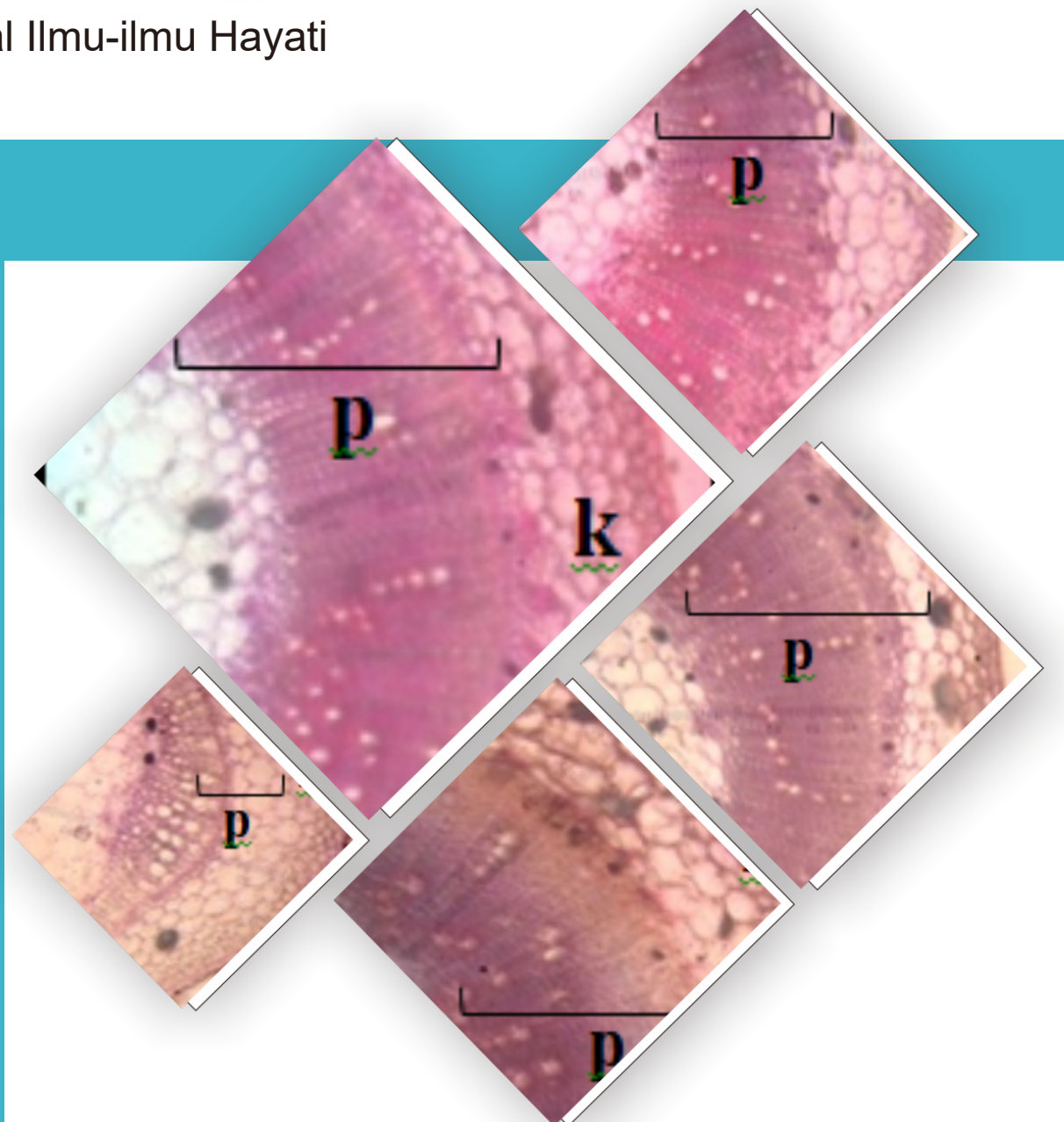


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Kompleks Cibinong Science Center (CSC-LIPI)
Jalan Raya Jakarta-Bogor KM 46,
Cibinong 16911, Bogor-Indonesia
Telepon (021) 8765066 - 8765067
Faksimili (021) 8765059
Email: berita.biologi@mail.lipi.go.id
jurnalberitabiologi@yahoo.co.id
jurnalberitabiologi@gmail.com



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PROGRESS IMPLEMENTATION OF TARGET 9 OF GLOBAL STRATEGY FOR PLANT CONSERVATION CONDUCTED BY INDONESIAN BOTANIC GARDEN NETWORK

(Capaian Target 9 Strategi Global Konservasi Tumbuhan oleh Jaringan Kebun Raya Indonesia)

Siti Fatimah Hanum**

Eka Karya¹ Bali Botanic Garden, Research Center for Plant Conservation and Botanic Garden - Indonesian Institute of Sciences, Candikuning, Baturiti, Tabanan, Bali 82191

ABSTRACT

Plant have been cultivated for a long time, they have been selected and bred by our ancestors for their nutritional qualities, flavor, productivity, storage ability and other valued traits. Crop Wild Relative (CWR) are often neglected because they have not been used for domestication. However, world population growth together with the potentially adverse impact of climate change on agricultural production, calls for greater action to ensure global food security. Indonesian Botanic Garden already ratified Convention on Biodiversity (CBD). One of the programs is the Global Strategy for Plant Conservation (GSPC). The GSPC vision is to stop the plant diversity loss through five objectives and 16 targets for plant conservation to be achieved by 2020. The study was to identify the implementation of target 9 of GSPC by Indonesian Botanic Garden Network. The result showed that there are four reason Indonesian Botanic Garden has participated in target 9 of GSPC, We also provided success stories from other botanic garden to encourage Indonesian Botanic Garden to conserve more Indonesian Crop Wild Relatives (CWR) whilst facilitating their use in crop improvement.

Keywords: Botanic garden, ex situ plant conservation, Global Strategy for Plant Conservation (GSPC), living collection, seed bank, target 9

ABSTRAK

Tanaman telah dibudidayakan sejak lama. Leluhur kita menyeleksi dan membudidayakan tanaman untuk kualitas nutrisi, rasa, produktivitas, daya simpan, dan sifat berharga lainnya. Kerabat tanaman liar pertanian sering diabaikan karena tidak digunakan untuk domestikasi. Namun seiring laju pertumbuhan populasi dunia dan pengaruh perubahan iklim yang merugikan bagi produksi pertanian mengharuskan adanya tindakan untuk menjamin ketahanan pangan. Kebun Raya Indonesia telah meratifikasi konvensi biodiversitas (CBD). Salah satu programnya adalah Strategi Global Konservasi Tumbuhan (GSPC). GSPC bertujuan untuk menghentikan proses kehilangan diversitas tanaman melalui lima sasaran dan 16 target konservasi tumbuhan yang akan dicapai pada tahun 2020. Penelitian ini bertujuan untuk mengidentifikasi capaian target 9 GSPC oleh Kebun Raya Indonesia. Hasilnya memperlihatkan bahwa Kebun Raya Indonesia berpartisipasi dalam pencapaian target 9 GSPC. Dalam tulisan ini kami juga memberikan contoh sukses dari kebun raya lain agar menginspirasi Kebun Raya Indonesia untuk mengonservasi kerabat tanaman liar pertanian Indonesia sambil memudahkan pemanfaatannya untuk perbaikan produk pertanian.

