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The Role of Home Gardens in Conserving Threatened Plants of the Philippines

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ABSTRACT

The number of threatened plants in the Philippines continues to rise due to emerging threats such as rapid growth of population, increased rate of land conversion, the introduction of invasive alien species, climate change and, illegal trade of wildlife. Sustainable conservation programs for Philippine plants that will promote the participation of ordinary citizens through the establishment of home gardens and collaboration among researchers and horticulturists are needed more than ever. This paper presents the potential role of home gardens in safeguarding species of conservation concern. Three home gardens on Luzon were surveyed, wherein 75 morpho-species were recorded. Ten were found to be endemic to the Philippines, while 18 were native. Of the 75 morpho-species, 19 were listed as threatened in either IUCN Red List (IUCN, 2018-1) or the Philippine Red List (DAO, 2017-11). This likely indicates the importance of home gardens in conserving species, especially the threatened ones, through ex-situ.

Keywords: community science, conservation, ex-situ, home gardens, threatened plants

INTRODUCTION

The Philippines is one of the most biologically rich countries based on plant endemism (Mittermeier et al., 1997; 1998). In the most recent statistics, approximately 4,441 species of flowering plants accounting for more than 50% of the total native species recorded in the country are known to be endemic (Pelser et al., 2011 onwards). This only proves the significant role of the country in maintaining plant diversity on a global scale. However, we fear that these endemic plants will go extinct if not given attention and left unprotected from the threats driven by human activities. Land-use change and other related pressures serve as the main driver for reduced terrestrial biodiversity (Newbold et al., 2016). From 2001 to 2019, the Philippines has lost 143,000 ha of primary forests due to commodity-driven deforestation, shifting agriculture, then establishment of plantations, natural forest harvesting, and urbanization (GFW, 2020). The presence of these threats makes the country a picture of ecological ruin (Bagarinao, 1999; Posa et al., 2008).

In the past decades, the increase in the total number of threatened species

proved that continuous and progressive habitat loss had placed the Philippine biodiversity at stake. In 2007, the Department of Environment and Natural Resources (DENR) released an official list of threatened Philippine plants. Among 526 threatened species, 99 are Critically Endangered; 187 are Endangered; 176 are Vulnerable, and 64 are listed under Other Threatened Species (DENR, 2007). The number of threatened plants almost doubled after a decade. The DENR (2017) included 948 species on the Updated National List of Threatened Philippine Plants and Their Categories (DAO, 2017-11). Based on the list, 179 are Critically Endangered; 254 are Endangered; 406 are Vulnerable, and 145 are Other Threatened Species.

The perilous state of Philippine biodiversity encouraged government agencies and organizations to implement collaborative conservation programs in the country. These programs include establishing Protected Areas (PAs), conservation breeding, and conducting research on globally important species. The DENR-Biodiversity Management Bureau (DENR-BMB), the primary institution responsible for the conservation and protection of biodiversity, initiated the Enhanced Biodiversity Conservation Program. This aims to establish ecotourism areas, delineate critical habitats, and strengthen the National Integrated Protected Areas System (NIPAS) Act. Similarly, non-government organizations (NGOs) like Conservation International-Philippines (CI-PH), Foundation for the Philippine Environment (FPE), Forest Foundation Philippines (FFP), Philippine Biodiversity Conservation Foundation Inc. (PBCFI), and many other groups share a common goal towards the protection of the environment and inhabiting species. Nevertheless, conducting and sustaining conservation activities are not instantaneous and require a large amount of funding. It has been recognized that conservation efforts in the Philippines continue to lag due to management and funding constraints (Dizon, 2012). In the concept of conservation, time is very crucial because species extinction is irreversible.

The protection of forestlands, which requires large capitals, does not guarantee efficient and successful conservation of species, particularly for plants. Moreover, species conservation does not depend solely on these practices. It is of great consideration that biodiversity conservation requires a holistic approach and versatile strategies. Hence, this can be done in numerous ways. For example, the conservation of plant genetic resources in home gardens is now being recognized by the International Plant Genetic Resources Institute (IPGRI) to contribute to their goal of preserving genetic diversity (Watson & Eyzaquirre, 2002). Home gardening in Nepal is considered a good source of food, fuel, medicine, and

building materials (Gautam et al., 2006). This is also recognized as a sustainable practice for the in-situ conservation of plants (Gautam et al., 2009; Pandey et al., 2006; Webb & Kabir, 2009). It was observed that home gardens help preserve rare and endangered species (Kumar & Nair, 2004). In Sri Lanka, biodiversity conservation in gewatta or the indigenous forest like home gardens surrounding the villagers' homes is also being practiced (Hochegger, 1998). Traditional home gardens in Northeast India preserve diverse types of local plant species (Tangjang & Arunachalam, 2009). Home gardening has proved its capability to house threatened species without the expenditure of a large sum of money.

