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CHAPTER 23

Rimba Ilmu and its role in plant conservation

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Abstract: Rimba Ilmu Botanic Garden, established in 1974 within Universiti Malaya, represents Malaysia's first university-based botanic garden and the largest campus forest garden in the Klang Valley. Originally developed from an abandoned rubber estate, it has evolved into a 57.3-hectare living repository housing approximately 1,500 tropical plant species, including numerous rare, endemic, and threatened taxa. Designed as a tropical rainforest garden, Rimba Ilmu integrates *ex situ* conservation, research, education, and public engagement within an urban setting. The garden maintains significant collections of Dipterocarpaceae, endemic palms, wild fruit trees, bamboos, citrus relatives, medicinal plants, and culturally important species. Its Conservatory of Rare Plants and Orchids safeguards hyper-endemic and threatened taxa, while the Medicinal Plant Collection preserves traditional knowledge associated with Malaysia's multicultural heritage. Together, these collections support germplasm conservation, crop improvement potential, and biocultural diversity. Rimba Ilmu is closely linked to the KLU Herbarium, which houses over 81,000 specimens and underpins national and international taxonomic projects, including the *Flora of Peninsular Malaysia and Flora Malesiana*. The integration of living collections and herbarium resources strengthens research in systematics, ecology, conservation biology, and biodiversity assessment. Beyond plant conservation, the garden sustains diverse fauna, demonstrating the ecological value of urban secondary forests. However, Rimba Ilmu faces challenges, including human resource and financial constraints, infrastructure limitations, wildlife management issues, and increasing environmental pressures such as extreme weather events. Strengthening institutional recognition, long-term planning, scientific research capacity, and collaborative networks will be essential to ensure its sustainability. As a living laboratory and conservation centre, Rimba Ilmu stands as a model for university -based tropical botanic gardens in urban Malaysia, bridging biodiversity conservation, scientific advancement, and community engagement.

INTRODUCTION

Established in 1974, Rimba Ilmu is a university botanic garden with the aim of supporting research and teaching in plant sciences, as well as conserving native plant species. Located within the Universiti Malaya campus in Kuala Lumpur (Figure 1), this botanic garden offers convenient access to students, educators, tourists, and nature enthusiasts alike. As Malaysia's first and oldest university botanic garden, today it stands as the largest campus forest garden, sustaining remarkable biological diversity in the Klang Valley. It is among the few systematically and scientifically organised botanic gardens in Malaysia, where most plant species cultivated are properly identified and labelled.

Originally covering 40 hectares in 1974, Rimba Ilmu has since expanded to 57.3 hectares and now serves as a living repository of approximately 1,500 tropical plant species, including rare, endemic and high conservation value taxa, making it a centre for conservation, research, and education (Mohamed 2000; Ong *et al.* 2025). The planting in

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the garden began in the early 1970s, when a piece of abandoned rubber estate within the campus was transformed into a botanical collection (Staton 1977; Wong and Mohamad 1997). Living samples were brought from different forests in Malaysia, targeting plant groups commonly referred to in botanical teaching, as well as research materials from various botanists and research students. Over the years, the Garden has accumulated a good number of diverse plant species in almost every plant form, from tiny bryophytes to low ferns, shrubs, epiphytes, climbers, palms, bamboos, and giant tall trees. These plants originated from different habitats, ranging from mangroves, peat swamp forests, streams and river banks, dipterocarp forests, heath forests, karst hills, and a small representation of highland species.

