluh serik
18 Bambusa bambos -
19 Thyrsostachys siamensis bambu siam
20 Schizostachyum blumei bambu tamiang
21 Gigantochloa manggong -
22 Schizostachyum lima bambu toi
23 Dinochloa matmat pring kadalang
24 Gigantochloa serik -
25 Gigantochloa luteostriata -
26 Neololeba atra -
27 Fimbribambusa sp. -
28 Pinga marginata -
29 Schizostachyum zollingeri bambu rampal
30 Schizostachyum brachycladum bambu talang
31 Dendrocalamus asper bambu betung
32 Bambusa jacobsii -
33 Schizostachyum sp 1 -
34 Bambusa sp -
35 Gigantochloa sp -
36 Gigantochloa kuring -
37 Dinochloa sp -
38 Meloccana baccifera -

Table 5. ICS value of bamboo collection in Purwodadi Botanic Gardens

| No | Bamboo species | Local name   | ICS Value |
|----|----------------|--------------|-----------|
| 1  | Dendrocalamus asper | Bambu betung | 194       |
| 2  | Bambusa blumeana   | Bambu gesing | 190       |
| 3  | Gigantochloa robusta| Bambu mayan  | 144       |
| 4  | Gigantochloa apus  | Bambu tali/apus | 136     |
| 5  | Bambusa tulda      | -            | 130       |
| 6  | Bambusa vulgaris    | Bambu ampel  | 126       |
| 7  | Bambusa bambos     | -            | 118       |
| 8  | Schizostachyum zollingeri | Bambu rampal | 112     |
| 9  | Thyrsostachys siamensis | Bambu siam   | 110       |
| 10 | Bambusa balcooa    | -            | 107       |

Some benefits of the types of bamboo found in Purwodadi Botanic Gardens include the use of building materials, construction, handicraft materials, tools or basic materials for spiritual and traditional ceremonies. Bamboo is also use for chairs, furniture, basic materials for making traditional
music instruments, containers, water pipes, sticks, chopsticks, toothpicks, skewers, rafts, ornamental plants, and various household appliances and also as raw material for paper pulp. Vegetables are usually chosen, the type of stem that is easily bitter and tastes good. The value of the importance index (ICS) of bamboo Purwodadi Botanic Gardens is high, indicated *Dendrocalamus asper* (Bambu petung) (Figure 1) with an index value of 194 and the smallest value is 107 by *Bambusa balcoa*. *D. asper* has the highest ICS value, with the element as a staple food being the highest compared to other uses. Ornamental plant function is the smallest of its use value. *D. asper* or commonly referred to as betung bamboo is one of the bamboo that produces bamboo shoots with a low HCN content and is good for consumption. Betung bamboo is a local bamboo that is widely known by the people of Indonesia.

![Figure 1. Dendrocalamus asper](image)

The second value of bamboo ICS in Purwodadi Botanic Gardens is *Bambusa blumeana*. This bamboo as known as local name Bambu gesing. *B. blumeana* is a type of bamboo that has a very high use, intensity of use and exclusivity, so plants in this area need to be maintained, managed well, and well conserved. The high exclusivity value is also an indication that the community is very dominant in favor of this plant compared to other types of plants in its utilization. *B. blumeana* is a type of bamboo that is loved by the people around the Purwodadi Botanical Garden. *B. blumeana* is the dominant bamboo species in Mount Baung Natural Tourist Park (MBNTP) [15], which is located close to the Purwodadi Botanical Gardens. In this area *B. blumeana* is also a type of bamboo that has the highest ICS value, so that good conservation management efforts are needed so that this bamboo species is maintained. *B. blumeana* or often called bamboo Gesing has a characteristic that is the existence of thorns so that bamboo also often referred to as bamboo thorns because in the book stem and branches grow thorns. In addition, this bamboo also has a very high potential compared to other bamboos. For example, in East Java, bamboo is often used to make daily necessities such as boxes, fruit baskets and paper. in Central Java, bamboo is more often used to make rough baskets where limestone and reeds are used as glass or drinking containers for palm wine [16].

In the village of Lopait, Semarang, Central Java, apus bamboo is the type of bamboo that is most often used. According to the people in that area, *Gigantochloa apus* has advantages over other bamboos. The advantages of this bamboo are that the fiber is smooth, easily shaped, more durable and easily available in the community.
In general, the meaning of plant conservation based on the utilization aspect shown through the ICS value is the type of plant that has a low INP value, but the ICS value is high. That is, its presence in nature is not too much, but its use by the community is very large, so that if conservation efforts are not made, then the plant can be lost in its habitat. In the context of the Purwodadi Botanical Garden is not the natural habitat of bamboo, but with the results of this study, the Purwodadi Botanical Garden is expected to seek optimal conservation. This optimal conservation by maintaining the diversity of bamboo species, with the best management and maintenance. It would be better if Purwodadi Botanic Garden helped develop species that had high ICS values, so that it could be passed on to the wider community. thus, these types of bamboo will remain sustainable.

4. Conclusion

There are 39 species of bamboo, consisting of 10 genera in the Purwodadi Botanical Garden, namely Bambusa, Dendrocalamus, Dinochloa, Fimbribambusa, Gigantochloa, Neololeba, Scizostachyum Thyrsostachys, Phylostachys and Pinga. Some of the benefits of the types of bamboo found in the Purwodadi Botanical Gardens, among others, can be used as home building materials, construction, craft materials, tools or basic materials for spiritual and traditional ceremonies, chairs, furniture, basic materials for making traditional music instruments, containers, pipes waterways,
sticks, chopsticks, toothpicks, skewers, rafts, ornamental plants, and various household appliances and also as raw material for paper pulp. Vegetables are usually chosen, the type of stem that is easily bitter and tastes good. The high importance index (ICS) of bamboo plants in the Botanical Gardens of Purwodadi is shown by *Dendrocalamus asper* (Bambu Betung) with an index value of 194 and the smallest 107 is *Bambusa balcoa*. *D. asper* is a bamboo that is supported to increase its conservation efforts in the Purwodadi Botanical Garden, so that it will increase in number, especially for the development of its benefits in society.

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