BOTANIC GARDEN PROFILE: BOGOR BOTANIC GARDENS

Siti Roosita Ariati[1] *& Didik Widyatmoko*[2]

ABSTRACT

Bogor Botanic Gardens (BBG) was established in 1817 and is the oldest botanic garden in South East Asia. The garden has long been a centre for scientific research and has been the founding institution of a number of other research centres in Indonesia, particularly in the life sciences. The garden initially covered 47 ha but has expanded over the years and is now 87 ha. It has evolved over its 200-year history from a collection of economically valuable plants to the multi-faceted institute it is today, undertaking activities in plant conservation, research, education, ecotourism and environmental services. In recent years, it has strengthened its role in plant conservation through the establishment of 32 new botanic gardens across Indonesia. These new gardens are managed by local government and universities and supervised by BBG. In its bicentenary year, 2017, BBG organised a number of activities, programmes and celebrations and these are highlighted in this article.

HISTORY

After the East Indies were handed over to the Dutch Kingdom in 1815, King Willem I ordered C.T. Elout, A.A. Buskens and G.A.G.P. Baron van der Capellen to travel from Holland to Batavia (Jakarta) to take over the government from the British administration. Dr C.G.C. Reinwardt, a German botany and chemistry expert, was part of the official delegation (Went & Went, 1945; Rijnberg, 1992; Soegiarto, 1992). On 15 April 1817, Reinwardt proposed the construction of a botanic garden to the General Commission. This was agreed, and on 18 May 1817 the first stone was laid to mark the beginning of the 'sLands Plantentuin te Buitenzorg, covering an area of 47 ha. Reinwardt was the first Director and remained in post until 1822. He was a very enthusiastic collector of plants from all over Indonesia and, as a result, the garden became an important centre for agriculture and horticulture. In 1822, Reinwardt returned to the Netherlands and a new Director, Dr Carl Ludwig Blume, was appointed. In 1823, Blume undertook an inventory of the plants growing in the garden and published the first catalogue, consisting of 912 plant species. He returned to Holland in 1826 due to ill health, and from 1826 to 1830 the garden was managed by a Curator, J. Hooper. With the advent of war in Europe the garden faced financial pressures and to save money the post of Director was discontinued. The garden was subsequently under the supervision of army officers of the Governor-General's Palace (Went & Went, 1945). In 1831, Johannes Elias Teijsmann

1. Siti Roosita Ariati is a Senior Researcher at Bogor Botanic Gardens (Center for Plant Conservation – Botanic Gardens, Indonesian Institute of Sciences).
Address: Jl. Ir. H. Juanda No. 13 Bogor 16003, Indonesia.
Email: sita_ariati@hotmail.com
2. Didik Widyatmoko is the Director of Bogor Botanic Gardens.

was appointed Curator, a role he held until 1868. Under his management, a great number of plant species were introduced from his expeditions all over the world. With the assistance of Dr J.K. Hasskarl, he rearranged the layout of the garden by grouping collections according to family. He introduced many exotic species, some of which have become economically important, such as *Elaeis guineensis* (oil palm) from West Africa, *Manihot utilissima* (cassava) and *Chinchona calisaya* (quinine). Hasskarl published the second catalogue of plants growing in the garden in 1844, this one comprising over 2,800 plant species – an enormous increase in species cultivated in the 20 years since the previous catalogue. During this period, the garden was extended to include land in Cibodas, a location on the slope of Mount Gede Pangrango, approximately 50 km south-east of Bogor. This land would act as an experimental centre to grow plants adapted to cool climates and mountain conditions. Cibodas Botanic Gardens was formally established on 11 April 1852 and, in addition to being a field laboratory, it also became important for its role in research on economic plants. In 1880, Dr Melchior Treub was appointed Director. During his tenure he set up the famous 'foreigner/visitor laboratory', known as the Treub Laboratory, in which studies in many fields have been conducted: botany, physiology, chemistry, microbiology and even zoology (Went & Went, 1945; Rijnberg, 1992; Soegiarto, 1992; Mahmud *et al.*, 1996).

