Inventory of Indonesian native montane trees for environmental support and space ornaments in Cibodas Botanical Garden

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Abstract. Nowadays, many urban outskirts which are commonly characterized by natural environment have changed into built environment including in the mountainous zones. In many cases, however, the use of plant species as recommended by policy makers for restoring the urban outskirts does not match with the local environmental settings that often causes failure in achieving the desired healthy environment. The objective of this study was to select and carry out inventory of suitable trees for improving the environmental settings in mountainous zone. Trees selection was conducted by gradual screening procedure, based on the plant collection in Cibodas Botanical Garden, specifically for Indonesian native trees. Tree inventory was performed based on core ecosystem functions such as shading function, soil adsorption capacity and aesthetic value. The results indicated that at least 125 trees species are suitable for shading function, such as Dipterocarpus cornutus, Castanopsis spp. and Cinnamomum spp. For soil adsorption capacity, 211 species were recorded, such as Canarium hirsutum, Magnolia spp. and Litsea spp., and for the aesthetic values, there were 237 recorded species, such as Garcinia spp., Lithocarpus spp. and Ficus spp. Certain trees have more than one function, such as Agathis dammara which is suitable for all functions, or Elaeocarpus spp. which is appropriate for soil adsorption and aesthetic function. These results are expected to be used as initial reference for tree selection within the framework of restoration of local mountain environment quality.

1. Introduction
Urbanization is the process of increasing population number in a city which has dramatically occured in the previous decade. It also implies that an urban condition with land use changes. Environmental conditions are increasingly becoming critical and deteriorating due to the rapid growth of urban development without considering the importance of ecological aspects [1]. Urbanization affects significantly the use of natural resources and management of the city causing environmental stresses such as the depletion of water resources and conservation of forest and land. Such development is likely worsening air and water pollution problems in urban areas [1, 2]. The impacts of the urban extension to natural ecosystems are often on a serious scale and long-lasting term. Therefore, urban development can have important environmental impacts at the local and the regional scales [1].
Urban extension and the increasing human activities have led to biodiversity losses. The number of local plant species has fallen quickly, while at the same time, the number of non-native plant species has expanded enormously due to the presence of numerous species in the green managed spaces and intensively man-made spaces (e.g. settlements, agricultural lands, industrial complex) [2]. An important consequence of urbanization is the loss of peripheral major wildlands. Historically, the cities were generally established near the high-quality agricultural lands and common wildlands. These facts driving to the competition for arriving between urban, agricultural uses and natural areas along urban populations grow [3, 4]. The disadvantages of major wildlands and farmland due to the urban extension have resulted in suggestions for environmental sustainability. These consequences have also occurred to highlands environment as supporting and the buffer zone of the city. Many highlands have changed into a built area, such as for settlements and recreation and other man-made areas [5]. This development can increase the potential hazards of natural disasters, such as flood and landslides.

On the other hand, along with the increasing awareness towards the environment from stakeholders, there have been many activities to restore the condition of these disturbed environments, one of them by movement of planting trees. However, another problem that arises in the planting of these trees is lack of attention to the suitability of the species on the targeted restoration sites and the environmental functions to be achieved [6]. Plants, especially trees, which are used and recommended by the policy maker for restoration program are frequently not suitable for local characteristics, so the program often fails to achieve a healthy biophysical and social environment. Appropriate planning in plants selection, especially tree(s), plays an important role to resolve and to construct a comfortable environment.

Therefore, the objective of this study was to select suitable tree species which can potentially be used as reference to restore the environmental condition at the montane zone through species-site matching based on Cibodas Botanical Garden (CBG) plants collection. The environmental functions which are expected to achieve from the selection process were shade benefit, soil adsorption capacity and aesthetic value. The results expected were as initial reference in tree selection activities for supporting the restoration of local mountain environment quality.

