Utilization of Invasive Alien Species (IAS) by communities around Cibodas Biosphere Reserve (CBR): a recommendation for invasive alien species management and policy

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Abstract. The distribution of Invasive Alien Species (IAS) in the Cibodas Biosphere Reserve (CBR) area is enormous. Controlling IAS distribution is essential to be carried out, for the high potential threat to the native plant species. Generally, IAS species invade an open area of the forest. A review has been conducted with a literature study regarding recorded data about invasive alien species and studies about the utilization of plants by communities around CBR, especially the Gunung Gede Pangrango National Park area. The selected IAS list was further analyzed by using Index Cultural Significant (ICS). Recent studies concluded that 88 species of IAS spread out in the CBR area. On the other hand, many studies showed that IAS is widely used by the related communities in the CBR area. About 41 species out of 88 IAS were used by the communities, mainly for medicinal purposes. Utilisations of the medicinal plant were rooted in their traditional knowledge and culturally important for the communities’ livelihood. Additional input or recommendation for IAS management and policy in CBR was formulated by considering these conditions.

1. Introduction
Cibodas Biosphere Reserves (CBR) is the oldest biosphere reserves in Indonesia. It was inaugurated in 1977 with a core area of 15.196 ha. CBR is part of Gunung Gede Pangrango National Park (GGPNP). CBR area includes three districts, i.e., Cianjur, Bogor, and Sukabumi. As an integrated conservation area, CBR is a biological hotspot that has a high potential for biodiversity, which can be used sustainably by the community.

The threat from the spread of invasive alien plant species (IAS) in the CBR area is a challenge that must be faced by area managers, especially in the core zone of the GGPNP area. It is recorded that more than 80 species of invasive alien species have spread in the area of GGPNP [1 - 7]. Management of invasive alien species should be carried out with an integrating program and has much consideration. There were several reports on the study about invasive alien species in GGPNP, including the inventory of invasive alien species diversity and its dispersion [3, 4, 5, 7, 8, 9, 10], and also study about invasiveness stage [11].
On the contrary, the plants' species of CBR area are still widely used by the communities for their daily needs. In the Cibodas area, as many as 461 plant species, both native and alien species, have been identified as a useful plant [12] and 45 species identified as medicinal plants [13]. The community of the Bodogol area uses 215 species for various purposes [14] and 80 species of medicinal plants [15]. [16] found that 80 species of plants in two communities include Cianjur and Sukabumi, used as medicine. Moreover, several types of plants from that study were categorized as IAS. It shows the dependence of the community on the CBR area along with its IAS, and proper management action should be conducted.

Therefore, this study was conducted to determine which communities around CBR use invasive alien species. Linking to IAS management, this data is expected as input for recommendations in IAS management in the CBR.

2. Methodology
A review has been conducted with a literature study regarding recorded data about IAS and studies about the utilization of plants by communities around CBR, especially the GGPNP area. Seven key papers of IAS in GGPNP [1 - 7] have been contemplated review to produce a list of IAS in the CBR area. These papers were selected because all of the IAS in GGPNP are listed in these papers. The selected IAS lists were further analyzed using Index Cultural Significant (ICS) [17]. The ICS were calculated by the following formula:

$$ICS = \sum_{i=1}^{n} (q \times i \times e)u_i$$

The "q" is Quality of use, which means the nature of the role of plant culture as primary food, secondary food, and primary material. "I" is the intensity of use, which means the impact of the daily lives of people in a culture. While "e" is the exclusivity of use, it means certain types of factory priorities set by the community. The ICS value of the IAS in the CBR area was further analyzed to evaluate and arrange activity strategy, management, and policy toward the IAS. Although IAS usually viewed as pariahs of the plant kingdom [18], the species are yet increasingly recognized for their positive contributions, especially for small-scale, rural livelihoods [19].

3. Results and discussion
This study recorded 41 species from 19 family plants classified as invasive alien species (IAS) in Cibodas Biosphere Reserves are used by the community (Figure 1). Asteraceae dominated the family of IAS with 14 species. Asteraceae is a widespread plant characterized by widely dispersed seed and fast-growing [20]. Most of Asteraceae's habitus is herbaceous, and the community around them intensively utilizes them. The following figure gives a clear picture of family diversity and the dominant invasive alien plant in CBR (see Figure 1).