Bogor Botanic Gardens (BBG) has been the foundation for many other significant Indonesian institutions, including Herbarium Bogoriense (BO), Museum Zoologicum Bogoriense, Bibliotheca Bogoriense, Department of Agriculture, Department of Forestry and three other botanic gardens: Cibodas, Purwodadi (East Java) and Eka Karya Bali (Soegiarto, 1992; Mahmud *et al.*, 1996).

Today BBG is under the management of the Center for Plant Conservation, Indonesian Institute of Sciences (LIPI). A chronology of important events in its history is listed in Table 1 of the Appendix and a full list of the Directors of the Institute in Table 2.

MISSION

In 2011, under Indonesian Presidential Decree No. 93 on Botanic Gardens, BBG legalised its five main functions: plant conservation, research, education, ecotourism and environmental services.

By the end of December 2017, the garden cultivated 12,746 living plants, comprising 219 families, 1,229 genera and 3,276 species. In addition, the orchid collection consisted of approximately 9,600 specimens belonging to 106 genera and 589 species. All collections have been documented following *Protocols and Mechanisms for Collection Registration* (Widyatmoko, 1998), modified from *Organization and Book Keeping of the Botanic Gardens* (Dakkus, 1930). The plant database used at BBG has evolved from dbaseIII to a modified BG-Recorder using MS Access which was developed by Botanic Gardens Conservation International (BGCI) in the 1990s, then to the current web-based database SIGit (Information System for Collection Registration). This latest database is an integrated data collection and specimen mapping system using Geographic