Kata kunci: kebun raya, Konservasi tumbuhan ex situ, Strategi global konservasi tumbuhan, koleksi hidup, bank biji, target 9

INTRODUCTION

Plants and animals have been used as a source of food and medicine (Ulian *et al.*, 2019). Our ancestors have been treat plant from cultivation, selection and breeding for benefit reason such as nutritional qualities, flavor, productivity, storage ability and other valued traits (Schaal 2019). Crop wild relatives (CWR) are wild plant species that holding

a common ancestor with cultivated crop plants of socio-economic value, such as human food, animal forage and fodder crops (Fielder *et al.*, 2015). Crop wild relatives are considered rich sources of useful traits for crop improvement and generally underrepresented in genebanks, (van Treuren, 2020). However, CWR are often neglected because they have not been used for domestication. Whereas CWR is

*Kontributor Utama

a genetic source for obtaining superior agricultural crops such as disease resistance, drought resistance, and more yields. Information about CWR is mostly compiled by traditional communities who live in the village and must be preserved.

Among the Southeast Asian countries, Indonesia was estimated to contain the highest number of vascular plants around 30.000- 40.000 plants (Butler, 2016; Widjaja *et al.*, 2014). The origin of cultivated plant in South East Asia is debatable, but based on latitudinal zones in eastern Asia in respect to cultivated plants divided into 4 namely (1). The Northern China Belt, (2) the Southern China Belt, (3) the Southern Asia Belt and (4) the Southern Islands Belt. While Indonesia belong to the Southern Islands Belt. The origin of cultivated plant from Southern Islands Belt consist of *Artocarpus altilis*, *Artocarpus integra*, *Averrhoa carambola*, *Averrhoa bilimbi*, *Citrus aurantifolia*, *Garcinia mangostana*, *Nephelium lappaceum*, *Lansium domestic*, *Durio zibethibus*, *Terminalia catappa*, *Eugenia javanica*, *Musa x paradisiaca*, *Saccharum officinarum*, *Myristica fragrans*, *Eugenia caryophyllus*. (Hui lin, 1970). Specifically, Kusmana and Hikmat (2015) mention Indonesia also one center of Vavilov for *banana* (*Musa* spp), *Nutmeg* (*Myristica fragrans*), *clove* (*Syzygium aromaticum*), *Durian* (*Durio* spp.) and *Rambutan* (*Nephelium* spp.).

However, Indonesia also has the highest number of global priorities CWR (Rahman *et al.*, 2019). Meanwhile, 18.700 plant species are predicted to be endemic in Indonesia. Unfortunately, only 1/3 of the total number of Indonesian plants that have been identified and documented (Surya *et al.*, 2013). Furthermore, Indonesia is 1 of 25 biodiversity hotspots in the world, an area with high endemic species and threatened by habitat loss (Myers *et al.*, 2000). On the other hand, the current world population growth together with the potentially adverse impact of climate change on agricultural production, calls for greater action to ensure global food security (Ulian *et al.*, 2019). Besides that, the use of superior varieties agricultural crop without conserve landrace increase plant genetic erosion (Widjaja *et al.*, 2014).

Since has the highest number of CWR in Indo-

nesia, Indonesia has not yet had the list of CWR that has priority to conserve (Rahman *et al.*, 2019). At national level the Ministry of Agriculture have determined 32 prioritized crop species comprise of 7 food crop (rice, soybean, maize, cassava, sweet potato, mungbean, and peanut), 10 horticultural species (chilli pepper, paprika, shallot, potato, mango, citrus, banana, durian, mangosteen and salacca), and 15 estate crop species (rubber, coconut, oil palm, coffee, cacao, cashew nut, pepper clove, tea, jatropa, pecan, sugarcane, cotton, tobacco and patcheoli (Sabran, 2016). Therefore, Rahman *et al.* (2019) proposes 234 taxa as priority for conservation. This priority taxa divided into three group comprised of ninety-five priority taxa that are important at the national and global level such as wild relatives of rice, banana, mango, breadfruit, sugarcane, taro, coconut, sweet potato, melon, sorghum, citrus, aubergine), 69 taxa are important at the national and regional level (such as wild relatives of tropical fruits and sugar crops) and 70 taxa are important at global level only such as wild relatives of yam, figs, and raspberry.

Meanwhile, the effort to safeguard Indonesian plants must be based on the Global Strategy for Plant Conservation (GSPC), because Indonesia has ratified Convention on Biodiversity (CBD). The GSPC vision is to halt the loss of the plant diversity through five objectives and 16 targets for plant conservation to be achieved by 2020 (Convention on Biological Diversity 2016; Hird and Kramer 2013). Botanic gardens address many of the GSPC targets (Jackson and Sutherland 2000). Indonesian Botanic Garden (IBG) can participate in at least 13 targets but unfortunately, there has been no progress on target 6, 9 and 12 (Widyatmoko and Rosniati 2017). This study focusses on the progress implementation target 9 of GSPC by Indonesian botanic garden network and recommendation to achieve this target in the future

MATERIAL AND METHODS

To assess how existing plant conservation projects are addressing target 9 GSPC in Indonesia, we compile plant collection data from Bogor (2019), Cibodas (2019), Purwodadi (2012) and Eka Karya Botanic Garden (2020). One of food and agriculture

priority commodity is banana, yam and taro. Beside that we also do study literature to give a comprehensive information about Target 9 GSPC achievement.

RESULTS

Progress Implementation of Target 9 GSPC by Indonesian Botanic Garden (IBG).