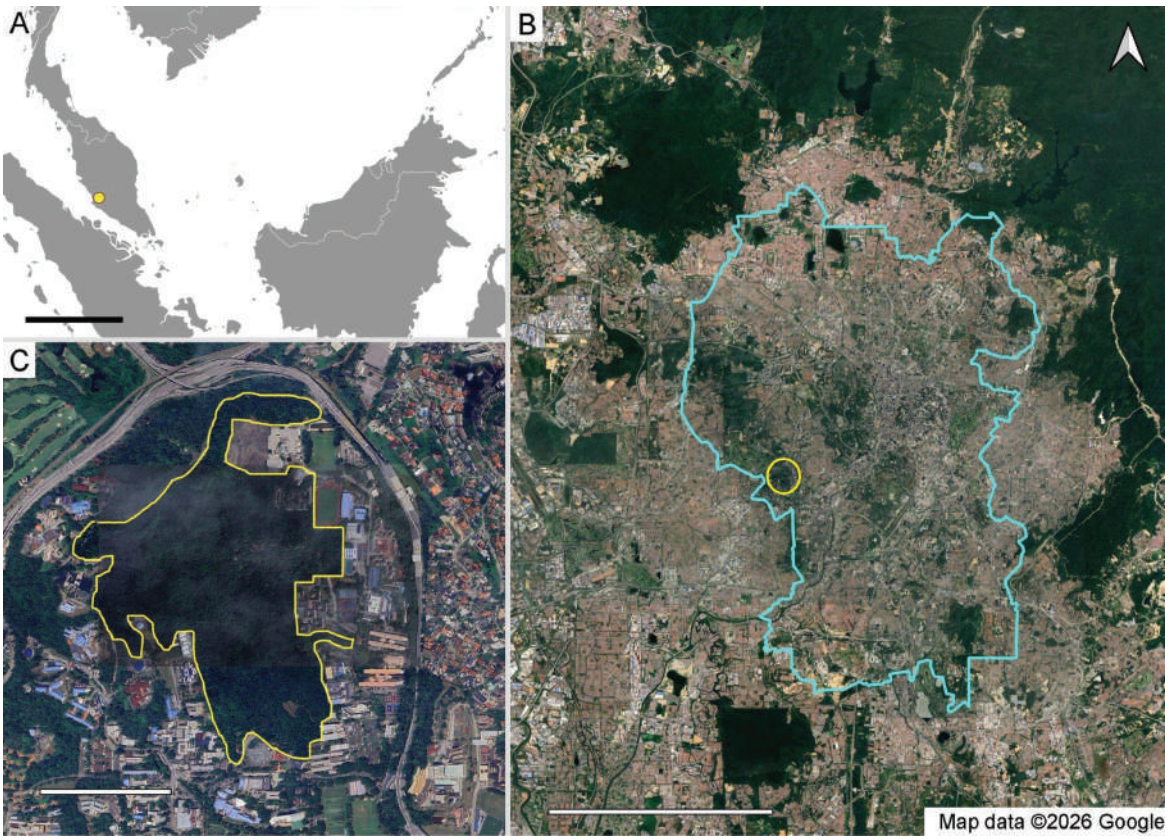

Figure 1. Map showing the location of Rimba Ilmu Botanic Garden (yellow) in **(A)** Peninsular Malaysia; **(B)** Federal Territory of Kuala Lumpur; and **(C)** close-up of the location within Universiti Malaya. Scale bars: A = 500 km, B = 10 km, and C= 0.5 km.

Building a rainforest garden

Since its establishment, the Rimba Ilmu Botanic Garden has adopted the concept of a tropical forest garden. The concept is reflected by its name: "*Rimba*" in Malay means forest, and "*Ilmu*" means knowledge. Many rainforest tree species were introduced and some portion of the original vegetation (the abandoned rubber trees with thick secondary growth) was set aside untouched for it to recover into a tropical lowland forest. Besides the timber species, several thematic collections were established, corresponding to the major research themes since the establishment of the garden and covering rainforest species that have specific anthropogenic uses or with certain cultural values (Soepadmo 1977; Stone 1977) (Figure 2). With Malaysia being a megadiverse country that is represented by more than 15,000 vascular plant species (Saw and Chung 2015), the conservation of Malaysian flora in Rimba Ilmu was prioritised towards native species with high conservation value and cultural importance in the country, which is a strategy that has been practised since its establishment (Stanton 1977).



Figure 2. The sketch map showing the different thematic collections in Rimba Ilmu (not according to scale).

Rimba Ilmu is generally low-lying, with an elevation range of 40 – 140 m above sea level. The soil is largely infertile and poor for agricultural purposes, but according to Stanton (1977) and Stone (1977), may still serve as a gallery of the rainforest species. The topography is largely undulating with ravines and gradual (10º) to steep slopes (30º – 45º) for about three-quarters of the total area. The major flat and more gentle area is located on its eastern side and has been the major planting area since 1971. A portion of the eastern flat area is low-lying and collects water, therefore forming a freshwater swamp area, where many swamp and riverine species were introduced and cultivated (Figure 2). The swamp area is home to some interesting palm species, including sago palm species (*Metroxylon sagu* Rottb. and *M. salomonense* (Warb.) Becc.), *kelubi* (*Eleiodoxa conferta* (Griff.) Burret), a relative of *salak* (*Salacca glabrescens* Griff.), *pinang raja* (*Cyrtostachys renda* Blume) and tree species such as *pulai paya* (*Alstonia spatulata* Blume), as well as herbs and shrubs that is common on wet ground, e.g., *Benstonea affinis* (Kurz) Callm. & Buerki, *Eriocaulon* spp. and members of Cyperaceae. A row of *gapis* (*Saraca cauliflora* Baker) was planted along

the stream bank, producing abundant, vibrant yellow to orange flowers every time they bloom. On one end of the *gapis* is a few clumps of handsome palm, *Arenga undulatifolia* Becc. – a native to Borneo – the other end erected with a few individuals of *pelawan* (*Tristaniopsis whiteana* (Griff.) Peter G.Wilson & J.T.Waterh.). Along the water's edge, several aroids are present, for instance, the thorny *Lasia spinosa* (L.) Thwaites and the elephant ears *Alocasia* and *Colocasia* spp. Meanwhile, the water itself supports the growth of the native water lily, *Barclaya motleyi* Hook.f., a few *Cryptocoryne* spp., the carnivorous *Utricularia* spp. and the non-native aquarium plant, *Mayaca fluviatilis* Aubl. All the aforementioned species were brought into cultivation at different periods of time during the last 52 years, establishing and forming a rather stable marsh and swamp system which also sustains other flora and fauna groups, including aquatic insects, reptiles, birds, and fishes.



Figure 3. (A) Entrance towards garden; **(B)** entrance to garden; **(C)** activity centre; **(D)** *Grammatophylum speciosum*; and **(E)** *Johannesteijsmannia lanceolata*.

After more than 50 years of development, most trees in the garden have grown into their lofty size, giving the garden a more or less forest-like appearance. The tall big trees with their wide-arching branches form the tree canopies that shield the ground from direct exposure to the sunlight and precipitation, helping to keep the lower canopy area cool and relatively humid. Old branches and fallen leaves on the ground accumulate over time to form a thick layer of plant litter. These organic materials were decomposed by fungi and ground-burrowing invertebrates that gradually migrated into the garden by chance. The on-site nutrient recycling process forms a thick layer of organic substrate, and together with its "forest-like" microclimate, conditions the soil to receive more rain forest species. With this in consideration, replanting of native tree species has been a regular activity, where around 100 to 300 individuals of trees representing different families were planted annually since the 2020s.