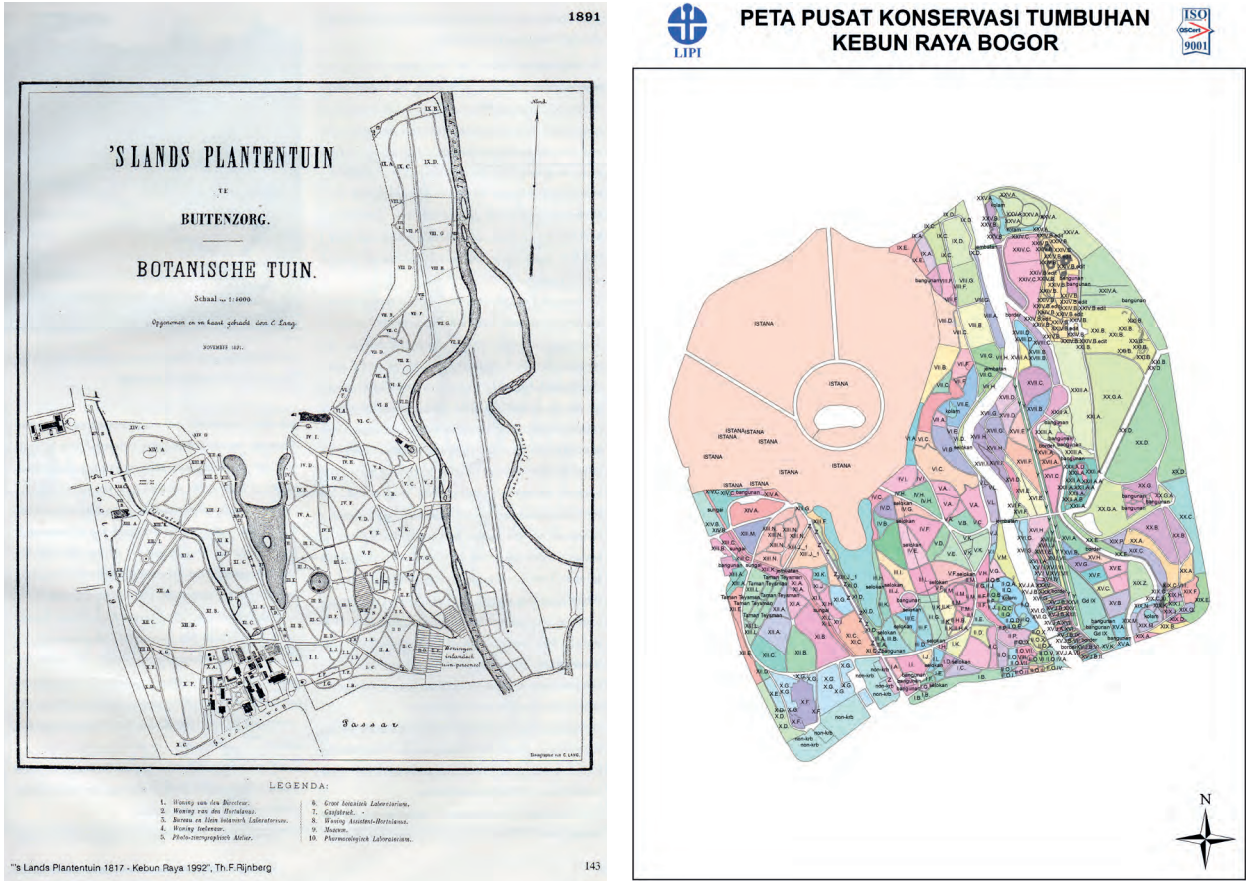

Fig. 1 Maps of BBG: (left) an 1891 map: BBG had an area of approximately 60 ha (Smith, 1892); (right) current map of BBG, now with an area of 87 ha (map produced by Ade Yusup Yuswandi).

Fig. 2 Main gate of BBG, with the original gateposts. Photo: S.R. Ariati.

Information Systems (GIS) and can be developed to monitor plant collection dynamics and support self-guidance/interpretation services for visitors.

BBG plays a strategic role as the National Focal Point for the implementation of the Global Strategy for Plant Conservation (GSPC) in Indonesia and is the founder and coordinator of the development of new regional botanic gardens across Indonesia. As the National Focal Point for the GSPC, BBG acts as facilitator to oversee measures to meet the 16 targets of the GSPC in Indonesia. One priority target for BBG is target 8: 'At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes'. This is a very ambitious target to be achieved in 2020 for such a megadiverse country as Indonesia.

BBG is the founder of the new regional botanic gardens, and as such it contributes to planning the gardens and to their scientific development. Today, there are 32 new botanic gardens managed by local governments and universities. Ten of these have been launched and are open to the public. Others are currently in the initiation and development stages. In total there will be at least 47 regional botanic gardens representing all ecoregions of Indonesia. With increasing rates of deforestation and habitat conversion, botanic gardens are one of the last bastions of plant diversity conservation in Indonesia, in particular for *ex situ* conservation of individual threatened plant species. At present BBG cultivates approximately 20 per cent of Indonesian threatened plant species. With the development of the new regional botanic gardens, a total of

28 per cent of the known threatened flora is now being conserved and it is hoped that this will increase. In addition, BBG has conducted a reintroduction programme for Indonesian threatened species, with a total of ten species in three National Parks: Halimun Salak NP, Ujung Kulon NP and Bukit Duabelas NP. Other programmes to support this target include developing and strengthening the seed bank maintained at the botanic gardens.

LOCATION AND CLIMATE

BBG is located in the city of Bogor at 6°35′32.69″–6°36′13.39″S and 106°47′39.80″–106°48′17.56″E, 60 km south of Jakarta, the capital city of Indonesia. It is situated in the centre of the city, adjacent to the Bogor Presidential Palace, and is surrounded by the central business area and residential properties. It represents the only remaining green and open space in the city and has a landscape that is mostly flat with some minor undulating areas. The Ciliwung River, which originates from Mount Gede Pangrango and flows to Jakarta, bisects the garden, and there are two large and several smaller ponds. Its climate is tropical, with average annual precipitation of 4,000 to 5,000 mm. The wettest months are December and January; however, in the dry season, heavy rains can also sometimes occur. The temperature ranges from 20°C to 33°C, with an average temperature of 24°C.

GARDEN FEATURES

BBG has two main gates for visitors and an additional gate for staff use only. Within the garden, there are several historic buildings and sites such as the Treub Laboratory, the Director's House (now used as a guest house), the Lady Raffles Memorial and the Dutch Cemetery (Fig. 3).