2. Methods
The study was conducted at CBG, which administratively located in Cipanas District, Cianjur Regency, West Java Province. CBG is located at mountainside of Mount Gede and Mount Pangrango at an altitude of approximately 1,300-1,425 meters above sea level, with an area of 84.99 hectares. The average temperature is 20°C, humidity of 80.82% and an average rainfall of 2,950 mm per year. Tree selection was conducted to plants collection of CBG. Based on CBG’s Registration Unit [7], up to 31 October 2017, the fertility of plants collection are 13,456 specimens, which consist of garden collection 7,931 specimens, indoor collection (i.e. orchids: 1,681, cactus: 985, Herbst: 1,267, Nepenthes: 222) and outdoor theme collection (i.e. Gesneriads: 67, Fern: 180, medicinal plant: 647, moss: 342, vines: 134).

Selection was done by gradual screening to Indonesian native montane trees, particularly at garden collection based on three main functions, which is shade benefit [8, 9, 10] (include of solar radiation control, temperature and humidity amelioration, rainfall control, and windbreaks), soil adsorption capacity [10, 11] (such as landslides control, soil aggregate control, water loss control) and aesthetic values [10, 12]. Each function has several morphological traits criteria, which is described in detail in table 1. Each criterion must be fulfilled by a tree species in order to be chosen as functional one, lack of any of the criteria will cause that tree type would not be selected. A tree may be selected for more a function if it met all criteria.

Morphological traits criteria were conducted by literature reviews and validated by field inspection to check the correspondences. The working process of trees selection described in figure 1. The results were expected to be the initial reference in trees selection in order to restore local mountain environment quality.
Table 1. Tree potential function and morphological traits criteria.

| Potential Function                                      | Morphological traits criteria                                                                 |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------|
| **Shade benefit**                                       | • Height (≥ 10 m); • Canopy shape (rounded, dome); • Wide canopy diameter (≥ 10 m); • Mass density of leaves and branches; • Evergreen. |
| (solar radiation control, temperature and humidity amelioration, rainfall control, and windbreaks) |                                                                                            |
| **Soil adsorption capacity**                            | • Strong roots (tap roots); • Wide fiber roots coverage (≥ 5 m).                             |
| (landslides control, soil aggregate control, water loss control) |                                                                                            |
| **Aesthetic Value**                                     | • Conspicuous flower, or • Elegant morphology (color or unique shape of trunk, branches, leaves), or • Majestic trees. |

3. Results and discussion

Based on the tree selection process, the study successfully identified 125 trees species potentially to be developed as shade function, 211 species for soil adsorption and 237 species as a focal point or aesthetic values. The Fagaceae, Myrtaceae and Lauraceae were found to be dominant and potentially to be developed as shading tree, each as much 15, 12 and 11 species, respectively. Ecological function as soil adsorbs were dominated by Myrtaceae, Elaeocarpaceae and Fagaceae, each as much as 29, 18
and 15 trees species. And for a focal point or aesthetical values were dominated by Myrtaceae, Phyllanthaceae and Elaeocarpaceae as much as 30, 23 and 18 trees species, respectively. The study has also found that some species have more than a function. For example, *Castanopsis javanica* (Fagaceae), *Syzygium antisepticum* (Myrtaceae) and *Cinnamomum burmanni* (Lauraceae) were potentially developed for all function. The results of trees selection in detail are described in table 2.