SPECIES WITH CONSERVATION IMPORTANCE

As the dominant timber member in the Malaysian rainforest, members of Dipterocarpaceae have been heavily felled in the Malaysian forest and thus warrant special attention in Rimba Ilmu. Today, there are more than 40 Dipterocarpaceae species being cultivated in the garden. Among these, there are species that have been classified as threatened under the IUCN Red List such as *Dipterocarpus rigidus* Ridl., *Dryobalanops tempehes* Slooten, and *Vatica flavida* Foxw. (IUCN 2026) (Table 1). Some of these early planted Dipterocarpaceae are as tall as 30 – 40m with girth size at breast height reaching 120 cm. Nevertheless, more plantings have been added over the years, incorporating both existing species and new additions. Of these, *Richetia kuantanensis* (P.S.Ashton) P.S.Ashton & J.Heck. is a species once thought extinct in the wild but was rediscovered in 2014 (Nasir *et al*. 2017), along with other hyper-endemic species like *V. yeechongii* Saw, which adds exceptional conservation value to the garden. Many of the said species cultivated have reached maturity and begun to bloom in the last few years.

Besides the Dipterocarpaceae, Rimba Ilmu garden is rich with representatives of popular timber species, including the national tree of Malaysia, *merbau* (*Intsia palembanica* Miq.), *kempas* (*Koompassia malaccensis* Maingay), and *nyatoh* (*Palaquium* spp.) amongst others. There are also examples of important timber species that warrant further conservation attention, for instance, Bornean ironwood (*Eusideroxylon zwageri* Teijsm. & Binn.), a highly durable, but slow-growing timber that is Sarawak's official state tree and has a strong cultural connection with local tribes in Borneo. Other forest tree species, *cempaka* (Magnoliaceae), *kedondong* (Burseraceae), *medang* (Lauraceae), *mempening* (Fagaceae), *penarahan* (Myristicaceae), *podo* (Podocarpaceae), and members of Elaeocarpaceae, Euphorbiaceae, Fabaceae, Malvaceae, Myrtaceae, Sapindaceae, etc., were variously planted in the garden. In recent years, planting has expanded into secondary forest areas dominated by old rubber trees, aiming to enrich species diversity and enhance forest recovery. An elaboration on the secondary forest and spontaneous species (i.e., those colonised through natural events) that occurred in the Rimba Ilmu has been provided by Ong *et al*. (2025).

The centerpiece of the woody plant collection are the endemic tree species (Table 2), including *Dillenia albiflos* (Ridl.). Hoogland, *Glenniea penangensis* (Ridl.) Leenh., *Maingaya malayana* Oliv., as well as various endemic palms, such as *Livistona endauensis* J.Dransf. & K.M. Wong, *Johannesteijsmannia lanceolata* J.Dransf., *J. magnifica* J.Dransf., and *J. perakensis* J.Dransf. etc. The genus *Johannesteijsmannia* is only represented by four species worldwide, where Rimba Ilmu Garden has all four of them (including *J. altifrons* (Rchb.f. & Zoll.) H.E.Moore), where three of these species have already reached their mature stage by blooming and bearing fruits. The assembling of a diverse array of tree species is to simulate Malaysian rainforest vegetation, while also functioning as a long-term experiment to assess the co-existence and inter-relationship of these different tree species.

Table 1. Examples of tree species with important conservation value found in Rimba Ilmu are shown here. Two conservation statuses are provided for each species listed: the upper row indicates the Malaysian Red List status according to Yong *et al*. (2021a, 2021b), while the lower row indicates the global IUCN Red List status according to the IUCN Red List (2026). The classification of Dipterocarpaceae follows Ashton and Heckenhauer (2022).

	Family	Species	Red list category	Notes
1.	Arecaceae	*Borassodendron machadonis* (Ridl.) Becc.	Malaysia: NE IUCN: VU	Peninsular Malaysia
2.	Dipterocarpaceae	*Anisoptera laevis* Ridl.	Malaysia: LC IUCN: VU	Peninsular Malaysia and Borneo
3.	Dipterocarpaceae	*Anthoshorea bracteolata* (Dyer) P.S.Ashton & J.Heck.	Malaysia: LC IUCN: EN	Peninsular Malaysia and Borneo
4.	Dipterocarpaceae	*Anthoshorea hypochra* (Hance) P.S.Ashton & J.Heck.	Malaysia: VU IUCN: EN	Peninsular Malaysia
5.	Dipterocarpaceae	*Anthoshorea roxburghii* (G.Don) P.S.Ashton & J.Heck.	Malaysia: NT nearly meeting VU	Peninsular Malaysia
6.	Dipterocarpaceae	*Dipterocarpus baudii* Korth.	Malaysia: LC IUCN: VU	Peninsular Malaysia
7.	Dipterocarpaceae	*Dipterocarpus costatus* C.F.Gaertn.	Malaysia: VU IUCN: EN	Peninsular Malaysia
8.	Dipterocarpaceae	*Dipterocarpus elongatus* Korth.	Malaysia: VU IUCN: CR	Peninsular Malaysia and Borneo
9.	Dipterocarpaceae	*Dipterocarpus gracilis* Blume	Malaysia: LC IUCN: VU	Peninsular Malaysia and Borneo
10.	Dipterocarpaceae	*Dipterocarpus grandiflorus* (Blanco) Blanco	Malaysia: LC IUCN: EN	Peninsular Malaysia and Sabah
11.	Dipterocarpaceae	*Dipterocarpus rigidus* Ridl.	Malaysia: VU IUCN: VU	Peninsular Malaysia and Sarawak
12.	Dipterocarpaceae	*Dipterocarpus tempehes* Slooten	Malaysia: EN IUCN: EN	Peninsular Malaysia and Borneo
13.	Dipterocarpaceae	*Dryobalanops aromatica* C.F.Gaertn.	Malaysia: NT IUCN: VU	Peninsular Malaysia and Borneo
14.	Dipterocarpaceae	*Dryobalanops oblongifolia* Dyer	Malaysia: LC IUCN: EN	Peninsular Malaysia
15.	Dipterocarpaceae	*Hopea beccariana* Burck	Malaysia: LC IUCN: VU	Peninsular Malaysia and Borneo