Some interesting places for visitors include the following:

Lady Raffles Memorial

This was built by Sir Thomas Stamford Raffles to commemorate his wife, Lady Olivia Mariamne, who died of malaria on 26 November 1814. Raffles wrote a poem to his wife which is engraved on the monument (Fig. 4):

> *Oh thou whom neer my constant heart, One moment hath forgot / Tho fate severe hath bid us part / Yet still – forget me not.*

Scissor-shaped Pond

This is located near Canarium Avenue (Fig. 5) and gives a view of the Bogor Presidential Palace. It has a small island in the middle which is an important habitat for *Nycticorax*

Fig. 3 Map of BBG showing some points of interest. Map produced by Tatang Rohana.

nycticorax (migrant heron) and other animals. The pond has been recently renovated and enriched with aquatic plants for educational use (Fig. 6).

Reinwardt Monument

This was presented by the German Embassy to Indonesia on 16 May 2006 to commemorate and honour Dr C.G.C. Reinwardt as the founder of BBG. The monument is located in a straight line from the main gate and near the end of Scissor-shaped Pond, and the Presidential Palace can be seen in the background. It is very picturesque and has become a favourite spot for taking photographs (Fig. 7).

Fig. 4 The Lady Raffles Memorial. Photo: S.R. Ariati.

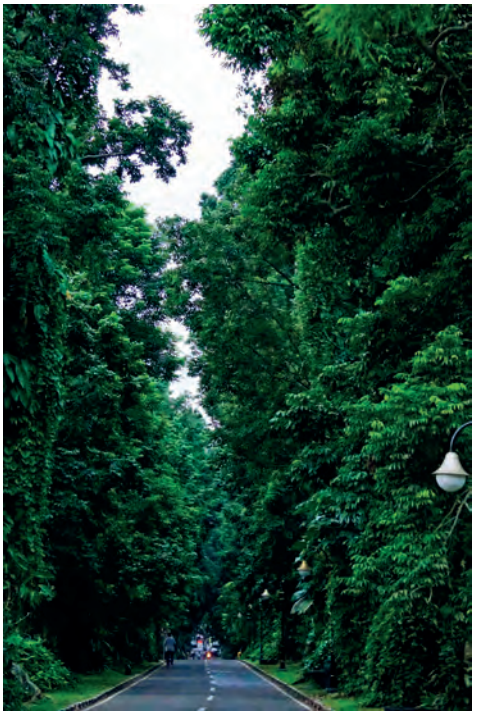

Fig. 5 Canarium Avenue, planted in the early 1900s. Photo: S.R. Ariati.

Fig. 6 Scissor-shaped Pond with a new feature allowing children to touch aquatic plants and learn more about them. Photo: S.R. Ariati.

Fig. 7 The Reinwardt Monument with the Bogor Presidential Palace in the background. Photo: S.R. Ariati.

Teijsmann Garden

This is named after J.E. Teijsmann, the distinguished Curator between 1830 and 1868, who managed the garden with passion and enthusiasm. This garden was set out in 1884 by Dr Melchior Treub and is arranged in the formal European style with a granite monument at its centre shipped from Germany (Fig. 8).

BICENTENARY CELEBRATIONS

A wide range of activities took place to celebrate the bicentenary of BBG. The theme was 'Plants and People in Harmony', chosen to emphasise the use of plants to support human life. The main ceremony took place on 18 May 2018. It was attended by around a thousand guests, including the former President Mdm Megawati Sukarnoputri, along with high-ranking Indonesian government officials such as Mr Teten Masduki (a State Palace representative), Dr Bima Arya (Bogor city mayor) and Mr Rudiantara (Minister of Communications and Information). Other distinguished guests included the honourable ambassadors of the Netherlands and Germany (Fig. 9).

A calendar of events and activities throughout the bicentenary included sports competitions, scientific meetings and exhibitions. Some new landmarks, both permanent and temporary, were also installed including the Bicentenary Monument and the Ecodome. A special set of commemorative stamps was issued.

Fig. 8 The Teijsmann Garden, a formal European garden named in honour of J.E. Teijsmann and his long-standing curatorship of BBG. Photo: S.R. Ariati.

Fig. 9 The bicentenary celebration ceremony was attended by a number of high-ranking people, including Megawati Sukarnoputri, former President of Indonesia. Photo: M. Djohari.