Despite the efforts of the government and other sectors in taking actions against biodiversity loss, the number of Philippine threatened plants keeps on rising. However, the viewpoint regarding this conservation status is limited to the number of plant species in their natural habitat. An accurate assessment of the status of these threatened species will only be settled if all possible repositories are evaluated. Similarly, the role of home gardens in conserving threatened plant species in the Philippines is not yet recognized.

OBJECTIVES OF THE STUDY

This study provided an overview of the potential role of home gardens in conserving threatened and endemic plants in the Philippines. Specifically, it aimed to: a) survey and identify the plant species in home gardens; b) confirm the ecological and conservation status of the identified plants; and c) determine conservation implications of threatened plants in home gardens.

MATERIALS AND METHODS

Selection of Home Gardens

Three home gardens were surveyed to document the occurrence of threatened plants outside the forest (Table 1, Figure 1). The home garden in Cavite was established in 1987 when the owner started collecting ornamental plants from the different parts of the country. On the other hand, the home garden in Isabela started by cultivating few plants found around the area since the 1960s. It is only in the year 2007 that the owner of the said garden started purchasing plants from landscape gardens. The home garden in Quezon City was established in 2009, driven by the advocacy to conserve endemic and threatened plant species. Home gardens were selected based on the size of the area, accessibility, and diversity of

plant collections. Owners of the home gardens were informed about the study's purpose before surveying the garden.

Table 1

Home gardens surveyed on Luzon Island

No.	Code	Location	Size (m^2)	Year of Establishment
1	CAV	Indang, Cavite	156	2007
2	ISA	San Mariano, Isabela	300	1960
3	QC	Quezon City, Metro Manila	250	2009

Figure 1. Surveyed home gardens in a) Isabela, b) Cavite and c) Quezon City.

Documentation of Threatened Plants

All plants in the surveyed home gardens were recorded and documented. Classification of the conservation status of plants was based on the Updated National List of Threatened Plants in the Philippines (DAO, 2017-11) and the IUCN Red List (IUCN, 2018-1).

Identification of Plants

Plants observed in home gardens was initially identified by reviewing relevant literature on Philippine flora. Subsequently, photos of the unknown plants were compared with the digital images available online. Scientific names were verified on the International Plant Names Index (IPNI, 2020) and standardized with the Plants of the World Online (POWO, 2019). Distribution and endemism of plants were determined using online databases such as the Co's Digital Flora (Pelser et al., 2011 onwards), and Global Biodiversity Information Facility (GBIF, 2020).

RESULTS AND DISCUSSION

Species Richness

There were 75 morpho-species belonging from 60 genera and 33 families recorded in three home gardens. Out of 75 morpho-species, 64 were identified to species level and 11 to genus level. These include *Nepenthes* sp. (Nepenthaceae), *Aeschynanthus* sp. (Gesneriaceae), *Begonia* sp. 1 and, 2 (Begoniaceae), *Melastoma* sp. (Melastomataceae), *Phalaenopsis* sp. (Orchidaceae), *Zamia* sp. (Zamiaceae), *Syngonium* sp. (Araceae), *Spathiphyllum* sp. (Araceae), *Calanthe* sp. (Orchidaceae), and *Schefflera* sp. (Araliaceae).

Plant families with the highest species richness were Asparagaceae, followed by Dipterocarpaceae and Orchidaceae (Figure 2). Most of the species belonging to Asparagaceae were recorded in San Mariano, Isabela, while species from Dipterocarpaceae were found in Quezon City. On the other hand, most of the orchids were from Indang, Cavite.