**Table 2.** The results of trees selection.

| Family          | Genus         | Species                        | Shade benefit | Soil adsorption capacity | Focal point and aesthetical values |
|-----------------|---------------|--------------------------------|---------------|--------------------------|-----------------------------------|
| Actinidiaceae   | Sauraulia     | bracteosa; cauliflora; montana; peduncularis; retewardiania; setigera; tristyla; vulcani | -             | -                        | conspicuous flower (shape/ size/ color of the flower) |
|                 |               |                                |               |                          | elegant trees (unique shape of trunk/ branches/ leaves) |
| Adoxaceae       | Viburnum      | cylindricum; sambucinum        | -             | -                        | majestic trees (trunk diameter ≥ 1.5 m) |
| Anacardiaceae   | Dracantonelon  | Dafo                           | -             | -                        |                                    |
|                 | Mangifera     | feoetida                       | -             | -                        |                                    |
|                 |               | laurina                        | -             | -                        |                                    |
|                 | Odorata       | -                              | -             | -                        |                                    |
|                 | Semecarpus    | caesia                         | -             | -                        |                                    |
| Annonaceae      | Artabotrys    | sumatranus                     | -             | -                        |                                    |
|                 | Cananga       | odorata                        | -             | -                        |                                    |
|                 | Friesodielsia | Excise                         | -             | -                        |                                    |
|                 |               | -                              | -             | -                        |                                    |
|                 | Goniothalamus | macrophyllus                   | -             | -                        |                                    |
|                 | Melodorum     | breviflorum                    | -             | -                        |                                    |
|                 | Mitrephora    | humilis; polypyrena            | -             | -                        |                                    |
|                 | Orophea       | hexandra                       | -             | -                        |                                    |
|                 | Sagroaera     | lanceolata                     | -             | -                        |                                    |
|                 | Trivalvaria   | macrophylla; timoriensis       | -             | -                        |                                    |
| Apocynaceae     | Alstonia      | angustifolia                   | -             | -                        |                                    |
|                 | Cerbera       | manghas                        | -             | -                        |                                    |
|                 | Tabernaemontana | macrocarpa                    | -             | -                        |                                    |
|                 | Voacanga      | africana                       | -             | -                        |                                    |
| Aquifoliaceae   | Heo            | cymosa                         | -             | -                        |                                    |
|                 |               | verticillata                   | -             | -                        |                                    |
|                 | Itea          | macrophylla                    | -             | -                        |                                    |
| Araliaceae      | Aralia        | montana                        | -             | -                        |                                    |
|                 | Brassaiopsis  | glomerulata                    | -             | -                        |                                    |
|                 | Macropanax    | concinnus                      | -             | -                        |                                    |
|                 |               | dispermus                      | -             | -                        |                                    |
|                 |               | undulatus                      | -             | -                        |                                    |
|                 | Polycisas     | javanica                       | -             | -                        |                                    |
|                 | Schefflera    | rugosa                         | -             | -                        |                                    |
|                 | Trevesia      | palmate; sudaiica              | -             | -                        |                                    |
| Araucariaceae   | Agathis       | dammarae; labillardierae       | -             | -                        |                                    |
|                 | Araucaria     | cunninghamii                   | -             | -                        |                                    |
| Bignoniaceae    | Radermachera  | pinnata                        | -             | -                        |                                    |
| Burseraceae     | Canarium      | denticulatum; hirsutum; oleosum | -             | -                        |                                    |
|                 | Santiria      | kevagata; nitida              | -             | -                        |                                    |
| Casuarinaceae   | Allocasuarina | littoralis                     | -             | -                        |                                    |
|                 | Casuarina     | junghuhniana                   | -             | -                        |                                    |
|                 | Gymnostoma    | papuanum                       | -             | -                        |                                    |
| Clusiaceae      | Calophyllum   | soulatri                       | -             | -                        |                                    |

