The development of Bogor Botanic Garden design from 1817 to 2017 base on spatial and functional

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Abstract: Bogor Botanic Garden (BBG) is one of the ex situ conservation areas with overall site approximately 87 ha. BBG is the oldest botanical garden in Southeast Asia and become an icon of the city of Bogor. From its inception in 1817 to its present age of 200 years, the botanical garden has evolved into an institution that combines diverse activities in science and horticulture with public education, as well as a rich heritage of historic buildings and monuments of living plants. The development of a botanical garden that presents new roles and functions led to a design change in the botanical garden. The objective of this study was to identify the development and function of The Bogor Botanic Garden. This research was conducted using descriptive methods consisting of historical reference search, compare, from initial map and current condition. The results of The Bogor Botanic Garden design established based on taxonomy patterns with the classic English garden concept. From the function of the botanical garden initially only serves as a garden where the collection of plants, then became the center of research, education, and now developed as a place for recreation and educational activities of nature observation.

Keywords: Bogor Botanic Garden, English garden, function, history, conservation

1. Introduction

The Botanical Garden is an ex situ plant conservation area that has a collection of documented and arranged plants based on the taxonomic, bioregion, thematic, or combination pattern of those patterns for conservation, research, education, tourism, and environmental services [1]. Currently, there are about 3,422 botanical gardens in 148 countries worldwide [2]. Most of the Botanical Gardens are in the urban area of about 60%. Botanic gardens in South-East Asia made a significant contribution during the discovery and dissemination of flowering and economic botany throughout the world from the mid-1800s to the mid-1900s became an important supplier of tropical trees, plants and orchids to Europe and North America. The Bogor Botanic Garden is one of significant Botanical Gardens, in Southeast Asia together with the Calcutta Botanic Gardens in India (1787), Peradeniya Botanic Gardens in Sri Lanka (1843), and Singapore Botanical Garden (1859).

Tropical botanic gardens remain important for their records of local floras. This work is the essential basis for all other studies of plants, whether scientific or technological. The gardens also remain important as collections of living plants for botanical study of all kinds and for local education. [2]. The
origins, history and functions of modern botanic gardens predate the European Renaissance and that they reflect the social, economic and environmental circumstances of their times [3]. As expansion proceeded, botanic gardens established in the colonial region were designed to function as imperial way stations for the acclimatization and exportation of economically desirable plants [4].

The planning and design of Bogor Botanic Gardens have changed over time to reflect changes in purpose, changes in science, and changes in the aesthetic expressions of human cultures over time. As such, the conservation botanic garden is one that evolved in response to the conservation desires and requirements of local cultures; contains or is associated with areas of natural vegetation within the context of local biotic zones; focuses exclusively on plants native to the region; and engages in public education [5]. From its inception in 1817 to its present age of 200 years, The Bogor Botanic Garden has evolved into an institution that combines diverse activities in science and horticulture with public education, as well as a rich heritage of historic buildings and monuments of living plants. The development of a botanical garden that presents new functions and roles led to a design change in the KRB that adopted the function. The objective of this study was to identify the development and function of The Bogor Botanic Garden.

2. Methods

2.1. Study area
The study area is located in Bogor Botanic Gardens, located in the center of Bogor City, West Java (Figure 1). Bogor Botanic Garden (BBG) has an area of 87 ha with a height of 260 m above sea level. BBG is a living plant museum with the most complete collection of tropical plants in the world, built with a beautiful landscaping concept. BBG location is very strategic because it is easy to reach from anywhere. Its location close to the highway can be easily accessed by visitors from outside the city of Bogor. Bogor Botanic Garden is the oldest botanical garden in Southeast Asia.