16.	Dipterocarpaceae	*Hopea johorensis* Symington	Malaysia: VU IUCN: VU	Peninsular Malaysia
17.	Dipterocarpaceae	*Hopea kerangasensis* P.S.Ashton	Malaysia: EN IUCN: VU	Peninsular Malaysia and Sarawak
18.	Dipterocarpaceae	*Hopea odorata* Roxb.	Malaysia: VU IUCN: VU	Peninsular Malaysia
19.	Dipterocarpaceae	*Hopea pedicellata* (Brandis) Symington	Malaysia: NT nearly meeting VU IUCN: EN	Peninsular Malaysia and Borneo
20.	Dipterocarpaceae	*Hopea subalata* Symington	Malaysia: EN IUCN: EN	Peninsular Malaysia
21.	Dipterocarpaceae	*Neobalanocarpus heimii* (King) P.S.Ashton	Malaysia: NT IUCN: EN	Peninsular Malaysia
22.	Dipterocarpaceae	*Parashorea densiflora* Slooten & Symington	Malaysia: NT IUCN: NT	Peninsular Malaysia
23.	Dipterocarpaceae	*Rubroshorea dasyphylla* (Foxw.) P.S.Ashton & J.Heck.	Malaysia: VU IUCN: NT	Peninsular Malaysia and Borneo
24.	Dipterocarpaceae	*Rubroshorea kunstleri* (King) P.S.Ashton & J.Heck.	Malaysia: NT IUCN: LC	Peninsular Malaysia and Borneo
25.	Dipterocarpaceae	*Rubroshorea pauciflora* (King) P.S.Ashton & J.Heck.	Malaysia: LC IUCN: NT	Peninsular Malaysia and Borneo
26.	Dipterocarpaceae	*Rubroshorea platyclados* (Slooten ex Endert) P.S.Ashton & J.Heck.	Malaysia: LC IUCN: NT	Peninsular Malaysia and Borneo
27.	Dipterocarpaceae	*Shorea foxworthyi* Symington	Malaysia: VU IUCN: VU	Peninsular Malaysia and Borneo
28.	Dipterocarpaceae	*Shorea laevis* Ridl.	Malaysia: LC IUCN: VU	Peninsular Malaysia and Borneo
29.	Dipterocarpaceae	*Shorea materialis* Ridl.	Malaysia: EN IUCN: EN	Peninsular Malaysia and Sarawak
30.	Dipterocarpaceae	*Shorea maxwelliana* King	Malaysia: LC IUCN: NT	Peninsular Malaysia and Borneo
31.	Dipterocarpaceae	*Shorea sumatrana* (Slooten) Desch	Malaysia: NT IUCN: EN	Peninsular Malaysia

32.	Dipterocarpaceae	*Vatica flavida* Foxw.	Malaysia: CR IUCN: CR	Peninsular Malaysia
33.	Dipterocarpaceae	*Vatica nitens* King	Malaysia: NT IUCN: NT	Peninsular Malaysia and Borneo
34.	Dipterocarpaceae	*Vatica pauciflora* Blume	Malaysia: NT IUCN: VU	Peninsular Malaysia and Borneo
35.	Dipterocarpaceae	*Vatica stapfiana* (King) Slooten	Malaysia: VU IUCN: VU	Peninsular Malaysia and Borneo
36.	Dipterocarpaceae	*Vatica yeechongii* Saw	Malaysia: CR IUCN: CR	Peninsular Malaysia
37.	Hamamelidaceae	*Maingaya malayana* Oliv.	Malaysia: NE IUCN: VU	Peninsular Malaysia
38.	Lauraceae	*Eusideroxylon zwageri* Teijsm. & Binn.	Malaysia: NE IUCN: VU	Borneo
39.	Lecythidaceae	*Careya arborea* Roxb.	Malaysia: VU IUCN: LC	Peninsular Malaysia
40.	Thymelaceae	*Aquilaria hirta* Ridl.	Malaysia/IUCN: VU	Peninsular Malaysia
41.	Thymelaceae	*Aquilaria malaccensis* Lam.	Malaysia: VU IUCN: CR	Peninsular Malaysia and Sabah

Table 2. Examples of Malaysian endemic plant species cultivated at Rimba Ilmu.