The results of trees selection.
| Family           | Genus          | Species                                      | Synonyms                                                                 |
|------------------|----------------|----------------------------------------------|--------------------------------------------------------------------------|
| Lauraceae        | Persea         | x mangostana; burkili;                      |                                                                          |
|                  |                | celebica; dioica; dulcis;                   |                                                                          |
|                  |                | hirsutiflora; lateriflora;                  |                                                                          |
|                  |                | pareiflora; rostrata                         |                                                                          |
| Compositae       | Eupops         | pectinatus                                   |                                                                          |
|                  | Vernonia       | arborea                                      |                                                                          |
|                  | Alangium       | chinense; rotundifolium                     |                                                                          |
|                  | Mastisia       | cuspidate; pentandra                         |                                                                          |
| Cunoniaceae      | Weimannia      | blumei                                       |                                                                          |
| Dilleniacae      | Dillenia       | ptempoda; reticulata                        |                                                                          |
|                  | Tetracera      | scandens                                     |                                                                          |
| Dipterocarpaceae | Dipperocarpus  | coriarius                                    |                                                                          |
|                  | Parashorea     | malayanan                                   |                                                                          |
|                  | Shorea         | lucida; playceidos                          |                                                                          |
| Ebenaceae        | Diospyros      | aurea; discolor                              |                                                                          |
|                  | Diospyros      | celebica                                    |                                                                          |
| Elaeocarpaceae   | Elaeocarpus    | acromonia; angustifolia;                    |                                                                          |
|                  |                | angustipes; densiflorus;                    |                                                                          |
|                  |                | ferruginea; fulvis; grandiflorus;           |                                                                          |
|                  |                | griffithii; petiolarus; pierrei;            |                                                                          |
|                  |                | polystachys; reticulatus;                  |                                                                          |
|                  |                | serrata; stipularis; undulatet;             |                                                                          |
|                  |                | sylvestris; submonoceras                    |                                                                          |
| Euphorbiaceae    | Sloanea        | sigan                                        |                                                                          |
| Hamamelidaceae   | Homalanthus    | populeum                                    |                                                                          |
|                  | Macaranga      | pachyphyla; triloba                         |                                                                          |
|                  |                | tanarius                                     |                                                                          |
|                  | Mallotus       | paniculatus                                  |                                                                          |
| Fagaceae         | Castanea       | mollissima                                   |                                                                          |
|                  | Castanopsis    | acuminataissima; argentea;                  |                                                                          |
|                  |                | javanicas; tangurru                        |                                                                          |
| Lithocarpus      | blumeanuas; elegans; hystrix;              |                                                                          |
|                  | lucidus; oreophilus; pollidus;             |                                                                          |
|                  | pseudomoluccus; rassa                        |                                                                          |
| Gentianaceae     | Quercus        | gemelliiflora; lineata; subsericea           |                                                                          |
| Hamamelidaceae   | Fagraea        | blumei                                      |                                                                          |
| Distylidium      | stellare       | populea                                      |                                                                          |
| Exubucklandia    | populea        | -                                            |                                                                          |
| Rhodoleia        | forrestii; teysmannii                         |                                                                          |
| Engelhardtia     | serrata; spicata                              |                                                                          |
| Gmelina          | arborea        | -                                            |                                                                          |
| Lauraceae        | Actinodaphne   | macophylla; macropera; proceras; sesquipedalis |                                                                          |
|                  | Cinnamomum     | burmanni; cassia; heyneanum;                |                                                                          |
|                  |                | iners; javanicum; porrectum;                |                                                                          |
|                  |                | sintox                                      |                                                                          |
|                  | Cryptocarya    | costata; crassinervia; densiflora;          |                                                                          |
|                  |                | ferrea; gigantocarpae; laevigata;           |                                                                          |
|                  |                | vulgaris                                    |                                                                          |
| Endiandra        | macrophylia; rubescens                         |                                                                          |
| Linderia         | polyantha      | -                                            |                                                                          |
| Litsea           | accedentoides; cassiaefolia                   |                                                                          |
|                  | cubeba; deccanensis; diversifolia;           |                                                                          |
|                  | ferruginea     | elliptic; firma                              |                                                                          |
|                  | garciae; grisea; insignis;                   |                                                                          |
|                  | javanica; leefeanza; mappacea;              |                                                                          |
|                  | noronhae; oppositifolia;                     |                                                                          |
|                  | tomentosa; umbellata                           |                                                                          |
| Machilus         | rimosas                                  |                                                                          |
| Neolitsea        | cassifolia; javanica; mollissima; sericea    |                                                                          |
| Persea           | excels; rimosas                                |                                                                          |
|                  |                                                          |                                                                          |