Scientific meetings

Three scientific meetings (one national and two international) were conducted in conjunction with the bicentenary celebrations:

(1) The Management of Water Resources in Botanic Gardens, a seminar hosted by BBG on 9 May 2017.
(2) Tropical Plant Conservation and Utilisation, an international conference hosted by BBG on 18 May 2017. The conference had nine invited speakers, seven from botanic gardens in Europe, Asia and Australia, and was attended by over 200 people. Discussions took place on the roles of botanic gardens in science and conservation, and the domestication and use of plants.
(3) Bioeconomics and the Utilisation of Natural Resources, an international symposium held on 12–14 October 2017. The symposium had 20 speakers from Taiwan, the UK and Indonesia. More than 150 people representing government institutions, industry and universities attended 76 presentations. The symposium shared information on the potential use of Indonesian bioresources for scientific research and public stakeholders in the areas of food, health, energy and the environment.

Bicentenary Monument

This monument was built to commemorate the 200th anniversary of the founding of BBG. The circular head represents the flower of *Rafflesia patma*, which has been successfully cultivated in BBG for ten years. It has a diameter of 200 cm and contains 200 dots, each representing one year of BBG's existence. The shaft represents the vine genus *Tetrastigma* (Vitaceae), *Rafflesia*'s host plant (Fig. 10). The monument was officially opened on 18 May 2017 and its inscription signed on 11 March 2018 by the President of Indonesia, Joko Widodo.

Ecodome

The travelling Ecodome in BBG was a symbol of the collaboration between BBG and Erasmus Huis, the Dutch Embassy in Indonesia. The Ecodome was displayed in BBG

Fig. 10 The Bicentenary Monument resembles the flower of *Rafflesia patma* and the host plant *Tetrastigma* sp. Photo: S.R. Ariati.

for a year after being on display in Amsterdam (The Netherlands) and Philadelphia (USA). While at BBG it was host to a wide range of education programmes and classes, exhibitions, art performances and workshops (Fig. 11).

Commemorative stamps

To mark the bicentenary, PT Pos Indonesia (the Indonesian postal service), in collaboration with BBG, issued a set of 34 stamps featuring beautiful illustrations of orchids growing in BBG, representing the diversity of orchids found in the 34 provinces of Indonesia (Fig. 12). These stamps complemented a previous set issued in 2004 to mark *Negara Kesatuan RI dalam Puspa* (the Unitary State of Floral Diversity).

EX SITU CONSERVATION OF *RAFFLESIA PATMA*

Rafflesia is a unique genus of parasitic flowering plants, known as a 'holoparasite'. It infects and grows on the vine genus *Tetrastigma* (Vitaceae), getting all of its nutritional needs from the vine. *Rafflesia* is only found in South East Asia (Thailand, Malaysia, Indonesia and Philippines) and of the approximately 29 species, 12 occur in Indonesia (Mursidawati & Irawati, 2017). The rarity of *Rafflesia* is probably due to the uniqueness of its life cycle but studies to understand its biology and host associations, including the micro-environment, are still very limited. Many *Rafflesia* can only be seen *in situ* or in

Fig. 11 The Ecodome, a new venue for education programmes. Photo: S.R. Ariati.

Fig. 12 The 34 stamps with orchid illustrations representing the 34 provinces of Indonesia.

gardens local to their natural habitat, such as Vivian's Rafflesia Garden, Borneo (Molina *et al*., 2017). Since 2004, BBG research staff have initiated the *ex situ* cultivation of the plant in BBG and undertaken a series of grafting trials. In 2009, the first flower bud was observed; this was followed by a number of other buds, but only a few flowered. In the twelve years since the first attempt to cultivate *Rafflesia patma*, it has bloomed ten times at BBG but only produced two male flowers (Mursidawati & Irawati, 2017). This continues to be a challenge and further research is required to investigate whether this *ex situ* population of *Rafflesia* will be viable in the future.

BENEFICIAL EFFECTS OF THE BICENTENARY CELEBRATIONS

The bicentenary celebrations started in May 2016 to help promote the garden and make the most of the bicentennial year. During 2017, the garden was visited by approximately 1.15 million visitors, a significant increase of 23 per cent from the 935,000 of the previous year. A number of high-level state events and activities also took place. The President of Indonesia hosted several VIP guests, including former US President Barack Obama. The spirit and energy of the bicentenary celebrations had the effect of encouraging garden staff to work harder and with a greater sense of teamwork to improve the quality of our public services and collections. It was a great experience for all involved in the huge and complex task of organising the wide range of activities for the celebrations.