Based on life form, the most widely used plant is in the form of herbs (Figure 2). Plants with herbaceous habitus are generally easier to find and use. The utilization of invasive alien species by communities was divided into five groups, i.e., medicinal plant (38), food (4), firewood (2), feed (1), and lalab (3). Lalab (raw vegetable) is considered as a separate category due to the Sundanese menu habit. Fresh vegetable has been part of the life and culture of Sundanese people in West Java [21]. The utilization of invasive alien plants in CRB is dominated for medicinal purposes (Figure 3), corresponding with the high number of habitus herbaceous and shrub, which generally harvested for medicine in small-scale/ rural communities.
**Figure 1.** Number of IAS for each family.

**Figure 2.** Category of plant habitus.
3.1. Cultural significance value of invasive alien plant in CBR
A total of 41 invasive alien species in CBR have been analyzed by using ICS [17] (Table 1). The ICS value of the species varied from 3 (28 species) to 24 (Centella asiatica and Oxalis corniculata). A total of 38 species are used as a medicine, four as food, three as lalab, two as firewood, and one as feed (Figure 4). Seven species from the list have more than one use; for instance: Centella asiatica, Oxalis corniculata, Eryngium foetidum are consumed as medicine and food; Erechtites valerianifolius, Solanum torvum, Lantana camara are consumed as medicine and lalab; and Calliandra calothyrsus used as firewood and fodder. Medicinal uses to become the highest percentage of IAS utilization. Generally, several species such as Centella asiatica; Oxalis corniculata, Erechtites valerianifolius; Solanum torvum; Ageratum conyzoides; Artemisia vulgaris; Lantana camara; Mentha arvensis; Kalanchoe pinnata and Eryngium foetidum are used as medicinal purposes.

Figure 3. Group of IAS utilization.

![Figure 3](image_url)

Figure 4. Overlapping in IAS utilisations by community around CBR.

![Figure 4](image_url)
The highest rank of cultural significance invasive species in CBR is *Centella asiatica* (*antanan*) and *Oxalis corniculata* (*calincing*). These species are used for medicine and food. *Centella asiatica* has been using as a traditional medicine compound and mixed with other herbs to cure diarrhea and post-natal treatment in the Gede-Pangrango area [16]. *Centella asiatica* has become a potential herbal remedy for all in the world, because of its broad treatment goals, such as wound healing characteristics, sedative and anxiolytic properties, antidepressants, antiepileptic, cognitive and antioxidant properties, peptic ulcers, nociceptive and anti-inflammatory antics, and radioprotection [22]. This species is also directly consumed by the community. Based on Purnawan [12], *Centella asiatica* is among those of plants found in GGPNP, which has the potential to be developed and beneficial for the community. *Oxalis corniculata* is among those of plants found in GGPNP, which has the potential to be developed and beneficial for the community. *Oxalis corniculata* is an endangered species and medicinally important plant indigenous in tropical and subtropical regions [23]. In CBR, this species generally used as medicine and food (vegetable).