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| Family            | Genus                         | Scientific Name           |
|-------------------|-------------------------------|---------------------------|
| Pandanaceae       | Phoebe                        | grandis                   |
|                   | Tetranthera                  | angulata; resinosa        |
| Leguminosae       | Planchonia                    | valida                    |
|                   | Archidendron                 | elyppearia                |
|                   | Erythrina                    | fusca                     |
|                   | Hylodesmus                   | repandum                  |
|                   | Paraserianthes               | lophantha                 |
| Magnoliaceae      | Magnolia                     | calophyloide; gigantifolia; |
|                   |                               | tilifera; montana         |
|                   |                               | champaca; ovata           |
|                   |                               | sumatrana                 |
| Malvaceae         | Dombeya                       | vallichi                 |
|                   | Durio                         | zibethinus               |
|                   | Heritiera                    | globosa; sumatrana        |
|                   | Pterospermum                 | diversifolium             |
|                   |                               | javanicum                 |
|                   | Tetradia                      | horyfieldi                |
|                   | Urena                         | sinuata                   |
| Melastomataceae   | Astronia                      | spectabilis               |
|                   | Bellucia                      | pentamera                 |
|                   | Phylogalathis                | rotundifolia              |
| Meliaceae         | Aglaia                        | edulis; elliptica; extima; |
|                   |                               | forbesi; bieri; lowii;    |
|                   |                               | lepantaha                 |
|                   | Chitscheton                  | patens                    |
|                   | Dysoxylum                    | alliaceum                 |
|                   |                               | densiflorum; excelsum     |
|                   |                               | nutans; parasiticum       |
|                   | Sandoricum                   | koejapae                  |
|                   | Toona                         | sinensis                  |
|                   |                               | sureni                    |
| Menispermaceae    | Arcangelista                  | flavas                    |
| Monimiaceae       | Kibara                        | coriacea; macrophylla     |
| Moraceae          | Artocarpus                    | integer                   |
|                   | Ficus                         | ampelac; deltoidea; heterophylla; |
|                   |                               | hirta; montana; obscura; padana; |
|                   |                               | septica                   |
|                   |                               | fistulos; grossularioides; |
|                   |                               | leptica; racemosa; variegata |
|                   | Morus                         | macroura                  |
|                   | Parartocarpus                 | bracteata                 |
| Myristicaceae     | Myristica                     | elliptica                 |
| Myrtaceae         | Acmena                        | acuminatissima            |
|                   | Corymbia                      | citriodora                |
|                   | Eucalyptus                    | deglupta saligna          |
|                   | Jambosa                       | anastomosans              |
|                   | Lepnospermum                  | javanicum; polygolfolium; |
|                   |                               | scoparium                 |
|                   | Rhodannia                     | cinerea                   |
|                   | Syzygium                      | acuminatissimum; antisepcticum; aquem; cumin; discophorum |
|                   |                               | ampliflorum; filiforme; |
|                   |                               | formosum; garcinifolium; |
|                   |                               | glabrum; insign; lineatum; |
|                   |                               | malacense; nigricans; |
|                   |                               | polyanthem; polycrahalum; |
|                   |                               | puncrictalum; pyrcnatum; |
|                   |                               | rostratum; siphonanther; |
|                   |                               | syzygioides; versteegi    |
| Nothofagaceae     | Nothofagus                    | starkenborghii; sumatrana |
| Oleaceae          | Olea                          | javanica                  |
| Pandanaceae       | Benstonea                     | pectinata                 |
|                   | Pandanus                      | conoideus                 |
| Phyllanthaceae    | Antidesma                     | bunias                    |
Stemonuraceae
Staphyleaceae
Smilacaceae
Sapotaceae
Sapindaceae
Rutaceae
Rubiaceae
Rhizophoraceae
Putranjivaceae
Pittosporaceae
Podocarpaceae
Primulaceae
Proteaceae
Rosaceae
Rutaceae
Sapindaceae
Sapotaceae
Smilacaceae
Staphyleaceae
Stemonuraceae

Stemonurus
dulcis; motleyana; racemosa
dulcis; motleyana; racemosa

cuspidatum; montanum;
tetrandrum
tetrandrum
tetrandrum
tetrandrum

dulcis; motleyana; racemosa
dulcis; motleyana; racemosa

dulcis; motleyana; racemosa
dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