Indonesian Botanic Garden has significant progress to achieve the target through GSPC (Table 1.). Unfortunately, target 9 not yet reported (Widyatmoko and Rosniati 2017)

Tabel 1. Indonesian botanic garden result to achieve Global Strategy for Plant Conservation Target 2010-2020 (Widyatmoko and Rosniati 2017). (*Capaian target strategi global konservasi tumbuhan tahun 2010-2020 oleh Kebun Raya Indonesia (Widyatmoko dan Rosniati, 2017)*)

GSPC Target 2010-2020 (<i>Target GSPC tahun 2010-2020</i>)	Indonesian Botanic Garden result (<i>Capaian Kebun Raya Indonesia</i>)
Objective I Plant diversity is well understood, documented and recognize (<i>Tujuan 1. Keanekaragaman tumbuhan dapat dipahami, didokumentasikan dan diakui nilai pentingnya</i>)	
Target 1. An online flora of all known plants (target 1. <i>Tersedianya online flora untuk tumbuhan yang sudah teridentifikasi</i>)	Significant progress (<i>kemajuan yang signifikan</i>)
Target 2. An assessment of the conservation status of all known plant species, as far as possible to guide conservation action (<i>Target 2. Penilaian status konservasi tumbuhan yang sudah diketahui, lebih jauh sebagai panduan kegiatan konservasi</i>)	Little progress (<i>sedikit kemajuan</i>)
Target 3. Information, research and associated outputs and methods necessary to implement the strategy developed and shared (<i>Target 3. Informasi, penelitian dan keluaran serta metode terkait yang diperlukan untuk mengimplementasikan strategi yang dikembangkan dan dibagikan</i>)	Little progress (<i>sedikit kemajuan</i>)
Objective II. Plant diversity is urgently and effectively conserved. (<i>Tujuan II. Keanekaragaman tumbuhan sangat penting dan dikonservasi secara efektif</i>)	
Target 4. At least 15% of ecological region or vegetation type secured through effective management and/or restoration. (<i>Target 4. Setidaknya 15% Kawasan ekologi atau tipe vegetasi dijamin melalui pengelolaan dan/ atau restorasi yang efektif</i>)	
Target 5. At least 75% of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity. (<i>Target 5. Setidaknya 75% dari kawasan terpenting untuk keanekaragaman tumbuhan di setiap kawasan ekologi dilindungi dengan pengelolaan efektif untuk melestarikan tumbuhan dan keanekaragaman genetiknya</i>)	Significant progress (<i>kemajuan yang signifikan</i>)

Tabel 1. Indonesian botanic garden result to achieve Global Strategy for Plant Conservation Target 2010-2020 (Widyatmoko and Rosniati 2017). (*Capaian target strategi global konservasi tumbuhan tahun 2010-2020 oleh Kebun Raya Indonesia (Widyatmoko dan Rosniati, 2017)*) (lanjutan).

GSPC Target 2010-2020 (<i>Target GSPC tahun 2010-2020</i>)	Indonesian Botanic Garden result (<i>Capaian Kebun Raya Indonesia</i>)
Target 6. At least 75% of production lands in each sector managed sustainably consistent with the conservation of plant diversity (<i>Target 6. Setidaknya 75% lahan produksi di setiap sector dikelola secara lestari sesuai dengan Konservasi keanekaragaman tumbuhan</i>)	No progress (<i>Tidak ada perkembangan</i>)
Target 7. At least 75% of known threatened plant species conserved in situ (<i>Target 7. Sedikitnya 75% tumbuhan terancam punah dikonservasi secara in situ</i>)	Little progress (<i>sedikit kemajuan</i>)
Target 8. At least 75% of threatened plant species in ex situ collections, preferably in the country of origin, and at least 20% available for recovery and restoration program (<i>Target 8. Sedikitnya 75% tumbuhan terancam dikoleski secara ex situ, diutamakan di negara asalnya dan sedikitnya 20% sudah tersedia untuk program pemulihan dan restorasi</i>)	Significant progress (<i>kemajuan yang signifikan</i>)
Target 9. 70% of the genetic diversity of crops including their wild relative and other socio-economically valuable plant species conserved, while respecting, preserving, and maintaining associated indigenous and local knowledge. (<i>70% dari keanekaragaman tumbuhan termasuk kerabat liar dan spesies tanaman bernilai sosial ekonomi lainnya dilestarikan dengan tetap menghormati, melestarikan, dan memelihara kearifan dan pengetahuan local</i>)	No progress (<i>Tidak ada perkembangan</i>)
Target 10. Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded. (<i>Target 10. Tersedia rencana pengelolaan yang efektif untuk mencegah invasi biologis baru dan untuk mengelola kawasan penting bagi keanekaragaman tumbuhan yang sudah diinvasi</i>)	Little progress (<i>sedikit kemajuan</i>)
Objective III. Plant diversity is used in a sustainable and equitable manner (<i>Tujuan III. Keanekaragaman tumbuhan dimanfaatkan secara berkelanjutan dan adil</i>)	Little progress (<i>sedikit kemajuan</i>)
Target 11. No species of flora endangered by international trade. (<i>Target 11. Tidak ada spesies tumbuhan terancam punah dalam perdagangan internasional</i>)	
Target 12. 30% of plant-based products derived from sources that are sustainably managed. (<i>Target 12. 30% produk nabati berasal dari sumber yang dikelola secara berkelanjutan</i>)	No progress (<i>Tidak ada perkembangan</i>)

Tabel 1. Indonesian botanic garden result to achieve Global Strategy for Plant Conservation Target 2010-2020 (Widyatmoko and Rosniati 2017). (*Capaian target strategi global konservasi tumbuhan tahun 2010-2020 oleh Kebun Raya Indonesia (Widyatmoko dan Rosniati, 2017)*) (lanjutan).

GSPC Target 2010-2020 (<i>Target GSPC tahun 2010-2020</i>)	Indonesian Botanic Garden result (<i>Capaian Kebun Raya Indonesia</i>)
<p>Target 13. Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased as appropriate to support customary use, sustainable livelihoods, local food security, and health care. (<i>Target 13. Inovasi dan praktek kearifan dan pengetahuan lokal yang terkait dengan sumber daya tumbuhan yang dipertahankan atau ditingkatkan sesuai kebutuhan yang mendukung penggunaan secara adat, mata pencaharian berkelanjutan, ketahanan pangan lokal dan perawatan kesehatan</i>)</p>	<p>Little progress (<i>sedikit kemajuan</i>)</p>
<p>Objective IV. Educational and awareness about plant diversity, its role in sustainable livelihoods, and importance to all life on earth is promoted. (<i>Tujuan IV. Pendidikan dan kesadaran tentang keanekaragaman tumbuhan, perannya dalam mata pencaharian berkelanjutan dan pentingnya untuk seluruh kehidupan di bumi dipromosikan</i>)</p>	<p>Significant progress (<i>kemajuan yang signifikan</i>)</p>
<p>Target 14. The importance of plant diversity and the need for its conservation incorporated into communication, educational and public-awareness programs. (<i>Target 14. Pentingnya keanekaragaman tumbuhan dan perlunya konservasi dimasukkan dalam program komunikasi, Pendidikan dan kesadaran publik</i>)</p>	<p>Little progress (<i>sedikit kemajuan</i>)</p>
<p>Objective V. The capacities and public engagement necessary to implement the strategy have been developed. (<i>Tujuan V. Kapasitas dan keterlibatan public diperlukan untuk mengimplementasikan strategi yang telah dikembangkan</i>)</p>	<p>Significant progress (<i>kemajuan yang signifikan</i>)</p>
<p>Target 15. The number of trained people working with appropriate facilities in plant conservation increased. (<i>Target 15. Jumlah orang terlatih yang bekerja dengan fasilitas yang sesuai dalam konservasi tumbuhan meningkat</i>)</p>	<p>Significant progress (<i>kemajuan yang signifikan</i>)</p>
<p>Target 16. Network for plant conservation activities established or strengthened at national, regional and international levels. (<i>Target 16. Jejaring untuk kegiatan Konservasi tumbuhan dibentuk dan diperkuat di tingkat nasional, regional dan internasional</i>)</p>	<p>Significant progress (<i>kemajuan yang signifikan</i>)</p>

