

PAPER • OPEN ACCESS

The Role of Seed Banking Technology in The Management of Biodiversity in Indonesia

To cite this article: D Latifah *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **298** 012006

View the [article online](#) for updates and enhancements.

You may also like

- [Tree slenderness coefficient at Bali Botanic Garden](#)
S F Hanum, I D P Darma, M B Atmaja et al.
- [A safety factor of old trees *Pterocarpus indicus* Willd. in Bogor Botanic Gardens](#)
H Helmanto, F Damayanti and A N Rachmadiyanto
- [Mapping the Dynamics of Dead Trees Collection to Support Sustainable Landscape Management at Bogor Botanic Gardens](#)
D Setyanti, Nurhayati and D O Pribadi



The Electrochemical Society
Advancing solid state & electrochemical science & technology

243rd Meeting with SOFC-XVIII

Boston, MA • May 28 – June 2, 2023

Early registration discounts end **April 24!**

Accelerate scientific discovery!

Learn More & Register



The Role of Seed Banking Technology in The Management of Biodiversity in Indonesia

D Latifah^{1*}, D Widyatmoko¹, S U Rakhmawati¹, M Zuhri², K Hardwick³, A S Darmayanti⁴ and P K Wardhani⁵

¹ Center for Plant Conservation Botanic Gardens - LIPI, Jl. Ir.H. Juanda 13 Bogor

² Cibodas Botanic Gardens – LIPI, Cianjur

³ Royal Botanic Gardens Kew UK

⁴ Purwodadi Botanic Gardens – LIPI, Pasuruan

⁵ Eka Karya Bali Botanic Gardens – LIPI, Bali

*Corresponding Email: dian.latifah@gmail.com

Abstract. Indonesian biodiversity including the rich flora is facing various threats, including deforestation, habitat degradation, fire, natural disasters and climate change. Many ex situ conservation strategies have been implemented in response to this problem, including the development of new local botanic gardens in each province throughout Indonesia. The purpose of this paper is to reveal the important role of seed banks in forming part of the botanic gardens' collections management strategies –they now play an increasingly important role in saving the Indonesian flora from extinction. This study was conducted by undertaking a literature review and analysis of secondary data on the four largest botanic gardens of Indonesia. Currently there are 33 botanic gardens in Indonesia consisting of five national botanic gardens under Lembaga Ilmu Pengetahuan Indonesia (LIPI/Indonesian Institute of Sciences), two botanic gardens under universities and 26 botanic gardens managed by Local Governments. Among the five national botanic gardens, four manage seed banks: the Seed Bank of the Center for Plant Conservation Botanic Gardens/Bogor Botanic Gardens banks 749 accessions covering 460 species, 305 genera and 114 families; Cibodas Botanic Garden Seed Bank has 61 accessions covering 57 species, 57 genera, 40 families; Purwodadi Botanic Garden Seed Bank has 413 accessions covering 207 species, 134 genera and 46 families; and Eka Karya Bali Botanic Garden Seed Bank maintains 132 accessions covering 89 species, 43 genera and 21 families. The Indonesian Botanic Garden Seed Banks thus hold 1,355 accessions in total, covering less than 1% of total Indonesian plant diversity. In order to increase this coverage, Indonesian seed banking capacity needs to be increased, through the technical development of existing seed banks and the engagement of local botanic gardens throughout Indonesia to establish mini seed banks using the community seed bank approach.

1. Introduction

Bogor Botanic Gardens was established in 1817 by C.G.C. Reinwardt and is one of the oldest gardens in South East Asia. There are many architectural buildings that were built in colonial times and today collection management still follows the Dutch rules, with the plant collections grouped according to family. This historic legacy means that Bogor is considered to be a Heritage Botanic Garden, and is



currently in the process of applying to the UNESCO World Heritage Centre to become as a World Heritage Site (WHS).