	Family	Species	Notes
1.	Arecaceae	*Licuala khoonmengii* Saw	Endemic to Pahang
2.	Arecaceae	*Licuala sallehana* Saw	Endemic to Terengganu
3.	Arecaceae	*Livistona endauensis* J. Dransf. & K.M.Wong	Endemic to Endau-Rompin and Bukit Bauk, Terengganu
4.	Balsaminaceae	*Impatiens vinosa* Kiew	Endemic to Kelantan
5.	Begoniaceae	*Begonia abdullahpieei* Kiew	Hyper-endemic to Perak
6.	Begoniaceae	*Begonia alpina* L.B.Sm. & Wassh.	Hyper-endemic to Genting Highland
7.	Begoniaceae	*Begonia conipila* Irmsch. ex Kiew	Endemic to Sarawak's limestone area
8.	Begoniaceae	*Begonia holttumii* Irmscher	Endemic to Peninsular Malaysia
9.	Begoniaceae	*Begonia kingiana* Irmsch.	Native to Peninsular Malaysia - Limestone area
10.	Begoniaceae	*Begonia nurii* Irmsch.	Limestone species
11.	Begoniaceae	*Begonia rajah* Ridl.	Endemic to Terengganu and Johor
12.	Begoniaceae	*Begonia reginula* Kiew	Endemic to Terengganu and Negeri Sembilan
13.	Begoniaceae	*Begonia rhoephila* Ridl.	Endemic to Selangor, Peninsular Malaysia
14.	Begoniaceae	*Begonia ruthiae* S.Julia	Endemic to Sabah. Grows in shady areas along riverbanks or on wet rocks at elevations between 200 and 500 m.
15.	Begoniaceae	*Begonia sirukitii* S.Julia & C.Y. Ling	Endemic to Sarawak. It grows on rocky cliffs or forested slopes near riverbanks
16.	Begoniaceae	*Begonia yenyeniae* J.P.C.Tan	Endemic to Endau-Rompin National Park, Johor
17.	Cycadaceae	*Cycas clivicola* K.D.Hill	A karst hill species, confined to northern Malay Peninsula
18.	Dilleniaceae	*Dillenia albiflos* (Ridl.) Hoogland	Endemic to Endau-Rompin
19.	Lecythidaceae	*Barringtonia corneri* Kiew & K.M.Wong	Endemic to Endau-Rompin area. Johor, Peninsular Malaysia
20.	Orchidaceae	*Bulbophyllum macrochilum* Rolfe	Endemic to Malaysia
21.	Orchidaceae	*Dendrobium pensile* Ridl.	Endemic to Peninsular Malaysia
22.	Orchidaceae	*Paphiopedilum rothschildianum* (Rchb.f.) Pfitzer	Endemic to Sabah. Also known as Gold of Kinabalu.
23.	Orchidaceae	*Paphiopedilum stonei* (Hook.f.) Pfitzer	Endemic to Sarawak
24.	Zingiberaceae	*Burbidgea nitida* Hook.f.	Endemic to Sarawak
25.	Zingiberaceae	*Globba nawawii* Ibrahim & K.Larsen	Endemic to Terengganu

Between the trees lies the understorey species of ferns, shrubs, herbs and climbers which were introduced for the garden, whereas a good number were self-established after the vegetation had grown into a partial forest look. Several tree ferns (*Alsophila latebrosa* Wall. ex Hook., *Sphaeropteris glauca* (Blume) R.M.Tryon, *S. moluccana* (R.Br. ex Desv.) R.M.Tryon, and *S. trichodesma* (Scort.) R.M.Tryon) were planted in the last 52 years. There are also the king fern (*Angiopteris evecta* (G.Forst.) Hoffm.), golden chicken fern (*Cibotium barometz* (L.) J.Sm.), and other fern and lycophyte species (e.g., *Adiantum* spp., *Asplenium* spp., *Drynaria* spp., *Selaginella* and *Tectaria* spp.). Among the fern collection, there is a rare and endangered fern, *Nephrolepis abrupta* (Bory) Mett., that was rescued from a karst hill in Perak that has been half quarried. A filmy fern, *Tricomanes* sp., and a gesneriad herb producing white flowers, *Codonoboea platypus* (C.B.Clarke) C.L.Lim is present in the shaded and humid ravine, with both likely to be the original species of the land that have survived the early forest conversion. Other shrub species like members of Liliaceae,

Pandanaceae, Rubiaceae, *Tacca* spp., *Thottea* spp. are also commonly present among the big trees. Meanwhile, native herb species like *Crinum asiaticum* L., *Hellenia speciosa* (J. Koenig) S.R.Dutta, *Orchidantha longiflora* (Scort.) Ridl., and *Proiphys amboinensis* (L.) Herb. were introduced for cultivation, however many of these species prefer slightly open areas and are often present in clumps at the edge of vegetation.

ESTABLISHING GERMPLASM COLLECTIONS

One of the very important functions of a botanic garden is sustaining living materials for future crop improvement programs. In the early 20th century, the world witnessed the role of tropical botanic gardens in the introduction and proliferation of two economically important crops that have reshaped the human lifestyle, namely rubber from the Singapore Botanic Gardens and oil palm from the Bogor Botanic Garden. With this in mind, Rimba Ilmu has embarked on a program to collect and preserve the local wild fruit tree species since its establishment (Soepadmo 1977). The collection includes notable species such as wild durian (*Durio graveolens* Becc., *D. oxleyanus* Griff., *D. wyatt-smithii* Kosterm.), malay apple (*Syzygium aqueum* (Burm.f.) Alston, *S. malaccense* (L.) Merr. & L.M.Perry), mangosteen and its relatives (*Garcinia mangostana* L., *G. celebica* L., etc.), *rambutan* (*Nephelium lappaceum* L.), *langsat* (*Lansium domesticum* Corrêa), and various breadfruit species like *Artocarpus* spp. With a collection of different members of the same genus, Rimba Ilmu serves as a resource for genetic improvement of native original species.