dulcis; motleyana; racemosa

Turpinia
retusa
retusa

Turpinia
retusa
retusa

Smilax
oblongifolius
oblongifolius

Smilax
oblongifolius
oblongifolius

Pouteria
sphaerocarpa
sphaerocarpa

Pouteria
sphaerocarpa
sphaerocarpa

Planchonella
formosana; montana; pomifera
formosana; montana; pomifera

Planchonella
formosana; montana; pomifera
formosana; montana; pomifera

Payena
lucida
lucida

Payena
lucida
lucida

Pterygota
sphaerocarpa
sphaerocarpa

Pterygota
sphaerocarpa
sphaerocarpa

Stemonurus
scorpioides
scorpioides

Stemonurus
scorpioides
scorpioides

Pittosporaceae
Pittosporum
cornifolium; moluccanum
cornifolium; moluccanum

Podocarpaceae
Dacrycarpus
imbricatus; walllachiana
imbricatus; walllachiana

Podocarpaceae
Phyllocladus
hypophyllus
hypophyllus

Podocarpaceae
Podocarpus
nerifolius
nerifolius

Primulaceae
Ardisia
ecliptica; fuliginosa; pendula;
ecliptica; fuliginosa; pendula;

Primulaceae
Ardisia
ecliptica; fuliginosa; pendula;
ecliptica; fuliginosa; pendula;

Primulaceae
Ardisia
ecliptica; fuliginosa; pendula;
ecliptica; fuliginosa; pendula;

Primulaceae
Ardisia
ecliptica; fuliginosa; pendula;
ecliptica; fuliginosa; pendula;

Primulaceae
Ardisia
ecliptica; fuliginosa; pendula;
ecliptica; fuliginosa; pendula;

Primulaceae
Musa
ramuntchae
ramuntchae

Primulaceae
Rapanea
avenis; hasseltii
avenis; hasseltii

Primulaceae
Brabejum
stellatifolium
stellatifolium

Primulaceae
Brabejum
stellatifolium
stellatifolium

Putranjivaceae
Drypetes
longifolia
longifolia

Putranjivaceae
Carallia
brachiata
brachiata

Rhizophoraceae
Carallia
brachiata
brachiata

Rhizophoraceae
Carallia
brachiata
brachiata

Rosaceae
Phiotinia
integrifolia
integrifolia

Rosaceae
Prunus
arbores; stipulacea
arbores; stipulacea

Rosaceae
Sorbus
granulosa
granulosa

Rubiacceae
Cinchona
pubescens
pubescens

Rubiacceae
Coffea
canephora
canephora

Rubiacceae
Ixora
grandifolia; javanica; lanceolata
grandifolia; javanica; lanceolata

Rubiacceae
Musae
frondosa
frondosa

Rubiacceae
Mycketia
cauliflora
cauliflora

Rubiacceae
Neuhausia
cyrtopoda; superba
cyrtopoda; superba

Rubiacceae
Pavetta
montana
montana

Rubiacceae
Psychotria
angulata; micrantha
angulata; micrantha

Rubiacceae
Wendlandia
densiflora; glabrata; avarifolia;
densiflora; glabrata; avarifolia; trifoliolata
densiflora; glabrata; avarifolia; trifoliolata

caprifolium
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caprifolium
caprifolium