Based on a Presidential Decree of the Republic Indonesia Number 93 year 2011 Chapter IV: Providing guidance and supervisory, Article: 19, Bogor Botanic Gardens is mandated to support the development of local botanic gardens throughout Indonesia. These botanic gardens will be managed by local governments and universities. Currently, there are 33 botanic gardens in Indonesia: five of them are managed by Indonesian Institute of Sciences (LIPI) and have been established for a many years; two botanic gardens are managed by universities and 26 are managed by local governments.

Indonesian biodiversity is facing numerous threats, including deforestation, habitat degradation, fire, natural disasters, as well as climate change. There is now international consensus that ex situ plant conservation by botanic gardens is an important response to these threats, complementing in situ conservation strategies. Botanic Gardens have many ways of fulfilling their role as ex situ conservation centers, one of which is seed banking. Seed banks provide an important resource for research and are vital for achieving Target 8 of the Global Strategy for Plant Conservation (GSPC) 2011-2020, which aims for at least 75% of endangered species to be held in ex situ conservation. These factors led to the development of seed banks by all botanic gardens under LIPI management.

The aim of this study was to review the seed bank technology used in the botanic gardens in Indonesia, and compare the biodiversity conserved in seed banks with that conserved in living collections.

2. Methods

This study was based on a literature review and secondary data on the four major botanic gardens under LIPI management, (Bogor, Cibodas, Purwodadi and Eka Karya Bali Botanic Gardens) as well as the botanic gardens under local government control. We collected data on the number of seeds or plants in the collections of all the gardens, and on the processes and technology used by the seed banks of the four national botanic gardens.

3. Result and Discussion

The Indonesian botanic garden seed banks aim to work towards developing facilities and procedures that meet Millennium Seed Bank Partnership (MSBP) Seed Conservation Standards [1]. All seed bank managers have been trained through the MSBP in seed bank management and seed collection, processing, storage and viability testing. The facilities were constructed based on international standards [2] and with advice from the MSBP, Royal Botanic Gardens Kew, UK (Figure 1). In addition, many procedures, including viability testing, refer to the International Seed Testing Association, as far as the limited budget and resources allow. The levels of temperature and relative humidity of the storage facilities and the target seed moisture contents/equilibrium relative humidity follow the procedures and guidelines of FAO/IPGRI [3] and the MSB, Kew [4], as far as is achievable within the limited funding and resources available to Indonesian seed banks. This seed banking technology keeps the seeds alive (viable) for many years. A summary of the facilities in each LIPI national botanic garden seed bank is showed in Table 1.

Seed banks collect seeds, especially orthodox (or bankable) seeds, on expeditions in natural forests and botanic gardens. When the seeds arrive from the field, they are cleaned, processed and dried before being stored in the seed storage facilities. Some seeds are sown to determine their initial viability. After some years in the storage, the seed viability is tested again to monitor the seed quality. These seed banking procedures can be seen in Figure 2 [7,8].

Seed banks in botanic garden have three main functions: they collect and store seeds for complementary, supplementary and active collections. A complementary collection is a seed collection that duplicates a plant collection in the botanic gardens. A supplementary seed collection is an additional plant species that has not been collected and grown in the garden. An active collection

means that the seed collection is distributed and used for research, reintroductions, and seed exchange based on orders, needs and requests.



Figure 1. Facilities in seed banks of national botanic gardens under LIPI (a) cold storage in Bogor Botanic Gardens, (b) freezer in Cibodas Botanic Gardens, (c) freezer in Bogor Botanic Gardens, (d) freezer in Purwodadi Botanic Gardens and (e) freezer in Eka Karya Bali Botanic Gardens

To date, the seed banks in the LIPI National Botanic Gardens have banked a total of 1,355 accessions (Table 2), meaning that the currently conserve less than 0.05% of Indonesia's 28,000 flowering plant species.

A comparison was made between the seed collections in LIPI/Bogor Botanic Gardens Seed Bank and the living plant collections in four newly developed local botanic gardens, to assess their current contribution to biodiversity conservation (Table 3 and Figure 3).

The capacity of seed banks to conserve materials/specimens of biodiversity can be equal to or greater than that of living plant collections in botanic gardens, as seed banks store smaller biodiversity materials, which require less space. Seed banking technology nowadays is well developed and can ensure the viability of the seed stored in the seed banks for many years [9]. Seed banks can thus be an important component of a botanic garden's ex situ conservation strategy.