Emphasis has also been given to cultivate the "forgotten" fruit tree species ("*buah nadir*" in Malay), like *bacang* (*Mangifera foetida* Lour.), *buah perah* (*Elateriospermum tapos* Blume), *buah sengkuang* (*Dracontomelon dao* (Blanco) Merr. & Rolfe), *ceri terengganu* (*Lepisanthes alata* (Blume) Leenh.), *kundang* (*Bouea macrophylla* Griff.), *meninjau* (*Gnetum gnemon* L.), *nam-nam* (*Cynometra cauliflora* L.), *rambai* (*Baccaurea macrophylla* (Müll.Arg.) Müll.Arg., *B. motleyana* (Müll.Arg.) Müll.Arg.), *sentul* (*Sandoricum koetjape* (Burm.f.) Merr.), *tampoi* (*Baccaurea macrocarpa* (Miq.) Müll.Arg.), and *tempunik* (*Artocarpus rigidus* Blume) amongst others. They were once popular in rural areas, but are gradually disappearing from the fruit market due to the lack of large-scale production and supply inconsistencies. By conserving these species, the materials will always be available for further field and laboratory research to enhance the diversity of fruit trade in the country.

The Rimba Ilmu Citrus and Citroid Collection was initiated in the early 1980s, while the Bambusetum was launched in 2000. The former targets agricultural-importance crops while the latter focuses on species with landscaping value and industrial importance. During its peak, The Citrus and Citroid Collection comprises 51 species in 20 genera (Wong and Santiago 1997), with some plants variously planted in Rimba Ilmu where *kemuning gajah* (*Merrillia caloxylon* (Ridl.) Swingle), an extremely rare species, can still be found in this collection. Meanwhile, there are no less than 30 different bamboo species cultivated in the Bambusetum, covering exotic species (e.g., *Vietnamosasa pusilla* (A.Chev. & A.Camus) T.Q.Nguyen), species only known in cultivation (e.g., *Bambusa glaucophylla* Widjaja), local species (e.g., *Gigantochloa latifolia* Ridl.) and local endemic species (e.g., *Schizostachyum lengguanii* K.M.Wong). Some interesting examples are the giant bamboo (*Dendrocalamus giganteus* Munro), thorny bamboo (*Bambusa bambos* (L.) Voss), slender climbing bamboo (*Dinochloa malayana* S.Dransf.) and a much larger version of climbing bamboo, *Dinochloa scabrida* S.Dransf. Many of the bamboo planted in the Bambusetum produce edible bamboo shoots, but there are also examples of ornamental species (e.g., *Thyrsostachys siamensis* Gamble, *Bambusa vulgaris* Schrad. ex J.C.Wendl.) and species important for craft and construction (e.g., *Schizostachyum brachycladum* (Kurz ex Munro) Kurz).

THE CONSERVATORY OF RARE PLANTS AND ORCHIDS

The installation of The Conservatory of Rare Plants and Orchids in 2000 greatly enhanced the collection of threatened and rare plant species. This facility displays living specimens of the rarest and most threatened species in Peninsular Malaysia, focusing on wild orchids, *Begonias*, pitcher plants, gingers, aroids, wild pandans, miniature palms, and other shade and humid loving shrubs.

There are three groups of rarity displayed in the conservatory:

1. Plant species that are naturally endemic or restricted to particular localities or sites. If these are destroyed or transformed drastically, such species will be endangered. Technically, this is termed as hyper-endemic, and examples of these collections are *Begonia abdullahpieei* Kiew, *B. alpina* L.B.Sm. & Wassh., *Etlingera corneri* Mood & Ibrahim, *Impatiens vinosa* Kiew, *Licuala sallehana* L.G.Saw, *Paraphalaenopsis laycockii* (MR.Hedn.) A.D.Hawkes, and *Salacca minuta* Mogea.
2. Species that have a relatively wide distribution outside of Malaysia, but which are infrequently encountered (and thus rare) in the country. For example, *Calanthe tankervilleae* (Banks) M.W.Chase and *Vandopsis gigantea* (Lindley) Pfitzer.
3. Species that were once much more common, usually in lowland forests, but whose range and population have decreased as a result of habitat reduction. Such species may become threatened if the habitat area further decreases. Examples are *Agrostophyllum stipulatum* subsp. *bicuspidatum* (J.J.Sm.) Schuit, *Barringtonia corneri* Kiew & K.M.Wong, *Coelogyne asperata* Lind., and *Pandanus albifrons* B.C.Stone.

Besides, The Conservatory of Rare Plants and Orchids also acts as a site for experimental introduction of highland species. Plants collected from the highlands in Malaysia are first nurtured and acclimatised here, before being transferred into the garden (or continued to be maintained within the conservatory if the species prefers a higher humidity environment). *Dacrycarpus imbricatus* (Blume) de Laub., *Pandanus klossii* Ridl, and *Paphiopedilum rothschildianum* (Rchb.f.) Stein, are among such examples. The facility also displays endemic wild orchid species that were badly threatened by overharvesting such as *Bulbophyllum macrochilum* Rolfe, *Dendrobium pensile* Ridl., and *Paphiopedilum stonei* (Hook.) Stein.