2.2. Method of the study
This research was conducted using descriptive method consisting of historical reference search, and compare from initial map origin of Bogor Botanic Gardens in 1826, 1892, 1927 and current condition, and field observation to explore space, functions, landscape elements and layout. Map selection based on the occurrence of additional areas.
3. Result and Discussion

3.1. History and Development of Bogor Botanic Garden

The History begun when the Kingdom of the Netherlands sent Cornelis Theodorus Elout, and G.A.G.P. Baron van der Capellen to Indonesia with Prof. Caspar George Carl Reinwardt was a Director of Agriculture, Arts, and Education for Java in 1816. On April 15, 1817 Reinwardt sparked the idea of establishing a botanical garden to Governor-General G.A.G.P. Baron van der Capellen, the idea was then approved. Finally, on May 18, 1817 formally established a Botanical Garden in Bogor City, under the name of 'Lands Plantentuin te Buitenzorg. After independence, 1949's Lands Plantentuin te Buitenzorg renamed Jawatan Penyelidikan Alam, then became the Lembaga Pusat Penyelidikan Alam (LLPA) for the first time managed and led by the Indonesian nation, Prof. Ir. Kusnoto Setyodiwiryo. At that time LPPA had 6 subsidiary institutions, namely Bibliotheca Bogoriensis, Hortus Botanicus Bogoriensis, Herbarium Bogoriensis, Treub Laboratory, Zoologicum Bogoriensis Museum and Marine Investigation Laboratory. In 1956 for the first time the leadership of the Botanical Garden was held by the Indonesian people, Sudjana Kassan [6].

Bogor Botanic Gardens which was originally only ±40 ha in the course of his life experienced several times the expansion, so now the extent has reached ±78 ha (Figure 2). The addition of the BBG area occurred in 1892 and 1927. This expansion was important because of the increased of research and expedition in botany, more area was needed. Then gradually established branches of botanical gardens in various regions, such as Cibodas Botanical Gardens in West Java (1862). Purwodadi Botanical Gardens in East Java (1941) and Eka Karya Botanical Gardens in Candi kuning/Bali (1959). The Bogor Botanic Gardens and their branches form a separate unit, also known as Kebun Raya Indonesia.

Map of Bogor City

Figure1. Map of detailed study area
3.2. Role and Function Bogor Botanic Garden

Establishment of the Bogor Botanic Garden was originally based on two main roles that are plan collections and research activities of cultivating various types of native plants of Indonesia and to help provide educational facilities. It turns out that in the further development of the function of the Botanical Gardens is increasingly widespread, among others by the introduction of economic crops (rubber, quinine, coffee, vanilla, palm oil etc.) from various other tropical countries, and the expansion of the scope of activities that ultimately cover the overall resources biology (microorganisms of plants and animals) and their environment [7].

There is a change / development of organizational structure. Various centers / research institutes were built, although then one by one eventually escape from its parent (Botanical Gardens). Therefore, it is not surprising that the Botanical Gardens are still recognized as the parent who gave birth to almost all research institutions in the field of biology and agriculture in Indonesia. Currently Botanical Gardens have 5 main functions, that is:

1. Organize exploration / collection of living plants that have or are expected to have economic potential and / or are considered important in terms of the science of botany.
2. Conducting research in various fields of botany, such as morphology, genetics, physiology and ecology.
3. Plants introduction to support the development of agriculture in general.
4. Provide assistance in the form of guidance, facilities and plant material for educational purposes.
5. Provide a healthy recreation place for public, as well as stimulate the growing awareness and understanding of the meaning and role of natural resources, especially vegetation resources (flora).

BBG plays a role in the conservation of plants in Indonesia by working with the local government to build a regional botanic garden. Until 2015, there are 27 Botanic Gardens in Indonesia consisting of 5 Botanic Gardens managed by LIPI, and 22 Botanical Gardens managed by the Regional Government. In addition to conserving plants, the Botanical Gardens also play a role in reducing carbon emissions [8]. Existence of the Bogor Botanic Garden support the growth of Bogor City, because many institute were founded as development of BBG [9].