Table 1. Facilities in the seed banks of each botanic garden managed by LIPI

No	Facilities	Bogor Botanic Gardens (LIPI Botanic Gardens)	Cibodas Botanic Gardens	Purwodadi Botanic Gardens	Eka Karya Bali Botanic Gardens
1.	Cold Storage -20±2°C (capacity for 10.000 collections)	√			
2.	Chest Freezer -21±2°C, 67x88x300 cm (capacity for 500 collections)	√	√	√	√
3.	Standing Freezer -20±2 °C (capacity for 100 collections)	√	√	√	√
4.	Refrigerator 4±2°C	√	√		
5.	Seed storage room with temperature 18±2°C			√	
6.	Air-conditioned drying room 18 ± 2° C; RH 50-60%	√	√		
7.	Seed drying equipment (Blue drum kit*, dessicator, eRH Tiny Tag Data Logger)	√	√		
8.	Growth Chamber	√	√		√
9.	Glass house	√	√	√	√
10.	Research facilities/laboratory	√	√	√	√

* Two 60 litre blue plastic drums half-filled with silica gel

Sources: [5,6,7]

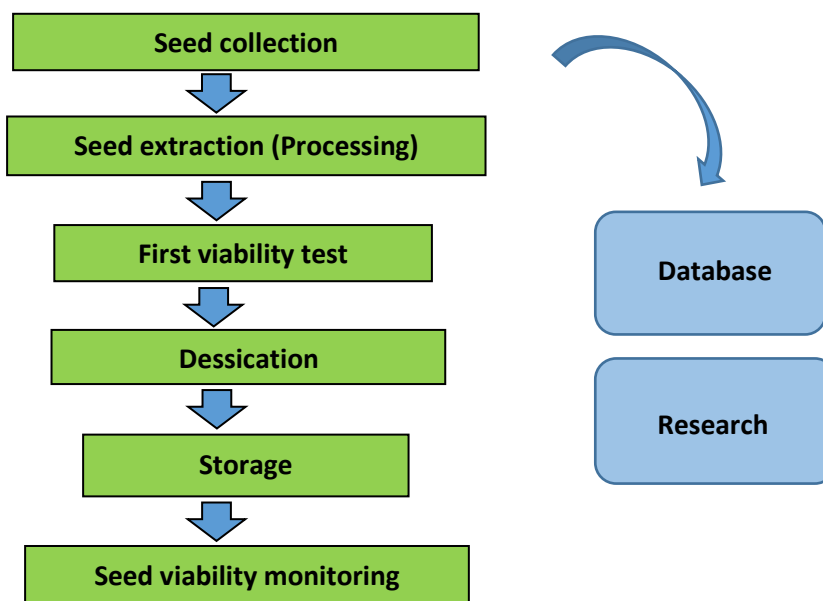


Figure 2. Flow chart of seed banking business process.

Table 2. Number of seed collections in Seed Banks of National Botanic Gardens under LIPI

No	Seed Banks of Botanic Gardens	Seed Collection Number
1	LIPI/Bogor Botanic Gardens	749 accessions (460 species, 305 genera and 114 family)
2	Cibodas Botanic Gardens	61 accessions (57 species, 57 genera, 40 family)
3	Purwodadi Botanic Gardens	413 accessions (207 species, 134 genera and 46 family)
4	Eka Karya Bali Botanic Gardens	132 accessions (89 species, 43 genera, 21 family)

Table 3. Seeds or plants collection of several botanic gardens and seed bank of LIPI/Bogor Botanic Gardens

No	Ex Situ Plant Conservation Sites (Seed Bank or Botanic Gardens)	Number of collections	
		2017	2018
1	Seed Bank of LIPI/Bogor Botanic Gardens, Java Island (initiated in ca. 1974 and further developed in 2006)	586 accessions/specimens (413 species)	749 accessions/ specimens (460 species)
2	Liwa Botanic Gardens, Sumatera Island (launched in 2017)	712 specimens (158 species)	4.377 specimens (672 species)
3	Katingan Botanic Gardens, Kalimantan/Borneo Island (launched in 2015)	772 specimens (153 species)	2.044 specimens (343 species)
4	Jompie Botanic Gardens Sulawesi/Celebes Island (launched in 2017)	702 specimens (159 species)	16.425 specimens (701 species)
5	Gianyar Botanic Gardens Bali Island (Soft launched in 2017)	682 specimens (113 species)	3.029 specimens (245 species)

Sources: [10,11,12].