CONSERVATION OF TRADITIONAL KNOWLEDGE

Rimba Ilmu has also played a role in the conservation of local and traditional knowledge, in addition to the preservation of forest plant species. The key setup that addresses this aspect is the Medicinal Plant Collection, established at the garden's inception (Table 3). More than 380 medicinal plant species have been recorded in Rimba Ilmu (Mohamed 2000), with about 80 of them cultivated at the core Medicinal Plant area (Wong 2001). The medicinal plants maintained in the garden are represented by native rainforest species (e.g., *Curculigo latifolia* Dryand. ex W.T.Aiton, *Eurycoma longifolia* Jack, *Labisia pumila* (Blume) Fern., *Scaphium macropodum* (Miq.) Beumée ex K.Heyne) as well as foreign species that have long been introduced to Malaysia for their medicinal uses (e.g., *Euphorbia tirucalli* L., *Jatropha multifida* L., *Senna alata* (L.) Roxb.). The traditional Malay medicinal practice has a highly mixed origin, with elements of Arabic, Indian (Ayurvedic), Javanese, Siamese, Sundanese, local natives, and others. This is well reflected by the great diversity of the medicinal herbs maintained by the rural communities. In a multiracial society like Malaysia, knowledge is often shared freely, where traditional Malay medicinal herbs are also appreciated and have entered the traditional medicinal practice of other ethnic groups. Rimba Ilmu's medicinal plant collection provides a glimpse into the country's rich medicinal flora, selectively preserving some of the most interesting species, from species with rich alkaloids

to those with high bioprospecting potential. Among the examples are agarwood (*Aquilaria hirta* Ridl. and *A. malaccensis* Lam.), *dukung anak hutan* (*Phyllanthus watsonii* Airy Shaw), *gelam* (*Melaleuca cajuputi* Maton & Sm. ex R.Powell), *petawali* (*Tinospora crispa* (L.) Hook.F. & Thomson), snakeroot (*Rauvolfia serpentina* (L.) Benth. ex Kurz), *temu hitam* (*Curcuma aeruginosa* Roxb.), *temu kunci* (*Boesenbergia rotunda* (L.) Mansf.), and others.

Table 3. Examples of plant species with important medicinal and cultural value that can be encountered in Rimba Ilmu.

	Family	Species
1.	Apiaceae	*Eryngium foetidum* L.
2.	Apocynaceae	*Catharanthus roseus* (L.) G.Don
3.	Arecaceae	*Cocos nucifera* L.
4.	Aristolochiaceae	*Thottea tomentosa* (Blume) Ding Hou
5.	Asphodelaceae	*Aloe vera* (L.) Burm.f.
6.	Asteraceae	*Elephantopus scaber* L.
7.	Blechnaceae	*Stenochlaena palustris* (Burm.f.) Bedd.
8.	Costaceae	*Hellenia speciosa* (J.Koenig) S.R.Dutta
9.	Euphorbiaceae	*Baccaurea ramiflora* Lour.
10.	Euphorbiaceae	*Hevea brasiliensis* (Willd. ex A.Juss.) Müll.Arg.
11.	Fabaceae	*Parkia speciosa* Hassk.
12.	Lauraceae	*Litsea garciae* Vidal
13.	Malvaceae	*Urena lobata* L.
14.	Melastomataceae	*Melastoma malabathricum* L.
15.	Menispermaceae	*Tinospora crispa* (L.) Hook.f. & Thomson
16.	Opihioglossaceae	*Helminthostachys zeylanica* (L.) Hook.
17.	Oxalidaceae	*Averrhoa carambola* L.
18.	Phyllanthaceae	*Phyllanthus oxyphyllus* Miq.
19.	Piperaceae	*Piper betle* L.
20.	Poaceae	*Cymbopogon nardus* (L.) Rendle
21.	Primulaceae	*Labisia pumila* (Blume) Benth. & Hook.f. ex Fern.-Vill.
22.	Rutaceae	*Citrus medica* L.
23.	Simaroubaceae	*Eurycoma longifolia* Jack
24.	Thymelaeaceae	*Aquilaria malaccensis* Lam.
25.	Zingiberaceae	*Alpinia galanga* (L.) Willd.
26.	Zingiberaceae	*Curcuma longa* L.
27.	Zingiberaceae	*Etlingera elatior* (Jack) R.M.Sm.
28.	Zingiberaceae	*Zingiber officinale* Roscoe

Several plant species with culinary value are cultivated alongside medicinal plants within the study area (Table 3). These species include *asam gelugur* (*Garcinia atroviridis* Griff. ex T.Anderson), tamarind (*Tamarindus indica* L.), *buah keluak* or *kepayang* (*Pangium edule* Reinw.), cashew (*Anacardium occidentale* L.), and lemongrass (*Cymbopogon citratus* (DC.) Stapf). In addition, several species commonly consumed as Malay salad (*ulam*) are cultivated within the same area, including *kesum* (*Persicaria ordorata* (Lour.) Sojak), *pegaga* (*Centella asiatica* (L.) Urban), *sambung nyawa* (*Gynura procumbens* (Lour.) Merr.), and young noni shoot (*Morinda citrifolia* L.). Many of these species are also traditionally regarded as having therapeutic properties. Spice crops are likewise interplanted among the medicinal herbs, such as nutmeg (*Myristica fragrans* Houtt.), clove (*Syzygium aromaticum* (L.) Merr. & L.M.Perry), basil leaves (*Ocimum basilicum* L.), *salam* leaves (*Syzygium polyanthum* (Wight) Walp.), cinnamon (*Cinnamomum verum* J.Presl.), black pepper (*Piper nigrum* L.), and turmeric (*Curcuma longa* L.). Notably, nutmeg and clove were introduced to Malaysia through the historical spice trade and represent some of the earliest forms of

commercial crop cultivation in Peninsular Malaysia. The diversity of culinary species and spices cultivated reflects the close relationship between Malaysia's rich food heritage and its multicultural society, correspondingly, the assemblage of medicinal and food plants at Rimba Ilmu mirrors this cultural heritage.