### Table 1. Cultural significance index of the invasive alien plant in Cibodas Biosphere Reserve.

| No. | Name | Vernacular | Uses | Intensity of Used | Quality of Used | Exclusivity of Used | ICS | Origin of the plants |
|-----|------|------------|------|------------------|----------------|---------------------|-----|----------------------|
| 1   | *Centella asiatica* | *antanan* | Medicine & food | 3 | 3 | 5 | 1 | 24 | Caucasus, Tropical & Subtropical Old World to New Zealand and Southwest Pacific. |
| 2   | *Oxalis corniculata* | *calincing* | Medicine & food | 3 | 3 | 5 | 1 | 24 | Mexico, Venezuela, Peru, and the Caribbean. |
| 3   | *Erechtites valerianifolius* | *sintrong* | Medicine & food | 2 | 3 | 5 | 1 | 16 | Mexico to Tropical America. |
| 4   | *Solanum torvum* | *takokak* | Medicine & food | 2 | 3 | 5 | 1 | 16 | Mexico to South America, the Caribbean, and East Brazil. |
| 5   | *Ageratum conyzoides* | *Babadota*; *bandotan* | Medicine | 5 | 3 | 0 | 1 | 15 | Mexico |
| 6   | *Artemisia vulgaris* | *ki saat*; *lokatmala* | Medicine | 5 | 3 | 0 | 1 | 15 | Temperate Eurasia to Indo-China, North Africa. |
| 7   | *Lantana camara* | *saliara* | Medicine & food | 3 | 3 | 2 | 1 | 15 | Mexico to Tropical America. |
| 8   | *Mentha arvensis* | *bijanggut* | Medicine | 4 | 3 | 0 | 1 | 12 | Europe to Kamchatka and Nepal. |
| 9   | *Kalanchoe pinnata* | *buntiris* | Medicine | 3 | 3 | 0 | 1 | 9 | Madagascar |
| 10  | *Eryngium foetidum* | *walang* | Medicine & food | 1 | 3 | 5 | 1 | 8 | Mexico to Tropical America |
| No. | Species                | Vernacular           | Uses                  | Intensity of Used | Quality of Used | Exclusivity of Used | ICS | Origin of the plants                                           |
|-----|------------------------|----------------------|-----------------------|-------------------|-----------------|---------------------|-----|----------------------------------------------------------------|
| 11  | Calliandra calothyrsus | kalliandra           | Firewood & food       | 1                 | 4               | 3                   | 1 7 | South Mexico to Central America.                                |
| 12  | Ageratina riparia      | teklan               | Medicine              | 2                 | 3               | 0                   | 1 6 | Mexico to Central America.                                     |
| 13  | Ageratum houstonianum  | bandotan             | Medicine              | 2                 | 3               | 0                   | 1 6 | Mexico to Central America.                                     |
| 14  | Bidens pilosa          | hareuga              | Medicine              | 2                 | 3               | 0                   | 1 6 | Topical & Subtropical America.                                 |
| 15  | Brugmansia suaveolens  | kecubung hutan        | Medicine              | 2                 | 3               | 0                   | 1 6 | Brazil                                                         |
| 16  | Euphorbia hirta        | nanangkaan, patikan  | Medicine              | 2                 | 3               | 0                   | 1 6 | Mexico to Tropical America.                                   |
| 17  | Piper aduncum          | kebo                  | Medicine              | 2                 | 3               | 0                   | 1 6 | Mexico to Tropical America.                                   |
| 18  | Polygala paniculata    | akar wangi, jukut rindik | Medicine            | 2                 | 3               | 0                   | 1 6 | Mexico to Tropical America.                                   |
| 19  | Sida rhombifolia       | sanagori              | Medicine              | 2                 | 3               | 0                   | 1 6 | Mexico to Tropical America.                                   |
| 20  | Solanum verbasciifolium | teter                | Medicine              | 2                 | 3               | 0                   | 1 6 | Florida, Bahamas, Texas to Guatemala.                         |
| 21  | Sonchus arvensis       | tempuyang             | Medicine              | 2                 | 3               | 0                   | 1 6 | Europe to Siberia and Caucasus.                               |
| 22  | Maesopsis eminii       | kaya afrika, manii    | Medicine              | 1                 | 4               | 0                   | 1 4 | Liberia to South Sudan and Zambira.                           |
| 23  | Amaranthus spinosus    | bayam dari            | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico to Tropical America.                                   |
| 24  | Austroeupatorium infulifolium | kirinyuh          | Medicine              | 1                 | 3               | 0                   | 1 3 | Panama to South Tropical America,                              |
| 25  | Bartlettina sordida    | babakoan              | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico to Guatemala.                                           |
| 26  | Cestrum aurantiacum    | ki jogo               | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico to Venezuela.                                           |
| 27  | Cestrum elegans        | ki jogo bereum        | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico                                                          |
| 28  | Clidemia hirta         | Food                  | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico to Tropical America.                                   |
| 29  | Cosmos caudatus        | Food                  | Medicine              | 1                 | 3               | 0                   | 1 3 | Mexico to South Tropical America.                             |
| 30  | Euphorbia prostrata    | patikan cina          | Medicine              | 1                 | 3               | 0                   | 1 3 | Macaronesia to West Siberia and Pakistan.                      |
| 31  | Euphorbia thymifolia   | nanangkaan            | Medicine              | 1                 | 3               | 0                   | 1 3 | Tropical & Subtropical America.                                |
| No. | Name                        | Vernacular       | Uses      | Intensity of Used | Quality of Used | Exclusivity of Used | ICS | Origin of the plants              |
|-----|-----------------------------|------------------|-----------|-------------------|----------------|---------------------|-----|----------------------------------|
| 32  | *Hyptis brevipes*           | puser, boboronga | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 33  | *Indigofera suffruticosa*   | tarum            | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 34  | *Passiflora edulis*         | pasi             | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 35  | *Passiflora suberosa*       | konyal           | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 36  | *Physalis peruviana*        | cecenet          | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 37  | *Rumex alpinus*             |                  | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 38  | *Solanum aculeatissimum*    | terong belanda   | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 39  | *Spilanthes acmella*        | getang           | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 40  | *Stachytarpheta jamaicensis*| jarong           | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |
| 41  | *Taraxacum officinale*      | jombang          | Medicine  | 1                 | 3              | 0                   | 1   | 3                               |