Fig. 13 The *Rafflesia patma* flower at BBG. Photo: S.R. Ariati.

ACKNOWLEDGEMENTS

We would like to thank all staff of BBG who have worked so hard for the bicentenary celebrations. Our gratitude also goes to individuals and companies who have contributed to the celebrations and to the electronic media, TV, radio and newspapers that have provided extensive coverage (live and printed) of the events.

The authors thank Peter Wilkie and Kate Hughes at Royal Botanic Garden Edinburgh for their assistance and suggestions on the content of this article. We also thank Izu Andry Fijridiyanto for assistance with finding the Smith (1892) publication with the original map in it.

REFERENCES

DAKKUS, P.W.M. (1930). An alphabetical list of plants cultivated in the Botanic Gardens. Archipel Drukkerij-Buitenzorg, Buitenzorg.

HASSKARL, J.K. (1844). *Catalogus Plantarum in Horto Botanico Bogoriensi Cultarum Alter*. Landsdruikerij, Batavia, p. 253.

MAHMUD, Z., SITEPU, D., KADARSAN, S., KARMAWATI, E. & HOBIR (eds) (1996). *Sejarah Penelitian Pertanian di Indonesia [History of Agricultural Research in Indonesia]*. Badan Litbang Pertanian, Jakarta.

MOLINA, J., MCLAUGHLIN, W., WALLICK, K., PEDALES, R., MARIUS, V.M., TANDANG, D.N., DAMATAC II, A., STUHR, N., PELL, S.K., LIM, T.M. & NOVY, A. (2017). Ex situ propagation of Philippine *Rafflesia* in the United States: Challenges and prospects. *Sibbaldia*, 15: 77–96.

MURSIDAWATI, S. & IRAWATI (2017). *Biologi Konservasi Rafflesia [Conservation Biology of Rafflesia]*. LIPI Press, Jakarta.

RIJNBERG, T.F. (1992). *'sLands Plantentuin, Buitenzorg 1817–1992*. Kebun Raya Indonesia, Enschede.

SMITH, J.J. (1892). *List der Families en Geslachten van Niet-Kruidachtige Gewassen uit den Botanischen Tuin te Buitenzorg*. Landsdrukkerij, Batavia.

SOEGIARTO, K.A. (1992). Sejarah Kebun Raya Bogor dalam Rangka Menyambut Ulang Tahunnya ke-175 [History of Bogor Botanic Gardens in Celebrating its 175th Anniversary]. *Warta Kebun Raya* 1(2): 1–12.

SUKARYA, D.G. & WITONO, J.R. (2017). *Kebun Raya Bogor. Two Centuries of Sowing the Earth's Plant Diversity in Indonesia.* P.T. Sukarya & Sukarya Pandetama, Jakarta.

WENT, F.A.F.C. & WENT, F.W. (1945). A short history of general botany in the Netherlands Indies. In: HONIG, P. & VERDOORN, F. (eds) *Science and Scientists in the Netherlands Indies*. Board for the Netherlands Indies, Surinam and Curacao, New York.

WIDYATMOKO, D. (1998). *Protokol dan Mekanisme Kerja Registrasi: Pedoman Pendataan Koleksi Kebun Raya [Protocol and Mechanism of Collection Registration: Guidelines for Collection Documentation in Botanic Gardens].* UPT Balai Pengembangan Kebun Raya–LIPI, Bogor.