Tabel 2. Indonesian Botanic Garden result to achieve Target 9 Global Strategy for Plant Conservation on Food priority (Banana, Yam and Taro). (*Capaian target 9 strategi global Konservasi tumbuhan untuk prioritas pangan (pisang, ubi, dan talas) oleh Kebun Raya Indonesia*)

Indonesian Botanic Garden (<i>Kebun Raya Indonesia</i>)	Wild banana species (<i>Spesies liar pisang</i>)	Dioscorea species (<i>Spesies Dioscorea</i>)	Colocasia species (<i>Spesies Colocasia</i>)
Bogor Botanic Garden (Ariati <i>et al.</i> , 2019)	<i>Musa acuminata</i> Colla <i>Musa brachycarpa</i> Baker <i>Musa laterita</i> E.E. Cheesman <i>Musa ornata</i> <i>Musa paradisiaca</i> <i>Musa salaccensis</i> Zoll. Ex Baker <i>Musa sanguinea</i> Hook.f. <i>Musa velutina</i> H. wendl.&Drude <i>Musa</i> sp.	<i>Dioscorea alata</i> L <i>Dioscorea bulbifera</i> L. <i>Dioscorea esculenta</i> (Lour) Burkill <i>Dioscorea hispida</i> Dennst <i>Dioscorea nummularia</i> Lam <i>Dioscorea retusa</i> Mast. <i>Dioscorea sansibarensis</i> Pax <i>Dioscorea</i> sp.	<i>Colocasia esculenta</i> (L.) Schott
Cibodas Botanic Garden (Sujarwo <i>et al.</i> , 2019)	<i>Musa acuminata</i> Colla <i>Musa banksia</i> F. Muell <i>Musa zebrina</i> van Houffe ex Planch <i>Musa</i> sp.	-	<i>Colocasia</i> spp.
Purwodadi Botanic Garden (Narko <i>et al.</i> , 2012)	<i>Musa acuminata</i> Colla <i>Musa balbisiana</i> Colla	<i>Dioscorea alata</i> L <i>Dioscorea esculenta</i> (Lour.)Burkill <i>Dioscorea hispida</i> Dennst <i>Dioscorea pentaphylla</i> (Lour) Burkill	<i>Colocasia</i> sp.
Bali Botanic Garden (Plant Registration Unit, 2020)	<i>Ensete superbum</i> (Roxb.) Cheesman <i>Musa velutina</i> H. Wendl & Drude <i>Musa balbisiana</i> Colla <i>Musa</i> sp.	<i>Dioscorea alata</i> L <i>Dioscorea bulbifera</i> L. <i>Dioscorea esculenta</i> (Lour.) Burkill <i>Dioscorea hispida</i> Denn <i>Dioscorea pentaphylla</i> (Lour) Burkill <i>Dioscorea</i> sp.	<i>Colocasia esculenta</i> <i>Colocasia gigantea</i> (Blume) <i>Colocasia</i> sp.

Since this target is not belong as the main activity of Indonesian Botanic Garden, but in fact, IBG show activity related to the implementation target 9 of GSPC. First, the main research of Indonesian Botanic Garden divide into tree cluster consist of Conservation, Domestication and Reintroduction. Regarding to this cluster research, some Indonesian botanic garden also conserve plant that has food function (Table 2) such as Purwodadi Botanic Garden collect many different types of *Dioscorea* spp, *Musaceae* and Yam wild relatives as their living collection (Sharrock 2013; Trimanto

and Hapsari 2015). However, in 90's Purwodadi Botanic Garden was the leading botanical garden of Musaceae collection in South East Asia (Hapsari, 2010). Purwodadi Botanic Garden has banana collection consist of 316 number collection, 114 cultivar and, 4 type parental for cross breeding. *Musa acuminata* and *Musa balbisiana* (pisang kluthuk wulung) are wild species that used as parental for cross breeding in Indonesia. Meanwhile, Bogor Botanic Garden also has wild banana species collection. Among them are *M.acuminata* var *malaccensis*, *M. balbisiana* var *liukiuensis*, *M. acuminata*

var *halabanensis*, *M.acuminata* var *zebrina*, dan *M. acuminata* var *nakaii* (Widjaja *et al.*, 2014). Therefore, Bali Botanic Garden also has wild banana species collection comprise of *Musa balbisiana* var *brachycarpa* (Ariati *et al.*, 2019) and Cibodas Botanic Garden also has one *Musa balbisiana* var *sumatrana* (CBG registration, 2019). IBG also conduct Breeding activities limited in their scope and intensities (Sabran, 2016). Lestari and Surya (2016) said that Bogor and Cibodas Botanic Garden have local fruit germplasm and plant breeding program, at least eight genera, consist of *Persea American*,

Baccaurea spp., *Garcinia* spp., *Nephelium* spp., *Durio* sp., *Mangifera* spp., *Artocarpus* spp., and *Willughbela* spp.

Second, there is a new botanic garden have been developed in some Indonesian region. Until recent times, Indonesia has 43 botanic gardens consist of five botanic gardens under the Indonesian Institute of Sciences (LIPI) while others are managed by local governments and universities. This botanic garden location spreading across 23 provinces. (Table 3.) (Bidang Pengembangan Kawasan Kebun Raya, 2019).