However, a total of 15 species from 41 useful invasive alien species (see Table 1) were considered as significant IAS in Indonesia, i.e., *Ageratina riparia*, *Austroeupatorium inulifolium*, *Bartlettina sordida*, *Bidens pilosa*, *Brugmansia suaveolens*, *Calliandra calothyrsus*, *Cestrum aurantiacum*, *Clidemia hirta*, *Erechtites valerianifolius*, *Lantana camara*, *Maesops eminii*, *Passiflora edulis*, *Piper aduncum*, *Solanum verbascifolium*, and *Stachytarpheta jamaicensis* [6, 13, 12]. It is showed that these species are widely used by the community in the Cibodas area. [24] stated that in Bodogol, *Calliandra calothyrsus* (7) and *Maesops eminii* (4) have high ICS. This means these species of IAS has become part of community culture in Bodogol. In the Alahan Panjang community, West Sumatra, *Passiflora edulis* was used as the main ingredient in making markisah syrup, so this species is a prospective horticultural fruit commodity to be developed [25]. *Calliandra calothyrsus* also used for revegetation on degraded land because of its roots ability to grip the soil and have rapid growth [26].

Many potentials of IAS are important points as consideration for IAS management in the CBS area. Adopting IAS management from *Cestrum aurantiacum* management at remnant forest Cibodas Botanic Gardens, there are five options to do: harvesting, bio-controlling, containment, eradication and do nothing [27]. Harvesting is applied when the community utilizes IAS. Hence, that species still exist and possible to be harvested regularly, so the population still controlled. Bio-controlling is applied if some animals or plants can interfere with the growth of IAS. This scheme needs further study to find out the animals or plants that can inhibit IAS growth. Containment is done by keeping IAS from spreading everywhere. This is certainly difficult for IAS that has far-off fruit and seed dispersal abilities, especially in the natural forest. Eradication scheme needs much cost, moreover for IAS,
which has spread widely. This scheme also has a high ecological impact. Do nothing is not a choice because the threat from the spread of IAS has really happened.

From that several management options, there are three management options that can be adopted for managing these potential IAS. Based on minimizing ecological impact, maximizing public acceptance, and minimizing cost, the three options to do are harvesting, bio-controlling, and containment. Based on the existing IAS list (Table 1), the application of harvesting can be executed towards an IAS, which commonly known as medicinal properties or food sources. Only species with high population abundance might be harvested regularly. Various species such as Centella asiatica, Artemisia vulgaris, Mentha arvensis, Piper aduncum, Physalis peruviana have been commonly known to have certain medicinal properties are potentially harvested regularly. Whereas species that have potential as alternative foods such as Centella asiatica, Solanum torvum, Cosmos caudatus, Eryngium foetidum, Lantana camara, Erechtites valerianifolius, Oxalis corniculata.

It is necessary to know the specific biological agents available for existing IAS to determine the bio-controls application. [28] showed the impact of classical biocontrol, biocontrol agents significantly reduced plant size (28 ± 4%), plant mass (37 ± 4%), flower and seed production (35 ± 13% and 42 ± 9%, respectively) and target plant density (56 ± 7%). The study showed that Chrysomelidae and Curculionidae (beetles) families were more effective in reducing plant size. A meta-analysis of biological agent performance by Stiling and Cornelissen [29] showed that biocontrol agents significantly reduced weed biomass (-82.0%), flower (-98.9%), and seed production (-89.4%). This analysis was used 145 studies that examine the effects of types of biocontrol agents, i.e. parasitoids, predators, and pathogens on weed and pest populations. In South Africa, [30] used six species of insects as biological agents to against Lantana camara, i.e Calycomyza lantanae (fly), Hypena laceratalis (moths/native to South Africa), Octotoma scabripennis (leaf beetle), Ophiomyia lantanae (fly), Teleonemia scrupulosa (lantana lace bug), and Uroplata girardi (Lantana leaf miner).