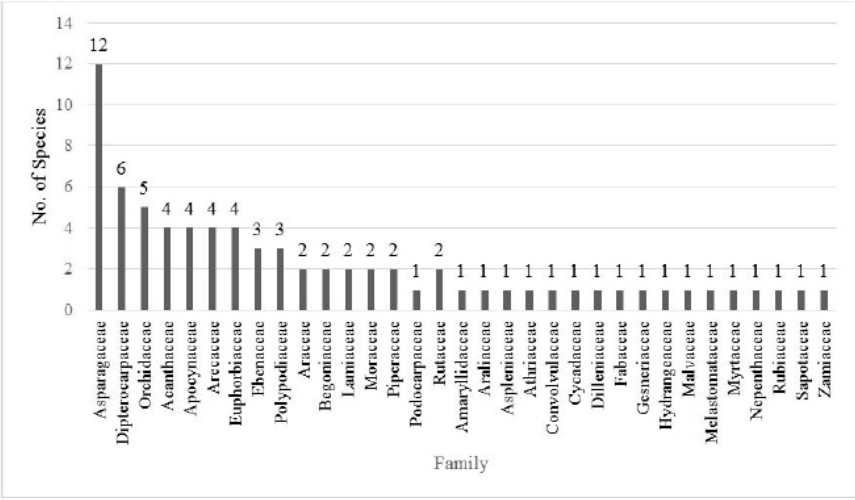

Figure 2. Species Richness per Family.

More than half of the species recorded were found in a 300m2 home garden in San Mariano, Isabela, as shown in Table 2. Most of which are exotic ornamental plants. Only six species were found native. Likewise, most species in a home garden in Indang, Cavite, were exotic. Only two species were endemic to the Philippines. Unlike the previously mentioned gardens, the 250 m2 home garden in Quezon City comprised most native species. Eight out of 15 species were found to be endemic to the Philippines.

Table 2

Total Number of Species Recorded in Home Gardens per Location

Location	No. of Species
Indang, Cavite	14
Quezon City	15
Quezon City & Indang, Cavite	1
Quezon City & San Mariano, Isabela	1
San Mariano, Isabela	44
Total	75

Endemism

Overall, there were ten endemic species and 18 indigenous species recorded, Noteworthy among these are island-endemic species such as *Vanda sanderiana*.,

Dillenia sibuyanensis and *Tectona philippinensis*. The summary of species with details on their endemism is presented in Table 3.

Table 3

List of all species recorded and their endemism

No.	Location	Common name	Scientific name	Family	Endemism
1	ISA	Diluario	*Acanthus ebracteatus* Vahl	Acanthaceae	NE
2	CAV		*Fittonia albivenis* (Lindl. ex Veitch) Brummitt	Acanthaceae	EX
3	ISA		*Sanchezia speciosa* Leonard	Acanthaceae	EX
4	CAV		*Thunbergia mysorensis* (Wight) T. Anderson	Acanthaceae	EX
5	CAV		*Hippeastrum puniceum* (Kar Gawl.) Herb.	Amaryllidaceae	EX
6	ISA	Desert rose	*Adenium obesum* (Forssk.) Roem. & Schult	Apocynaceae	EX
7	CAV	Waxflower	*Hoya australis* R. Br. ex Traill	Apocynaceae	EX
8	CAV		*Hoya cumingiana* Decne	Apocynaceae	PE
9	ISA		*Plumeria rubra* L.	Apocynaceae	EX
10	ISA		*Spathiphyllum* sp.	Araceae	-
11	ISA		*Syngonium* sp.	Araceae	-
12	ISA		*Schefflera* sp.	Araliaceae	-
13	ISA	Bunga	*Areca catechu* L.	Arecaceae	NE
14	ISA	Niog	*Cocos nucifera* L.	Arecaceae	NE
15	ISA	Palmera	*Dypsis lutescens* (H.Wendl.) Beentje & J.Dransf.	Arecaceae	EX
16	ISA	Date palm	*Phoenix canariensis* H.Wildpret	Arecaceae	EX
17	ISA	Foxtail	*Agave attenuata* Salm-Dyck	Asparagaceae	EX
18	ISA	Carribean agave	*Agave vivipara* L.	Asparagaceae	EX
19	ISA		*Asparagus setaceus* (Kunth) Jessop	Asparagaceae	EX
20	ISA	Cabbage palm	*Cordyline australis* (G. Forst.) Endl.	Asparagaceae	EX
21	ISA		*Cordyline fruticosa* (L.) A.Chev.	Asparagaceae	EX
22	ISA	Malasambal	*Dracaena angustifolia* (Medik.) Roxb.	Asparagaceae	NE
23	ISA	Fortune plant	*Dracaena fragrans* (L.) Ker Gawl.	Asparagaceae	EX
24	ISA	Song of India	*Dracaena reflexa* var. *angustifolia* Baker	Asparagaceae	EX
25	ISA		*Dracaena roxburghiana* (Schult. & Schult.f.) Byng & Christenh.	Asparagaceae	EX
26	ISA	Gold Dust Dracaena	*Dracaena surculosa* Lindl.	Asparagaceae	EX

Table 3 continued.