Table 3. Indonesian Botanic Garden (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko and Risna, 2017). (*Kebun Raya Indonesia (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko dan Risna, 2017)*)

No	Botanic garden (<i>Kebun Raya</i>)	Collection theme/focus (<i>tema koleksi/fokus</i>)	Province (<i>Propinsi</i>)
1	Bogor	Humid lowland and plants (<i>Tumbuhan dataran rendah beriklim basah</i>)	West Java (<i>Jawa Barat</i>)
2	“Eka Karya” Bali	Dry highland plants (<i>Tumbuhan dataran tinggi kering</i>)	Bali
3	Massenrempulu Enrekang	Wallaceae region flora (<i>Tumbuhan kawasan wallaceae</i>)	South of Sulawesi (<i>Sulawesi Selatan</i>)
4	Kuningan	Rocky and Mount Ceremai plants (<i>Tumbuhan daerah berbatu dan gunung ceremai</i>)	West Java (<i>Jawa Barat</i>)
5	Cibodas	Humid highland plants (<i>Tumbuhan dataran tinggi</i>)	West Java (<i>Jawa Barat</i>)
6	Purwodadi	Dry lowland plants (<i>Tumbuhan data- ran rendah</i>)	East Java (<i>Jawa Timur</i>)
7	Banua	Kalimantan medicinal plants (<i>Tumbuhan obat Kalimantan</i>)	South Kalimantan (<i>Kalimantan Selatan</i>)
8	Cibinong	Indonesian bioregion plants (<i>Tumbuhan Indonesia berdasarkan bioregion</i>)	West Java (<i>Jawa Barat</i>)
9	Balikpapan	Indonesian timber plants (<i>Tumbuhan kayu Indonesia</i>)	East Kalimantan (<i>Kalimantan Timur</i>)
10	Baturraden	Java mountainous flora (<i>Tumbuhan pegunungan Jawa</i>)	Central of Java (<i>Jawa Tengah</i>)
11	Wamena	Central papua mountainous flora (<i>Tumbuhan pegunungan tengah Papua</i>)	Papua
12	Liwa	Indonesian ornamental plants (<i>Tumbuhan hias Indonesia</i>)	Lampung

Table 3. Indonesian Botanic Garden (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko and Risna, 2017). (*Kebun Raya Indonesia (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko dan Risna, 2017)*) (lanjutan)

No	Botanic garden (<i>Kebun Raya</i>)	Collection theme/focus (<i>tema koleksi/fokus</i>)	Province (<i>Propinsi</i>)
13	Katingan	Indonesian fruit plants (<i>Tumbuhan buah Indonesia</i>)	Central of Kalimantan (<i>Kalimantan Tengah</i>)
14	Sriwijaya	Sumatera medicinal and wetland plants (<i>Tumbuhan obat dan lahan basah Sumatera</i>)	South Sumatera (<i>Sumatera Selatan</i>)
15	Sambas	Kalimantan riparian flora (<i>Tumbuhan riparian Kalimantan</i>)	West Kalimantan (<i>Kalimantan Barat</i>)
16	Bukit Sari	Sumatera lowland flora (<i>Tumbuhan dataran rendah Su- matera</i>)	Jambi
17	Samosir	North Sumatera highland flora (<i>Tumbuhan dataran tinggi sumatera utara</i>)	North Sumatera (<i>Sumatera Utara</i>)
18	Lombok	Lesser sunda plants (<i>Tumbuhan kepu- lauan sunda kecil</i>)	West Nusa Tenggara (<i>Nusa Tenggara Barat</i>)
19	“jompie” Pare-Pare	Coastal wallacea flora (<i>Tumbuhan Kawasan pesisir wallacea</i>)	South Sulawesi (<i>Sulawesi Selatan</i>)
20	Pucak	Economical value plants (<i>Tumbuhan bernilai ekonomi</i>)	South Sulawesi (<i>Sulawesi Selatan</i>)
21	Batam	Small islands flora (<i>Tumbuhan pulau- pulau kecil Indonesia</i>)	Riau island (<i>Kepulauan Riau</i>)
22	Danau Lait	Equatorial region plants (<i>Tumbuhan Kawasan ekuator</i>)	West Kalimantan (<i>Kalimantan Barat</i>)
23	Kendari	Ultrabasic flora (<i>Tumbuhan Ultra Basic</i>)	South east Sulawesi (<i>Sulawesi Tenggara</i>)
24	Minahasa	Highland wallacea region flora (<i>Tumbuhan dataran tinggi wallacea</i>)	North Sulawesi (<i>Sulawesi Utara</i>)
25	Solok	Spice plants (<i>Tumbuhan rempah In- donesia</i>)	West Sumatera (<i>Sumatera Barat</i>)
26	Megawati Soekarnoputri	Lowland wallacea regional plants (<i>Tumbuhan pamah Kawasan walla- ceae</i>)	North Sulawesi (<i>Sulawesi Utara</i>)
27	Pelalawan	Sumatran peat swamp plants (<i>tumbuhan rawa gambut Sumatera</i>)	Riau
28	Balangan	Balangan native plant and Kaliman- tan lowland forest (<i>Tumbuhan asli Balangan dan hutan pamah Kaliman- tan</i>)	South Kalimantan (<i>Kalimantan Selatan</i>)

Table 3. Indonesian Botanic Garden (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko and Risna, 2017). (*Kebun Raya Indonesia (Bidang Pengembangan Kawasan Kebun Raya, 2019; Widyatmoko dan Risna, 2017)*) (lanjutan)