The way these biological agents works is by damaging the leaves so it can reduce photosynthetically and also direct reduction of seed production by eating the fruit. Furthermore, a study by [31] found that Teleonemia scrupulosa has a significant effect on plant growth and reproductive capacity. It suggests that T.scrupulosa making a much greater contribution as biological control of Lantana camara in South Africa. Biological control programs have to be a species-by-species effort continually. When invasive alien plants, directly and indirectly, risking human well-being, biological control is a cost-effective program and sustainable tools to be used to maintain ecosystem services. This activity should be supported by strong commitment and sustainable funding. Biological controlling could play a larger role in mitigation and adaptation strategies to maintain biological diversity as well as contribute to human well-being [32]. More time is needed to study the specific types of biological agents on each IAS. Besides, comprehensive studies have to be conducted before implementing this type of management. Due to its complex process of determining the type of biological agent and its impact on the ecosystem, bio-controlling requires huge support of the study.

Containment can be implemented for IAS, which are in an early stage of invasion and expanding their range [33]. This action requires more information about the spread and level of IAS abundance in every area. Containment implementation needs adequate resources for a long period of time and commitment to management. IAS must be placed only in the area where the species is found, and evade the spread. Containment applications can be mixed with regular harvesting to control the species abundance.

4. Conclusion
There are 41 species of invasive alien species that used by communities around Cibodas Biosphere Reserves, with the highest use is medicinal purposes. The result of this study indicated that invasive alien species also have many beneficial potentials for the community, so the management option to do is harvesting, bio-controlling, and containment. For this reason, further studies should be conducted on
people's attitudes towards invasive foreign plants that are beneficial to them. A study on the abundance of each IAS and their physiology and ecology as considerations for the management of specific invasive alien species in the Cibodas Biosphere Reserve Area is also necessary.

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References
[1] Tjitrosoedirdjo S S 2005 Inventory of the invasive alien plant species in Indonesia Biotropia-The Southeast Asian Journal of Tropical Biology 25
[2] Tjitrosoedirdjo S S 2008 Notes on the profile of Indonesian invasive alien plant species Biotropia-The Southeast Asian Journal of Tropical Biology 14 (1) 62-68
[3] Sunaryo and Tihurua E F 2010 Catatan jenis-jenis tumbuhan asing dan invasif di Taman Nasional Gunung Gede-Pangrango, Jawa Barat Berita Biologi 10 (2) 265-267
[4] Sunaryo, Uji T and Tihurua E F 2012 Jenis tumbuhan asing invasif yang mengancam ekosistem di Taman Nasional Gunung Gede Pangrango, Resort Bodogol, Jawa Barat Berkala Penelitian Hayati 17 141-152
[5] Mustika D S, Panjaitan P B and Setiawan I 2013 Pemetaan sebaran Invasive Alien Species (IAS) konyal (Passiflora suberosa L) di Resort Pemangkuan Taman Nasional Mandalawangi, Taman Nasional Gunung Gede Pangrango Jurnal Nusa Sylva 13 (2) 1-8
[6] Tjitrosoedirdjo S S, Muwardi I and Tjitrosoedirdjo S 2016 75 Important Invasive Plant Species in Indonesia (Bogor: SEAMEO BIOTROP Indonesia)
[7] Padmanaba M, Tomlinson K W, Hughes A C and Corlett R T 2017 Alien plant invasions of protected areas in Java, Indonesia Sci. Rep. 7 (1) 9334
[8] Tjitrosoedirdjo S S and Veldkamp J F 2008 Bartlettina sordida (Eupatorium sordidum) (Compositae), an invasive alien plant species in the Gede Pangrango National Park, West Java, Indonesia Flora Malesiana Bulletin 14 (3)
[9] Zuhri M, and Mutaqien Z 2013 The spread of non-native plant species collection of Cibodas Botanical Garden into Mt. Gede Pangrango National Park J. Trop. Life Sci. 3 (2) 74-82
[10] Kudo Y, Mutaqien Z, Simbolon H and Suzuki E 2014 Spread of invasive plants along trails in two national parks in West Java, Indonesia Tropics 23 (3) 99-110.
[11] Utomo B, Kusmana C, Tjitrosemito S and Aidi M N 2007 Kajian kompetisi tumbuhan asing terhadap pohon hutan pegunungan asli Taman Nasional Gunung Gede Pangrango J. MHT 13 (1) 1-13
[12] Purnawan B I 2006 Inventarisasi keanekaragaman jenis tumbuhan di Taman Nasional Gunung Gede Pangrango (Bogor: Undergraduate School Institut Pertanian Bogor)
[13] Fakhirrozi I, Priyanti P and Astutik S 2015 Keanekaragaman jenis tumbuhan obat pada plot cuplikan di hutan Taman Nasional Gunung Gede Pangrango, Indonesia Al-Kauniyah: Jurnal Biologi 8 (2) 109-112
[14] Rahayu M, Susiarti S and Sihotang V B L 2012 A preliminary ethnobotanical study on useful plants by local communities in Bodogol Lowland Forest, Sukabumi, West Java J. Trop. Biol. Conserv. 9 (1) 115-125
[15] Sihotang V B L 2011 Ethnomedicinal study of the Sundanese people at the Bodogol area, Gede Pangrango Mountain National Park, West Java Garden Bulletin Singapore 63 (1-2) 519-526
[16] Rosita S M D, Rostiana O, Pribadi E R, Hernani H 2016 Penggalian iptek etnomedisin di Gunung Gede Pangrango Bulletin Penelitian Tanaman Rempah dan Medicine 18 (1) 13-28
[17] Turner N J 1988 "The importance of a rose": evaluating the cultural significance of plants in Thompson and Lillooet Interior Salish Am. Anthropol. 90 (2) 272-290
[18] Davis M A, Chew M K, Hobbs R J, Lugo A E, Ewel J J, Vermeij G J, Brown J H, Rosenzweig M L, Gardener M R, Carroll S P, Thompson K, Pickett S T A, Stromberg J C, Del Tredici P, Suding K N, Ehrenfeld J G, Grime J P, Mascaro J and Briggs J C 2011 Wild edible herbs in paddy fields and their sale in a mixture in Houaphan Province, the Lao People's Democratic Republic *Econ. Bot.* **67** 335–349.