No.	Commonname	Scientific name	Family	IUCN 2018-1	DAO 2017-11
1	Katmon sibuyan	*Dillenia stbuyanensis* (Elmer) Merr.	Dilleniaceae		EN
2	Palosapis	*Anisoptera thurifera* (Blanco) Blume	Dipterocarpaceae	VU	
3	Dao	*Dracontomalondao* (Blanco) Merr. & Rolfe	Dipterocarpaceae		VU
4	Bagtikan	*Parashorea malaanonan* (Blano) Merr.	Dipterocarpaceae	CR	
5	Yakal	*Shorea astylosa* Foxw.	Dipterocarpaceae	CR	CR
6	Red lauan	*Shorea negrosensis* Foxw.	Dipterocarpaceae	CR	VU
7	Tanguile	*Shorea polysperma* (Blanco) Merr.	Dipterocarpaceae	CR	VU
8	Mabolo	*Diospyros discolor* Willd.	Ebenaceae		VU
9	Ebony	*Diospyros ferrea* (Willd.) Bakh.	Ebenaceae	EN	VU
10	Bolongeta	*Diospyros pilosanthera* Blanco	Ebenaceae		VU
11	Tindalo	*Afzelia rhomboidea* (Blanco) Fern.-Vill.	Fabaceae	VU	EN
12	Philippine teak	*Tectona philippinensis* Benth. & Hook.f. ex Merr.	Lamiaceae	CR	CR
13	Antipolo	*Artocarpus blancoi* (Elmer) Merr.	Moraceae	VU	
14	Mangkono	*Xanthostemon verdugonianus* Náves ex Fern.-Vill.	Myrtaceae	VU	EN
15		*Vanda sanderiana* (Rchb.f.) Rchb.f.	Orchidaceae		CR
16		*Vanilla planifolia* Andrews	Orchidaceae	EN	
17	Igem dagat	*Podocarpus costalis* C.Presl.	Podocarpaceae	EN	
18	Giant staghorn fern	*Platycerium grande* (A.Cunn.) J.Sm.	Polypodiaceae		CR
19	Nato	*Palaquium luzoniense* (Fern. Vill.) Vidal	Sapotaceae	VU	VU

Note. VU – Vulnerable; EN – Endangered; CR – Critically Endangered

Table 3 continued.

No.	Location	Common name	Scientific name	Family	Endemism
55	CAV		*Melastoma* sp.	Melastomataceae	-
56	ISA	Rimas	*Artocarpus altilis* (Parkinson) Fosberg	Moraceae	NE
57	QC	Antipolo	*Artocarpus blancoi* (Elmer) Merr.	Moraceae	PE
58	QC	Mangkono	*Xanthostemon verdugonianus* Naves ex Fern.-Vill.	Myrtaceae	PE
59	CAV		*Nepenthes* sp.	Nepenthaceae	-
60	ISA		*Calanthe sp.*	Orchidaceae	-
61	CAV		*Epidendrum radicans* Pav. ex Lindl.	Orchidaceae	EX
62	ISA		*Phalaenopsis* sp.	Orchidaceae	-
63	CAV		*Vanda sanderiana* (Rchb.f.) Rchb.f.	Orchidaceae	PE
64	CAV		*Vanilla planifolia* Andrews	Orchidaceae	EX
65	CAV		*Peperomia obtusifolia* (L.) A.Dietr.	Piperaceae	EX
66	ISA	Ikmo	*Piper betle* L.	Piperaceae	EX
67	QC & ISA	Igem dagat	*Podocarpus costalis* C.Presl.	Podocarpaceae	NE
68	ISA	Kabkab	*Drynaria quercifolia* (L.) J.Sm.	Polypodiaceae	NE
69	ISA		*Microsorum punctatum*L. Copel.	Polypodiaceae	NE
70	QC & CAV	Giant staghorn fern	*Platycerium grande* (A.Cunn.) J.Sm.	Polypodiaceae	NE
71	ISA	Rosal	*Gardenia jasminoides* J. Ellis	Rubiaceae	EX
72	ISA	Lukban	*Citrus maxima* (Burm.) Merr.	Rutaceae	EX
73	ISA		*Citrus x aurantiifolia* (Christm.) Swingle	Rutaceae	EX
74	QC	Nato	*Palaquium luzoniense* (Fern.-Vill.) Vidal	Sapotaceae	PE
75	ISA		*Zamia* sp.	Zamiaceae	-