No	Botanic garden (Kebun Raya)	Collection theme/focus (tema koleksi/fokus)	Province (Propinsi)
29	Gianyar	Gianyar native plant, Balinese medicinal and ceremonial plant (<i>Tumbuhan asli Gianyar, upacara adat dan tumbuhan obat Bali</i>)	Bali
30	Indrokilo Boyolali	Eastern Java lowland rainforest (<i>Tumbuhan hutan hujan dataran rendah Jawa bagian timur</i>)	Central Java (<i>Jawa Tengah</i>)
31	Institut Teknologi Sumatera	Sumatera lowland forest (<i>hutan hujan pamah Sumatera</i>)	Lampung
32	Jagatnatha, Jembrana	Balinese medicinal and ceremonial plant (<i>Tumbuhan usada dan upacara adat Bali</i>)	Bali
33	Rimbe Mambang	Bangka native plant and lowland forest (<i>Tumbuhan asli Bangka dan hutan pamah Sumatera</i>)	Bangka Belitung Island (<i>Kepulauan Bangka Belitung</i>)
34	Sampit	Heath forest (<i>Tumbuhan hutan kerangas</i>)	West Kalimantan (<i>Kalimantan Barat</i>)
35	Sipirok Tapanuli Selatan	Sumatera transitional lowland forest to mountain rainforest (<i>Tumbuhan pada zona peralihan antara hutan hujan pamah dan hutan hujan pegunungan Sumatera</i>)	North Sumatera (<i>Sumatera Utara</i>)
36	Tanjung Puri Tabalong	Kalimantan lowland forest (<i>Tumbuhan hutan pamah Kalimantan</i>)	South Kalimantan (<i>Kalimantan Selatan</i>)
37	Tebit gadong Beltung Timur	Bangka Belitung heath forest (<i>Tumbuhan hutan kerangas Bangka Belitung</i>)	Bangka Belitung island (<i>Kepulauan Bangka Belitung</i>)
38	Uniersitas Halu Oleo Kendari	Sulawesi endemic plants (<i>Tumbuhan endemik Sulawesi</i>)	South East Sulawesi (<i>Sulawesi tenggara</i>)
39	Sigi	Sulawesi monsoon forest (<i>Tumbuhan hutan gugur daun Sulawesi</i>)	Central Sulawesi (<i>Sulawesi tengah</i>)
40	Walaboba Ngada	Mountain lesser sunda plants (<i>Tumbuhan pegunungan kepulauan Sunda kecil</i>)	East Nusa Tenggara (<i>Nusa Tenggara Timur</i>)
41	Belingkang Bangli	Mountain Balinese ceremonial plants (<i>Tumbuhan upacara hindu Kawasan pegunungan Bali</i>)	Bali
42	Gunung Tidar Magelang	Ornamental plant on Java lowland forest (<i>tumbuhan hias pada hutan hujan dataran rendah jawa bagian timur</i>)	Central Java (<i>Jawa Tengah</i>)
43	Mangrove Surabaya	Mangrove plants (<i>tumbuhan mangrove</i>)	East Java (<i>Jawa Timur</i>)

This new botanic garden has a thematical garden that focuses on the rare local excellent product such as Baturaden botanic garden focus on medicinal plants and liana; Katingan botanic garden focus on tropical fruit, Enrekang botanic garden focus on ornamental and aromatic plant. Many new botanic gardens will help rare plant conservation in Indonesia (Purnomo *et al.*, 2015).

Third, Kew Botanic Garden has the Millenium Seed Bank Project Partnership (MSBP, 2011 to present). The aim of MSBP is to continue safeguarding plant diversity worldwide with a focus on plants most at risk and most useful for the future while addressing global challenges for food security, sustainable energy, loss of biodiversity and climate change (Liu *et al.*, 2018). Seed banking remains a key part of RBG Kew to contribute on target 8 and 9 of GSPC (MSBP conserves propagules primarily from orthodox seed-bearing wild vascular plants. It is the largest ex-situ conservation program in the world, currently involving 96 countries and territories (Liu *et al.*, 2018). Indonesian Botanic Garden is one of them. The ability to store a large diversity of germplasm in a small space at relatively low cost makes seed banking a practical and attractive tool for plant conservation (Liu *et al.*, 2018).

Fourth, Botanical gardens present highly suitable venues for the presentation of agricultural displays and educational programs (Miller *et al.*, 2015). Miller *et al.*, 2015 added botanical garden are the house of useful germplasm for improving existing and future crops. By forming partnerships with appropriate universities and other institutions with active research programs in agriculture, state departments of agriculture, international agricultural organizations, farmer's organizations and industry groups, gardens will be able to improve their ability to present displays and information concerning agriculture. Botanical gardens currently have well-developed programs of plant diversity and conservation research, which can easily be expanded to strengthen sustainable agriculture, address agriculture impacts on natural biodiversity and advance public understanding of both.

DISCUSSION

The role of the botanic garden

The botanic garden has many roles. Nowadays the mission of many botanic gardens not only focuses on developing horticulture collections and taxonomic research but has expanded to include their contribution to species and habitat recovery in the wild (Havens *et al.*, 2006). Meanwhile, under Indonesian Presidential Decree number 93: 2011 explained that a botanic garden is an area for ex-situ conservation which has documented plant collections. The plant collection arranged based on taxonomical classification, bioregion, thematical pattern or combination from pattern describe before for conservation, research, education, recreation and ecosystem services (Sita and Widyatmoko, 2019; Surya *et al.*, 2013). Miller *et al.* (2015) mention botanic gardens are living collection repositories of plant biodiversity that cultivate approximately one-third of known plant species globally. Historically, many botanic gardens focused on plants for their utility rather than their aesthetic or diversity value. Until the early twentieth century, food plants and their wild relatives played a significant role in many botanical gardens. This caused prominent scientist to propose that botanic gardens should become a field museum of agriculture (Miller *et al.*, 2015).

The botanic garden also becomes an excellent place to document, conserve and make available wild plant diversity in the service of improving agriculture because botanic garden was the world's primary repository living plant collections. Living plant collection of botanic gardens can make crop varieties and their wild relatives more readily available than in nature, where they may even have become extinct (Miller *et al.*, 2015). Therefore, botanic garden take part in ex situ CWR conservation.

Target 9 of the GSPC

The Global Strategy for Plant Conservation (GSPC) is a cross-cutting strategy, developed and adopted by the United Nation's Convention on Biological Diversity (CBD) in 2002 (Ren *et al.*, 2019). The GSPC document incorporating social and economic goals therefore provided a useful model on how this target could be transformed into compre-

hensive, practical and measurable on the ground actions and programmes (Jackson and Kennedy, 2009). One of GSPC target is Target 9. Target 9 calls for 70% of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge.

Several institute consist of government and private participate in manage agriculture plant genetic resource consist of 18 institute under ministry of agriculture, ministry of forestry, ministry of research and technology, ministry of health, Indonesian Institute of Science (LIPI), university and private organization such as Taman Buah Mekarsari, Kampung Obat Martha Tilaar, Taman Bunga Nusantara (Widjaja *et al.*, 2014). Plant genetic resources includes landrace, improve cultivar, and crop wild relative (Sutoro, 2008). He stated Agricultural research institutes do exploration activities for collecting indigenous genetic material have been done to protect and save this endangered crop species. Plant character observed mostly such as resistant to pest and disease, drought, iron toxicity and acid soils. This genetic resource is the basis for future progress in developing new varieties.

Barrier to implementation target 9 of GSPC

Based on a survey conducted by Williams *et al.* (2012) to 505 botanic garden members of Botanic Garden Conservation International (BGCI) and 124 botanic gardens non-BGCI members show that compares with 16 other targets of GSPC, target 6,9 and 12 which is related to the sustainable use of plant resources and conservation of indigenous knowledge are least implemented. This result support previous research indicating target 6,9, and 12 which is relating to conservation of socioeconomics species and sustainable use of plants are the least implemented of the GSPC targets (Paton and Lughada 2011). Donaldson (2009) said that the three targets is not considered as traditional activities of the botanic garden which known only considered as conservation and body of knowledge on threatened species. Another botanic garden in the world faces a similar case. Some botanic garden has a weak implementation, less than 15% respondent

has an activity that supports these target (William and Sharrock 2010; William *et al.*, 2012).