[19] Kosaka Y, Xayvongsa L, Vilayphone A, Chanthavong H, Takeda S and Kato M 2013 Proceedings of International Conference of Cultural Sundanese. Vol. 2. (Indonesia: Yayasan Kebudayaan Rancage, Bandung).

[20] Funk V A 2009 Pharmacological review on Centella asiatica: a potential herbal cure-all *Indian J. Pharm. Sci.* **54** 6-556.

[21] Badwaik H, Singh M K, Thakur D, Giri T K and Tripathi D K 2011 The botany, chemistry, pharmacological and therapeutic application of Oxalis Corniculata Linn– A Review *Int. J. Phytomedicine* **3** 01-08

[22] Rahayu M, Purwanto Y and Susiarti S 2012 Nilai kepentingan budaya keanekaragaman jenis tumbuhan bergunadi hutan dataran rendah Bodogol, Sukabumi, Jawa Barat *Berita Biologi* **11** (3) 313-320

[23] Fauza H, Sutoyo S and Putri N E 2015 The status of the existence of the purple markisa germ plasm in Alahan Panjang, Solok District, West Sumatera *Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia* **1** (7) 1559-1564

[24] Narendra B H 2012 Pengaruh perbaikan kondisi tanah terhadap pertumbuhan kaliandra (Calliandra calothyrsus) dan buni (Antidesma bunius) di Kawasan Konservasi Gunung Batur, Bali *J. PHKA* **9** (2) 101-111

[25] Junaedi D I 2012 Invasive plants in mountainous remnant forest: recommendation for choosing best decision for invasive species management of Cestrum aurantiacum Lindl *Buletin Kebun Raya* **15** (1) 36-45

[26] Clewley G D, Eschen R, Shaw R H and Wright D J 2012 The effectiveness of classical biological control of invasive plants *J. Appl. Ecol.* **49** (6) 1287-1295

[27] Seastedt T R 2014 Biological control of invasive plant species: a reassessment for the Anthropocene *New Phytol.* **205** (2) 490–502

[28] Meyer J Y, Loope L L and Goarant A C 2011 Strategy to control the invasive alien tree *Miconia calvescens* in Pacific islands: eradication, containment or something else. *Island invasives: eradication and management. IUCN, Gland, 91-96*