Note. EX – exotic or introduced; NE – native but non-endemic; PE – endemic to the Philippines

Threatened Species

Aside from the Philippine endemic species, it is also important to note the species of conservation concern. Nineteen species were included in either the Philippine Red List or IUCN (Table 3). Most are species of dipterocarps, which provide premium timber. Three species of Ebenaceae, namely – *Diospyros discolor, Diospyros ferrea,* and *Diospyros pilosanthera,* were also recorded. In the list of threatened species, four are Critically Endangered, three Endangered and, seven Vulnerable based on DAO (2017-11). Contrariwise, five species were listed as Critically Endangered, three Endangered and, six Vulnerable based on the IUCN (2018-1).

Table 4

List of threatened species in selected home gardens

No.	Commonname	Scientific name	Family	IUCN 2018-1	DAO 2017-11
1	Katmon sibuyan	*Dillenia stbuyanensis* (Elmer) Merr.	Dilleniaceae		EN
2	Palosapis	*Anisoptera thurifera* (Blanco) Blume	Dipterocarpaceae	VU	
3	Dao	*Dracontomalondao* (Blanco) Merr. & Rolfe	Dipterocarpaceae		VU
4	Bagtikan	*Parashorea malaanonan* (Blano) Merr.	Dipterocarpaceae	CR	
5	Yakal	*Shorea astylosa* Foxw.	Dipterocarpaceae	CR	CR
6	Red lauan	*Shorea negrosensis* Foxw.	Dipterocarpaceae	CR	VU
7	Tanguile	*Shorea polysperma* (Blanco) Merr.	Dipterocarpaceae	CR	VU
8	Mabolo	*Diospyros discolor* Willd.	Ebenaceae		VU
9	Ebony	*Diospyros ferrea* (Willd.) Bakh.	Ebenaceae	EN	VU
10	Bolong eta	*Diospyros pilosanthera* Blanco	Ebenaceae		VU
11	Tindalo	*Afzelia rhomboidea* (Blanco) Fern.-Vill.	Fabaceae	VU	EN
12	Philippine teak	*Tectona philippinensis* Benth. & Hook.f. ex Merr.	Lamiaceae	CR	CR
13	Antipolo	*Artocarpus blancoi* (Elmer) Merr.	Moraceae	VU	
14	Mangkono	*Xanthostemon verdugonianus* Naves ex Fern.-Vill.	Myrtaceae	VU	EN
15		*Vanda sanderiana* (Rchb.f.) Rchb.f.	Orchidaceae		CR
16		*Vanilla planifolia* Andrews	Orchidaceae	EN	
17	Igem dagat	*Podocarpus costalis* C.Presl.	Podocarpaceae	EN	
18	Giant staghorn fern	*Platycerium grande* (A.Cunn.) J.Sm.	Polypodiaceae		CR
19	Nato	*Palaquium luzoniense* (Fern. Vill.) Vidal	Sapotaceae	VU	VU