Paton and Lughadha (2011) said FAO and IPGRI are institutions that facilitating to achieve target 9. This is clear that some botanic garden also has a different perspective on how to achieve this because of different responsibility. Furthermore, Sharrock *et al.* (2018) said the major challenge with target 9 is to identify and conserve the many thousands of other species that are of socio-economic importance at the national or local level as well as managing the indigenous knowledge associate with these species. Williams *et al.* (2012) said another reason for the least implemented target because other institutional and stakeholders are also involved in the implementation of the GSPC at national, regional and international levels. Sabran (2016) added to avoid duplication or overlap of activities, there is a need to delineate the task or activities among those institutions, universities and organizations. Since the absence of the national law governing genetic resources, the delineation might be difficult to be agreed upon. Other reason also because of limited funding to the implementation of the GSPC targets, William *et al.* (2012) gave a solution to increase communication between the GSPC policy actors and additional financial support (William *et al.*, 2012; Liu *et al.*, 2018).

Success story to achieve target 9 by another Botanic garden.

Botanic garden in agricultural biodiversity-rich regions is uniquely poised to help conserve regionally important foods in partnerships with local communities (Krishnan *et al.*, 2019). Target 9 focuses on crops, their wild relatives and other socio-economically important species, especially local importance product. This target can be achieved by working with local communities. There are two example CWR collection in botanic garden such as the collection of breadfruits at National Tropical Botanical Garden in Hawaii, and the collection of native and domesticated apples grown by the Almaty Botanical Garden in Kazakhstan (Miller *et al.*, 2015)

Botanical garden also play role to disseminate information on biodiversity conservation and sus-

tainable use of plants to students and the general population. In Mexico there are three botanic garden considered as ethnobotanical (i.e. link wild and semidomesticated species to human uses) (Gonzales and Cadena, 2018). However, a good example of collaboration between the botanic garden and other institutions is shown in Washington DC's United State Botanic Garden (USBG) exhibit celebrating wheat (*Triticum aestivum* L.) and the effort of American wheat breeder Norman Borlaug. This exhibition involves collaboration from agricultural researchers. This exhibition tells about the breeding history of Bourlaug's Mexico-based breeding program. The garden grew six main commercial classes of modern wheat alongside ancient wheats, Researchers at Cornell University provided seeds to grow the ancient wheats, while the USDA national small grains collection in Aberdeen provided the Bourlaug varieties. Scientist at USDA in Beltsville, Maryland generously provided their time and facilities for verification and provided valuable agromomic guidance (Krishnan *et al.*, 2019).

CONCLUSION

Indonesian Botanic Garden show activity related to implementation target 9 of GSPC. In national level, collaboration with another institution and organization have potency to conserve Indonesian food and horticulture crop wild relative. Botanic garden as an ex situ CWR conservation has role to disseminate information on biodiversity conservation and sustainable use of plants to student and the general population.

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Pedoman Penulisan Naskah Berita Biologi

Berita Biologi adalah jurnal yang menerbitkan artikel kemajuan penelitian di bidang biologi dan ilmu-ilmu terkait di Indonesia. Berita Biologi memuat karya tulis ilmiah asli berupa makalah hasil penelitian, komunikasi pendek dan tinjauan kembali yang belum pernah diterbitkan atau tidak sedang dikirim ke media lain. Masalah yang diliput harus menampilkan aspek atau informasi baru.

Tipe naskah

1. Makalah lengkap hasil penelitian (*original paper*)

Naskah merupakan hasil penelitian sendiri yang mengangkat topik yang *up to date*. Tidak lebih dari 15 halaman termasuk tabel dan gambar. Pencantuman lampiran seperlunya, namun redaksi berhak mengurangi atau meniadakan lampiran.

2. Komunikasi pendek (*short communication*)

Komunikasi pendek merupakan makalah hasil penelitian yang ingin dipublikasikan secara cepat karena hasil termuan yang menarik, spesifik dan atau baru, agar dapat segera diketahui oleh umum. Hasil dan pembahasan dapat digabung.

3. Tinjauan kembali (*review*)

Tinjauan kembali merupakan rangkuman tinjauan ilmiah yang sistematis-kritis secara ringkas namun mendalam terhadap topik penelitian tertentu. Hal yang ditinjau meliputi segala sesuatu yang relevan terhadap topik tinjauan yang memberikan gambaran '*state of the art*', meliputi temuan awal, kemajuan hingga issue terkini, termasuk perdebatan dan kesenjangan yang ada dalam topik yang dibahas. Tinjauan ulang ini harus merangkum minimal 30 artikel.

Struktur naskah

1. Bahasa

Bahasa yang digunakan adalah Bahasa Indonesia atau Inggris yang baik dan benar.

2. Judul

Judul diberikan dalam bahasa Indonesia dan Inggris. Judul ditulis dalam huruf tegak kecuali untuk nama ilmiah yang menggunakan bahasa latin, Judul harus singkat, jelas dan mencerminkan isi naskah dengan diikuti oleh nama serta alamat surat menyurat penulis dan alamat email. Nama penulis untuk korespondensi diberi tanda amplop cetak atas (*superscript*). Jika penulis lebih dari satu orang bagi pejabat fungsional penelitian, pengembangan agar menentukan status sebagai kontributor utama melalui penandaan simbol dan keterangan sebagai kontributor utama dicatat kaki di halaman pertama artikel.

3. Abstrak

Abstrak dibuat dalam dua bahasa, bahasa Indonesia dan Inggris. Abstrak memuat secara singkat tentang latar belakang, tujuan, metode, hasil yang signifikan, kesimpulan dan implikasi hasil penelitian. Abstrak berisi maksimum 200 kata, spasi tunggal. Di bawah abstrak dicantumkan kata kunci yang terdiri atas maksimum enam kata, dimana kata pertama adalah yang terpenting. Abstrak dalam Bahasa Inggris merupakan terjemahan dari Bahasa Indonesia. Editor berhak untuk mengedit abstrak demi alasan kejelasan isi abstrak.

4. Pendahuluan

Pendahuluan berisi latar belakang, permasalahan dan tujuan penelitian. Perlu disebutkan juga studi terdahulu yang pernah dilakukan terkait dengan penelitian yang dilakukan.