The Center for Plant Conservation Botanic Gardens – LIPI/Bogor Botanic Gardens has been mandated by the Indonesian Government to develop and supervise 32 botanic gardens in Indonesia. An Indonesian seed bank partnership should be initiated to support the development of seed banks in these gardens by facilitating the sharing of resources, expertise, data and materials. This would be a significant step towards delivering the current national ex situ conservation strategy to protect and manage Indonesian native plant biodiversity. The partnership or network approach was shown to help biodiversity management when applied to community seed banks in Nepal [13].

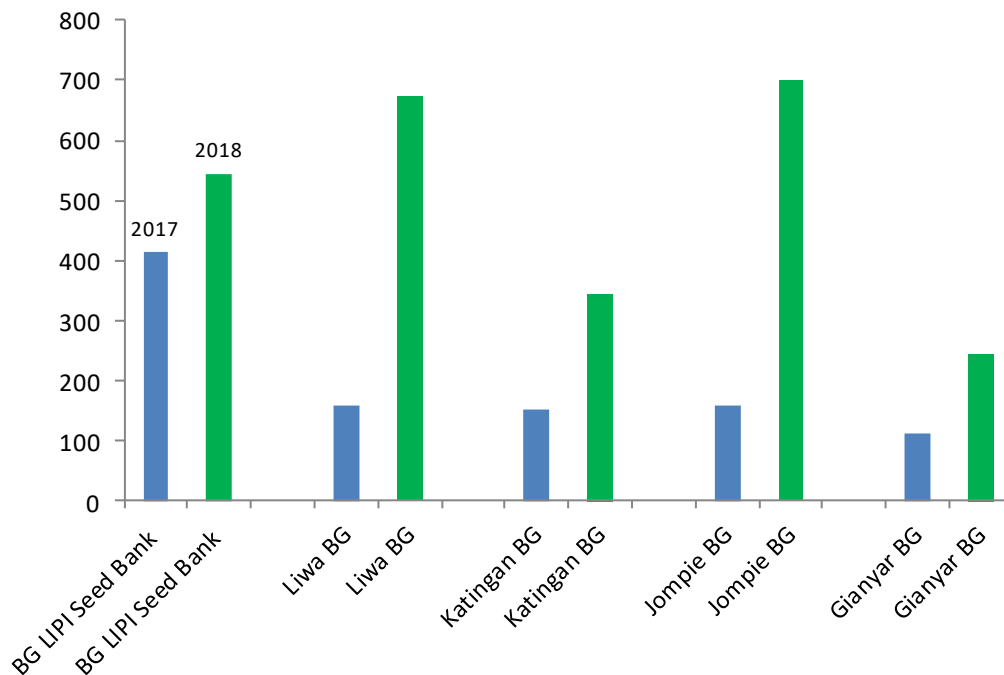


Figure 3. Comparison between the number of seed collection in Bogor Botanic Gardens/LIPI Seed Bank and plant collections in four new local Botanic Gardens.

4. Conclusion

Seed banks have the potential to play an important role in plant conservation. Indonesian seed banks have started to store and conserve many species representing native plant biodiversity, to combat the threats of habitat degradation that may cause the decrease in plant diversity and the possibility of plant species extinction in the future, but have so far only conserved less than 0.05% of the total flowering plant flora. In order to increase this coverage, Indonesian seed banking capacity needs to be increased. This could be achieved through the technical development of existing seed banks and the engagement of local botanic gardens throughout Indonesia to establish mini seed banks using the community seed bank approach. An Indonesian seed bank partnership could be initiated as an additional ex situ conservation strategy for the management of Indonesian native plant biodiversity.