Note. VU – Vulnerable; EN – Endangered; CR – Critically Endangered

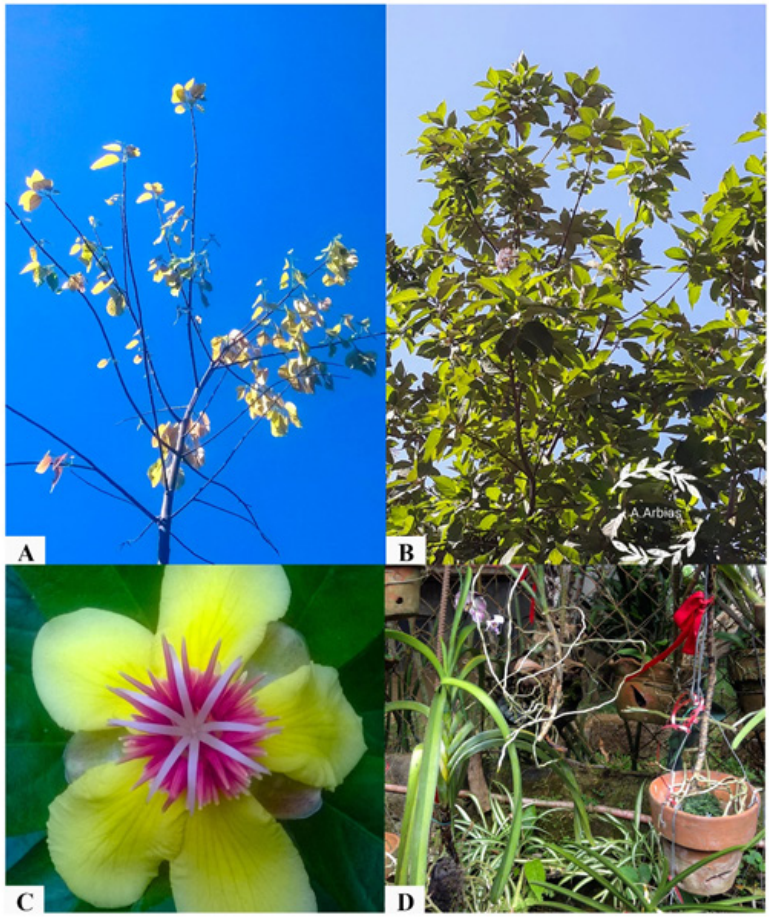

Figure 3. Selected photos of threatened plants recorded. – a) Shorea negrosensis, b) Tectona philippinensis, c) Dillenia sibuyanensis & d) Vanda sanderiana (Note. Photo credits: a-c. – A. Arbias & d. – A.M. Baltazar).

Planting of threatened species in home gardens provides a new perspective for species conservation. Nevertheless, this concept of conservation strategy has already been described and promoted in 2004. Michener (2004) described reconciliation ecology as a win-win strategy that allows humans and species to live in harmony. Moreover, it also "offers a valuable social by-product" aside from being a potential tool for conservation.

Based on the results, we have seen the differences of species planted in the three home gardens. Species in home gardens in Isabela and Cavite are mostly, if not all, exotics. On the other hand, the species planted in Quezon City are all endemic. Planting native trees have always been recommended by the scientific community to avoid altering of vegetation structure in natural habitats of species and invasion of exotics. The differences in the species composition of the home gardens are most likely related to the owner's interest. The owner of the home garden in Quezon City is an advocate of Philippine native trees. According to the owner, most of the planted species in his home garden came from the nursery of DENR. A "1 specimen to 1 species" policy is also being implemented in his home garden to maximize the space, which allows him to add more native plants to his garden.

Home gardens can both serve as a bridge for conservation or introduction of invasive alien species and illegal trade of wildlife. Therefore, the endemism and conservation status of the species should be considered by the owner of home gardens. In the Philippines, there are existing laws, which require Filipino citizens to plant trees. The Presidential Decree 1153 (PD 1153) "requires all Filipino citizens at least ten years of age to plant a tree once a month for five consecutive years." Other policies and laws that promote trees' planting are the Republic Act of 10176 or the Arbor Day Act of 2012, and PD 953. Unfortunately, these laws were not strictly implemented and are not feasible because of a lack of planting space, especially in urban areas.

For the past decades, and with the increasing rate of deforestation due to continuous land-use change, the conservation of plants is the least priority. However, it is seen that biodiversity conservation in the Philippines is heading towards success despite the slow progress with the efforts of the government and other conservation groups (Posa et al., 2008). This growing trend in species conservation is the fruit of numerous biodiversity assessments and surveys throughout the country that awakened the environmental consciousness of many Filipinos. A giant real estate firm in the Philippines already use native trees and ornamentals in their urban landscapes (Ayala Land, 2016a; 2016b).

Conservation of plants requires the shared efforts of the government and the community. The citizens should be aware that they can also participate in this agenda by housing native and threatened species in their gardens. Through time, the accumulated efforts of each citizen in species conservation will have a big positive impact on Philippine biodiversity.

CONCLUSIONS

Home gardens play a significant role in conserving Philippine plants, as evidenced by endemic (10) and threatened species (19) in the surveyed places. This study has identified endemic and exotic plants housed in the home gardens. It confirms as well that at least one threatened species is being conserved in a home garden. With these findings, we highly suggest that the role of home gardens should not be underestimated. Home gardens can also serve as an avenue to promote urban biodiversity. By educating the Filipinos on species conservation, working collaboratively, and mainstreaming the home gardens' significance, an effective method for protecting the threatened plants can be implemented sustainably. The number of home gardens surveyed represents only a small fraction of the total home gardens throughout the Philippines.

RECOMMENDATIONS

It is recommended that plants in all home gardens be documented. Lastly, the authors encourage the policy-makers to promote the establishment of home gardens with an effective monitoring system to fully serve its purpose for sustainable conservation and protection of threatened species.

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