Rutaceae
Citrus
maxima
maxima

Rutaceae
Clausena
anisata; excavata; harmandiana
anisata; excavata; harmandiana

Rutaceae
Euodia
suaveolens
suaveolens

Rutaceae
Lunasia
amara
amara

Rutaceae
Melicope
glabra; macrophylla
glabra; macrophylla

Rutaceae
Micromelum
minutum
minutum

Rutaceae
Tetradium
daniellii
daniellii

Sapindaceae
Acer
larix
larix

Sapindaceae
Euphorianthus
euneurus
euneurus

Sapindaceae
Guaisa
diploptera
diploptera

Sapindaceae
Harpullia
arborea
arborea

Sapindaceae
Lepisanthes
cauliflora; rubiginosa
cauliflora; rubiginosa

Sapindaceae
Mischocarpus
pentapetalus
pentapetalus

Sapindaceae
Pterygota
alata
alata

Sapindaceae
Sapindus
rarak
rarak

Sapindaceae
Palaquium
obstasifolium
obstasifolium

Sapindaceae
Payena
lucida
lucida

Sapindaceae
Planchnonella
ducitan
ducitan

Sapindaceae
Pouteria
campechiana
campechiana

Smilacaceae
Smilax
zeylanica
zeylanica

Smilacaceae
Smilax
zeylanica
zeylanica

Staphyleaceae
Turpinia
formosana; montana; pomifera
formosana; montana; pomifera

Staphyleaceae
Turpinia
formosana; montana; pomifera
formosana; montana; pomifera

Staphyleaceae
Stemonurus
scorpioides
scorpioides

Staphyleaceae
Stemonurus
scorpioides
scorpioides
Based on the data displayed above, the shading trees of CBG were dominated by a large rounded or dome canopy, such as *Castanopsis javanica* (figure 2a). Previous studies [13] have verified that the thickness of the tree crown would decrease the air temperature under the tree between 2 and 4 °C. Trees and other vegetation altogether provide the tasteful esteem and a high-quality habitat for the wildlife species. The trees selection has to be a critical issue in order to form the impression of space that the tree canopies give a distinctive sort of shading. Moreover, large-size and evergreen trees can be intercepted up to 59.5% of precipitation [10, 14]. In general, evergreen trees contribute more to interception than deciduous trees [14]. Every 5% of a tree-shaded area that added to a community, the run-off is reduced by approximately 2% [10].

**Figure 2.** Morphological features of some trees: (a) *Castanopsis javanica* (*Photograph by Habibulloh*); (b) above the ground root of *Castanopsis javanica* (*Photograph by Nanang Suryana*) (c) *Araucaria cunninghamii* (*Photograph by Bahtiar*); (d) flower of *Magnolia montana* (*Photograph by Habibulloh*).

Furthermore, community trees and forests such as in CBG, have also played important roles as filters removing nutrients and sediments while increasing groundwater reload. Trees with the trait of taproots and wide range coverage are also supporting this function (figure 2b). In addition, 37,500 tons of sediment per square mile per year from creating and created landscapes–trees could decrease the value by 95% [10]. The tree roots displace significant quantities of water descending to dry soil layers when the surface of soil layers getting wet following the rain. The benefits of this modification to the
external environment include reduced water-logging in surface soils and increased moisture content in dry sub-soils. The latter is of some significance to the growth of deep roots through otherwise dry soil. Further benefits may include improved nutrient status due to increased uptake of water from surface layers and increased water availability for a number of weeks following rain [11].

CBG as an ex situ conservation area also conducts an eduro-tourism effort. The plants were planted by following the taxa-relationship between the surrounding plants and considering the proportion design of the comfortable view. Plant arrangement for increasing levels of tree density can propose feelings of unsecured, therefore an optimum number of trees permits for visual distances and receptiveness while blocking or screening of a constructed areas [10]. A proper placement a large tree in a space, such as Araucaria cunninghamii, can provide a visual comforts effect, directs the view and emphasizes the space rather than be screening the view (figure 2c). Conifers, large-size trees, low tree compactness, enclosed tree canopies, remote views and native species all had determinate values in defining the scenic quality of the space.

The next reason for selecting tree species in a space is based on its aesthetic value. A high value of scenic quality of plants can also generate from the flower. The unique flower will give a distinct impression to the viewers. Flowering trees are also providing visual comforts to the viewers, such as shape, size and colour of the flower of Magnolia spp. (figure 2d). In order to generate aesthetic preferences, large old trees were also the most important indicator of the attractiveness [10].

Although the advantages of the green space are intangible, however, the vegetation is of substantial value to providing the community with a social communal area. These study results were expected to be a scientific consideration for the policy maker (i.e. designer, community and the authorities) in planning tree planting and the selection to achieve the desired healthy environment. The consideration is also referring to density and maturity of the trees for optimizing green space and at the same time give the community an area for urban rejuvenation. This significance of trees should be emphasized by the sustainable community for generations.

4. Conclusions
The study successfully carried out inventory of Indonesian native montane trees based on the garden collection of CBG which has potentials to be developed as shade trees (102 species), 162 species for soil adsorption and 332 species as a focal point or aesthetical values. This study was expected as the initial reference in tree selection processes in order to restore the local mountain environment quality. For future study, these potentials need to be tested further to determine the effectiveness of species in the field and for science-based restoration efforts.

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