References

- [1] Breman, E and Way, M 2018 Safe for the Future: Seed conservation standards developed for the Millennium Seed Bank Partnership. *Proc. of the Euro Gard VII Congress* (Paris: The European Botanic Gardens Consortium) p 502
- [2] ISTA 2015 *International Rules for Seed Testing* (Basserdorf: International Seed Testing Association)
- [3] FAO/IPGRI 1994 *Genebank standards* (Rome: Food and Agriculture Organisation of the United Nation-International Plant Genetic Resources)
- [4] Linington, S H 2003 The design of seed banks in R D Smith, J B Dickie, S H Linington, H W Pritchard, and R J Probert (Eds) *Seed Conservation- turning science into practice* (Kew: Royal Botanic Gardens Kew)
- [5] Irawanto R 2011 Seed conservation in Purwodadi Botanic Garden *Proc. Int. Conf. on Natural Science* (Malang: MaChung University)

- [6] Lestari D, N P S Asih 2015 Pengelolaan bank biji Kebun Raya Eka Karya Bali *Proc. Masy. Biodiv. Indonesia* vol 1 no 3, pp 515-520
- [7] Mimin, D Latifah, A H Widjaya, A R Gumilang, Harto, Supandi and Atma 2015 Pengembangan Metode Ekstraksi dan Penyimpanan Biji Beberapa Jenis Flora Tropika di Bank Biji Kebun Raya Bogor. *Proc. Ekspose dan Seminar Pembangunan Kebun Raya Daerah: Membangun Kebun Raya untuk penyelamatan keanekaragaman hayati dan lingkungan menuju ekonomi hijau* ed Yuzammi, J.T. Hadiah, D. Asikin, R. A. Risna (Jakarta: LIPI Press) pp 697-714
- [8] Yuzammi, T. Handayani and Y Isnaini 2012 Seleksi dan Pembibitan Kebun Raya *Modul Pendidikan dan Pelatihan Perkebunrayaan untuk Kelas Teknis – Tingkat III* ed R Lestari (Bogor: PKT Kebun Raya-LIPI)
- [9] Schmidt, L 2000 *Guide to handling of tropical and subtropical forest seed* (Denmark: Danida Forest Seed Centre)
- [10] Bogor Botanic Gardens-LIPI Seed Bank 2018 *Seed bank* <http://bankbiji.krbogor.lipi.go.id/biji>. Accessed on 16th August 2018
- [11] BPKKTE (Bidang Pengembangan Kawasan Konservasi Tumbuhan Ex Situ) 2017 *Profil Kebun Raya Daerah di Pulau Sumatera, Jawa, Kalimantan, Sulawesi dan Bali* (Bogor: Pusat Konservasi Tumbuhan Kebun Raya – LIPI)
- [12] BPKKTE (Bidang Pengembangan Kawasan Konservasi Tumbuhan Ex Situ) 2018 *Kebun Raya Daerah* <http://kebunrayadaerah.krbogor.lipi.go.id/> Accessed on 16th August 2018
- [13] Shrestha P, R Vernooy and P Chaudary 2013 Community Seed Banks in Nepal: Past, Present, Future *Proc. National Workshop* (Pokhara: LI-BIRD-USC Canada Asia-Oxfam- The Development Fund-IFAD-Biodiversity International)

Acknowledgement

Sources of funding are Indonesian Government (DIPA Scheme), Ministry of Research and Higher Education of RI, Garfield Weston Global Tree Seed Bank Project of the Millennium Seed Bank Partnership – Royal Botanic Gardens Kew UK. Seed sources: Indonesian Botanic Gardens and Forests/Ministry of Forestry and Environment of The Republic of Indonesia. Authors thanked staff and researchers of Seed Banks of Bogor Botanic Gardens/LIPI, Cibodas Botanic Gardens, Purwodadi Botanic Gardens and Eka Karya Bali Botanic Gardens for their hard work.