Figure 2. Maps of development of Lands Plantentuin te Buitenzorg (Bogor Botanic Garden) (source: http://media-kitlv.nl)
3.3. Plant Collections
KRB collection is the result of field expedition and donations from various countries. It increases the number of collections. Otherwise the deaths of various causes reduce the collection count. Based on the latest record number of Botanical Garden in 2016 reached 13,061 specimen representing 3,301 species, 1,227 genera or 218 tribes outside the orchid co-ordinates. The orchid collection itself recorded 6,169 specimen 572 species of 106 genera. In addition to orchids, a collection that also stands out is legumes (Leguminosae), Pinang-pinangan (Palmae), Talas-Talasan (Araceae) and Coffee-copies (Rubiaceae). In addition, the collection of various types of bamboo is also interesting to see considering its very important role, especially in the countryside. Changes in the number of collection plants in KRB can be seen in Figure 3. BBG has thematic gardens that focus on specific types of plant collections, such as the Mexican Garden, Teisman Garden, Medical Plants Garden, Water Garden, Soedjana Kassan Garden, and Araceae Garden.

![Figure 3. Plants collection of Bogor Botanic Garden](source: http://www.krbogor.lipi.go.id/id/Jumlah-Koleksi-Kebun-Raya-Bogor.html)

3.4. Design of Bogor Botanic Garden
According to the history at the earlier 1816 Caspar George Carl Reinwardt began research in the field of plant science and interested in investigating the various plants which used for treatment and considered the exploration of plants and agricultural problems as well as his duties in the Dutch East Indies. The collections of all those plants were located in a garden around the courtyard of the Bogor Palace (previously occupied by Lieutenant-Governor Thomas Stamford Raffles). Through the help of the Dutch gardener William Kent (1779-1827), the courtyard of the Bogor Palace developed into a beautiful garden with a classic English garden. This is then recognized as the beginning of the original design of The Bogor Botanic Garden. KRB is a colonial botanic gardens. Menurut Rutherford (2015), the main colonial botanic gardens were generally near towns and cities. They had complex ornamental landscapes like public parks, while containing botanical plant collections and systematic display beds, and became valued public gardens [10].

During the leadership of Teysmann (1830), the plant collections were established based on taxonomy patterns. The plants are arranged in large natural groups according of the same family (Figure 4). The most famous are the Canaries avenues (planted in 1832 and 1896), the trees are covered with climbing plants, orchid collection, the palm and rattans, pandanus, cactus collection and vines that are currently the emerging characters. The ponds with their water lilies, amongst which the splendid Victoria amazonica, belong to beautiful scenery. Identity of a botanical garden depends not only on its academic
association, but also on its function, which is revealed among other things through its structure and the arrangement of its content.

Rare and unique plants are things that make visitors come to the botanical garden. Research on visitor preferences to features and points of interest in Bogor Botanical Gardens has been done by Hadi et al. that there were 45.91% photos consist of plants as focused objects. The plants that mostly captured on those places are: 1) Orchid flowers in Orchid Interior garden, 2) Canna flowers as median of Astrid Avenue, and 3) Cactus, Agave, Yucca, Bromelia, Euphorbia and drought resistant plants in Mexican Garden and. These plants were arranged well with other materials and landscape elements in a good design [11].

![Figure 4. Layout of Bogor Botanic Garden based on plant taxonomy](source: Subdivision Registration-BBG, 2010)

4. Conclusion
The history of the botanical garden is closely related to the history of botany itself. The botanical garden is an example of the influence of science on the garden art. The design changes of the botanical garden are in line with the change in function. At the beginning of the establishment, the aim of the Botanic gardens is to collect and make easily accessible within its ground plans of the Malay Archipelago and other tropical areas. The design of the garden is simple; there is no arrangement in planting the collection. With its development, the function of the garden increased as a place of research and education, so began to be applied systematic arrangement of plants based on taxonomy, this is followed by the increase of garden area to the north and south of the Bogor Palace. Supporting facilities such as laboratories and herbaria began to be built well. Currently the botanical garden also serves as a place of recreation, and then the space needs and design of the botanical garden changed as the lawn for picnics and garden site furniture.

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