APPENDIX

Year	Milestone
1815	Special Commission established which included Dr C.G.C. Reinwardt
1817	Dr C.G.C. Reinwardt proposes the construction of 'sLands Plantentuin and is appointed its first Director
1822	Dr C.L. Blume appointed Director
1823	First plant catalogue, *Catalogus van eenige der merkwaardigste zoo in- al suit-heemsche gew assen, te vinden in 's Lands Plantentuin te Buitenzorg* published, in which 921 specimens are listed
1826	J. Hooper appointed Curator
1831	J.E. Teijsmann appointed Curator
1837	Botanist Dr J. Hasskarl appointed Assistant Curator to help Teijsmann. He rearranges the plant collections according to taxonomy
1842	Bibliotheca Bogoriense established
1844	Herbarium Bogoriense established Second catalogue published by J.K. Hasskarl
1848	Introduction of oil palm from West Africa. Plantations become widespread, with high economic value
1850	S. Binnedijk appointed Curator to help Teijsmann
1851	J.E. Teijsmann successfully carries out artificial pollination on vanilla
1852	Quinine tree planted on 11 April at Cibodas to commemorate the establishment of Cibodas Botanic Gardens
1854	Binnedijk and Teijsmann publish the third catalogue
1863	Gardens extended to cover 48 ha
1868	R.H.C.C. Scheffer appointed Director
1876	First journal, *Annales du Jardin Botanique de Buitenzorg*, published
1880	Melchior Treub appointed Director
1884	Treub sets up the 'foreigner/visitor' laboratory, known as the Treub Laboratory
1892	Gardens extended to cover 60 ha
1894	Dr J.C. Koningsberger opens a small laboratory, Landbouw Zoologisch Laboratorium, in order to study insect pests on plants. This laboratory developed into what is now known as the Museum Zoologicum Bogoriense
1927	Gardens extended to cover 87 ha as they are today
1941	Establishment of Hortus Botanicus Purwodadi, East Java by Baas Becking
1943	Japan invades Indonesia Prof. Takenoshi Nakai takes over as Director
1945	Independence Day Baas Becking takes over as Director

Table 1 Milestones at BBG.

Year	Milestone
1950	'sLand Plantentuin becomes Djawatan Penyelidikan Alam (Bureau for Nature Research) and is renamed Lembaga Pusat Penyelidikan Alam (LPPA – National Institute for Nature Research). The first Director is Prof. Ir Kusnoto Setyodiwiryo. BBG becomes part of this institution
1956	Sudjana Kassan appointed the first Indonesian Director
1959	Eka Karya Bali Botanic Gardens opened in Bedugul Bali
1962	LPPA becomes Lembaga Biologi Nasional (National Institute for Biology), under the management of Majelis Ilmu Pengetahuan Indonesia (MIPI – Indonesian Council of Sciences)
1967	MIPI changed to Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences). BBG becomes part of this institution
1987	New herbarium building for Hortus Botanicus Bogoriense Herbarium (HBBO)
1992	New programme for flora expedition called Ekspedisi Flora Nusantara (Flora Expedition throughout Indonesian Archipelago)
1999	Initiative to develop new botanic gardens begins across Indonesia
2001	Extension of the orchid nursery, Griya Anggrek (Orchid House)
2002	The Ecopark is initiated in the Cibinong Science Centre
2006	Reinwardt Monument constructed on the 189th anniversary of his appointment
2011	Presidential Decree No. 93 issued to permit the development of new botanic gardens in Indonesia
2014–	Revitalisation and new arrangement of facilities and gardens in BBG

Table 1 (*continued*)

Period	Name
1817–1822	Caspar Georg Carl Reinwardt
1822–1826	Carl Ludwig Blume
1826–1867	No Director was appointed. Johannes Elias Teijsmann (1831–1869) was appointed Intendant/Curator
1868–1880	R.H.C.C. Scheffer
1880–1910	Melchior Treub
1910–1918	J.C. Koningsberger
1918–1932	W.M. Docters van Leeuwen
1932–1939	K.W. Dammerman
1939–1940	L.G.M. Baas Becking
1940–1941	T.H. van den Honert, temporarily in charge while Baas Becking was in the Netherlands
1941–1944	D.F. van Slooten
1944–1946	Takenoshin Nakai
1946–1948	L.G.M. Baas Becking
1948–1949	D.F. van Slooten
1949–1959	Kusnoto Setyodiwiryo
1959–1969	Soedjana Kassan
1969–1981	Didin Sastrapradja
1981–1983	Made Sri Prana
1983–1987	Usep Sutisna
1987–1990	Sampurno Kadarsan
1990–1997	Suhirman
1997–2002	Dedy Darnaedy
2002–2008	Irawati
2008–2013	Mustaid Siregar
2013–	Didik Widyatmoko

Table 2 List of the BBG Directors (Went & Went, 1945; Rijnberg, 1992; Soegiarto, 1992; Mahmud *et al*., 1996; Sukarya & Witono, 2017).