5. Bahan dan cara kerja

Bahan dan cara kerja berisi informasi mengenai metode yang digunakan dalam penelitian. Pada bagian ini boleh dibuat sub-judul yang sesuai dengan tahapan penelitian. Metoda harus dipaparkan dengan jelas sesuai dengan standar topik penelitian dan dapat diulang oleh peneliti lain. Apabila metoda yang digunakan adalah metoda yang sudah baku cukup ditulis sitasinya dan apabila ada modifikasi maka harus dituliskan dengan jelas bagian mana dan hal apa yang dimodifikasi.

6. Hasil

Hasil memuat data ataupun informasi utama yang diperoleh berdasarkan metoda yang digunakan. Apabila ingin mengacu pada suatu tabel/grafik/diagram atau gambar, maka hasil yang terdapat pada bagian tersebut dapat diuraikan dengan jelas dengan tidak menggunakan kalimat 'Lihat Tabel 1'. Apabila menggunakan nilai rata-rata maka harus menyertakan pula standar deviasinya.

7. Pembahasan

Pembahasan bukan merupakan pengulangan dari hasil. Pembahasan mengungkap alasan didapatkannya hasil dan arti atau makna dari hasil yang didapat tersebut. Bila memungkinkan, hasil penelitian ini dapat dibandingkan dengan studi terdahulu.

8. Kesimpulan

Kesimpulan berisi informasi yang menyimpulkan hasil penelitian, sesuai dengan tujuan penelitian, implikasi dari hasil penelitian dan penelitian berikutnya yang bisa dilakukan.

9. Ucapan terima kasih

Bagian ini berisi ucapan terima kasih kepada suatu instansi jika penelitian ini didanai atau didukung oleh instansi tersebut, ataupun kepada pihak yang membantu langsung penelitian atau penulisan artikel ini.

10. Daftar pustaka

Tidak diperkenankan untuk mensitasi artikel yang tidak melalui proses *peer review*. Apabila harus menyitir dari "laporan" atau "komunikasi personal" dituliskan '*unpublished*' dan tidak perlu ditampilkan di daftar pustaka. Daftar pustaka harus berisi informasi yang *up to date* yang sebagian besar berasal dari *original papers* dan penulisan terbitan berkala ilmiah (nama jurnal) tidak disingkat.

Format naskah

1. Naskah diketik dengan menggunakan program Microsoft Word, huruf New Times Roman ukuran 12, spasi ganda kecuali Abstrak spasi tunggal. Batas kiri-kanan atas-bawah masing-masing 2,5 cm. Maksimum isi naskah 15 halaman termasuk ilustrasi dan tabel.
2. Penulisan bilangan pecahan dengan koma mengikuti bahasa yang ditulis menggunakan dua angka desimal di belakang koma. Apabila menggunakan Bahasa Indonesia, angka desimal ditulis dengan menggunakan koma (,) dan ditulis dengan menggunakan titik (.) bila menggunakan bahasa Inggris. Contoh: Panjang buku adalah 2,5 cm. Length of the book is 2.5 cm. Penulisan angka 1-9 ditulis dalam kata kecuali bila bilangan satuan ukur, sedangkan angka 10 dan seterusnya ditulis dengan angka. Contoh lima orang siswa, panjang buku 5 cm.
3. Penulisan satuan mengikuti aturan *international system of units*.
4. Nama takson dan kategori taksonomi ditulis dengan merujuk kepada aturan standar yang diakui. Untuk tumbuhan menggunakan *International Code of Botanical Nomenclature* (ICBN), untuk hewan menggunakan *International Code of Zoological Nomenclature* (ICZN), untuk jamur *International Code of Nomenclature for Algae, Fungi and Plant* (ICFAFP), *International Code of Nomenclature of Bacteria* (ICNB), dan untuk organisme yang lain merujuk pada kesepakatan Internasional. Penulisan nama takson lengkap dengan nama author hanya dilakukan pada bagian deskripsi takson, misalnya pada naskah taksonomi. Penulisan nama takson untuk bidang lainnya tidak perlu menggunakan nama author.
5. Tata nama di bidang genetika dan kimia merujuk kepada aturan baku terbaru yang berlaku.

6. Untuk range angka menggunakan en dash (–), contohnya pp.1565–1569, jumlah anakan berkisar 7–8 ekor. Untuk penggabungan kata menggunakan hyphen (-), contohnya: masing-masing.
7. Ilustrasi dapat berupa foto (hitam putih atau berwarna) atau gambar tangan (*line drawing*).
8. Tabel
Tabel diberi judul yang singkat dan jelas, spasi tunggal dalam bahasa Indonesia dan Inggris, sehingga Tabel dapat berdiri sendiri. Tabel diberi nomor urut sesuai dengan keterangan dalam teks. Keterangan Tabel diletakkan di bawah Tabel. Tabel tidak dibuat tertutup dengan garis vertikal, hanya menggunakan garis horisontal yang memisahkan judul dan batas bawah.
9. Gambar
Gambar bisa berupa foto, grafik, diagram dan peta. Judul gambar ditulis secara singkat dan jelas, spasi tunggal. Keterangan yang menyertai gambar harus dapat berdiri sendiri, ditulis dalam bahasa Indonesia dan Inggris. Gambar dikirim dalam bentuk .jpeg dengan resolusi minimal 300 dpi, untuk *line drawing* minimal 600dpi.
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Agusta, A., Maehara, S., Ohashi, K., Simanjuntak, P. and Shibuya, H., 2005. Stereoselective oxidation at C-4 of flavans by the endophytic fungus *Diaporthe* sp. isolated from a tea plant. *Chemical and Pharmaceutical Bulletin*, 53(12), pp.1565–1569.
 - b. **Buku**
Anderson, R.C. 2000. *Nematode Parasites of Vertebrates, Their Development and Transmission*. 2nd ed. CABI Publishing. New York. pp. 650.
 - c. **Prosiding atau hasil Simposium/Seminar/Lokakarya.**
Kurata, H., El-Samad, H., Yi, T.M., Khammash, M. and Doyle, J., 2001. Feedback Regulation of the Heat Shock Response in *Escherichia coli*. *Proceedings of the 40th IEEE Conference on Decision and Control*. Orlando, USA. pp. 837–842.
 - d. **Makalah sebagai bagian dari buku**
Sausan, D., 2014. Keanekaragaman Jamur di Hutan Kabungolor, Tau Lumbis Kabupaten Nunukan, Kalimantan Utara. Dalam: Irham, M. & Dewi, K. eds. *Keanekaragaman Hayati di Beranda Negeri*. pp. 47–58. PT. Eaststar Adhi Citra. Jakarta.
 - e. **Thesis, skripsi dan disertasi**
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Cibinong Science Centre, Jl. Raya Bogor Km. 46 Cibinong 16911
Telp: +61-21-8765067, Fax: +62-21-87907612, 8765063, 8765066,
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jurnalberitabiologi@yahoo.co.id atau
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