Other culturally important plants which could be encountered in the Rimba Ilmu Garden include, the betel piper (*Piper betle* L.) and the betel nut palm (*Areca catechu* L.), the two important components of the traditional sirih pinang or betel nut chewing custom. The lontar palm (*Borassus flabellifer* L.), with its huge and hardy palm leaf that was used as an early writing material in the Southeast Asian region before paper became affordable. The sugar palm (*Arenga pinnata* (Wurmb) Merr.), a forest species that was once commonly cultivated in rural areas for sugar production and fibre. The high-quality fibre is readily available on the surface of its trunk, and was once a popular ingredient for rope making. Besides, the fibre has been used in producing brooms, brushes, mats, and reinforced polymer composites in boat making in some local cultures. Both lontar and sugar palms were cultivated in Rimba Ilmu. There are also examples of poisonous plants in Rimba Ilmu, e.g., flame lily (*Gloriosa superba* L.) and *ipoh* tree (*Antiaris toxicaria* (J.F.Gmel.) Lesch.). The flame lily is highly lethal because the plant contains high levels of colchicine, a toxic alkaloid, but surprisingly, it is a popular herb in traditional medicine. Meanwhile, *ipoh* tree produces poisonous latex that is often collected by the native tribes and applied to the darts used in blowpipes for hunting.

SCIENTIFIC CONTRIBUTIONS AND SOCIAL IMPACTS

Currently, Rimba Ilmu is in the process of cataloguing all of their living and dried specimens. The Herbarium of Universiti Malaya, with its acronym KLU, houses more than 81,000 individuals of dried specimens, including historical collections dating as far back as 1908. With the digitisation of said records, a digital bridge can be created between researchers and Rimba Ilmu, making Rimba a reference centre in supporting knowledge transfer. The living collection in the garden and the herbarium collection have been essential resources for botanical research since the installation of these facilities. These materials were consulted in the major national projects like *Tree Flora of Peninsular Malaysia*, *Tree Flora of Sabah and Sarawak*, and later *Flora of Peninsular Malaysia*, as well as referred to in international projects like *Flora Malesiana*. Materials from Rimba Ilmu have been sourced by local and foreign researchers for a wide range of research, from systematic, phylogeny, anatomy, ecology, physiology, biochemistry and plant health to conservation status assessment. In addition to that, Rimba Ilmu is also maintaining a good relationship and active research collaborations with many local and overseas research institutions and botanical collection centres, supporting various biodiversity and conservation projects.

Moving away from academia, Rimba Ilmu works closely with many local agencies and organisations, from private, governmental to non-governmental organisations (NGOs) in promoting nature conservation and education. Among the regular partners in the last ten years are the Malaysian Nature Society (MNS), Kebun-kebun Bangsar, TRAFFIC International, Malaysia Cave and Karst Conservancy, Sunda Shelves, Forest House, YELL, and Roots and Shoots Malaysia. Other than that, Rimba Ilmu also facilitates and organises various training programs for local community groups, NGOs and students, particularly in the topics of reforestation and nature appreciation. Rimba Ilmu also plays a role in Klang Valley greening projects such as Rantaian Urban Green Spaces (RUGS). Besides functioning as a resource centre for the project, Rimba Ilmu contributes many wildlings for planting through the Free Tree Society, particularly in the effort of creating the Bangsar Ecological Connector.

IMPORTANCE OF FLORA-FAUNA INTERACTIONS AT RIMBA ILMU

The presence of diverse fauna is a key measure of the health and biodiversity of an environment. Rimba Ilmu has now developed into a mature secondary forest, where it has become a home to a significant number of terrestrial life such as small mammals, birds, reptiles, amphibians, and invertebrates (Ong *et al*. 2025). The diverse plant composition and vegetation stratification provide the heterogeneous microhabitats and niches required for different faunal species to thrive. For example, the different sections of the garden offer varied "architectures" that support specific spider guilds, resulting in 96 spider species recorded from the garden (Dzulhelmi and Norma-Rashid 2014). Rimba Ilmu also supports a diverse composition of insects that occupy different habitat niches, such as pygmy grasshoppers and odonates (understory and river vicinity), beetles and katydids (foliage and garden canopy), and fireflies and crickets (shrubs and grasses).

While generalist faunal species are no stranger to urban forests, specialists such as butterflies are also found under the canopy of these forests, as long as their necessities are met. Butterflies depend on their host plants as their caterpillars depend exclusively on specific host plants for survival (Syaripuddin *et al.* 2015). Occasionally-sighted butterflies such as Malaysia's national butterfly, the Rajah Brook birdwing, feed on the Aristolochiaceae that are found in the garden. Other insects showcasing host plant dependency include fruit flies which are attracted to plants by specific chemical compounds. The petals of *Murraya paniculata* (*kemuning lada*) produce chemicals that attract male fruit flies, other than for their consumption and sequestration (Chuah *et al.* 2001).

The wild fruit trees and young plant shoots growing within the garden serve as a "cafeteria" for our four-limbed visitors: the macaques, civets and frugivorous bats; which feed on various parts of plants such as fruits, leaves and petioles (Koh and Norma-Rashid 2020). Among the 11 bat species recorded, the Lesser Asiatic yellow bat (*Scotophilus kuhlii*) is an exclusive urban dweller, as Rimba Ilmu provides specific roosting and foraging niches that are absent in nearby primary and secondary forests (Nasir *et al*. 2021).

CHALLENGES AND FUTURE DIRECTIONS

The effective management and long-term sustainability of Rimba Ilmu Botanic Garden face multiple interrelated challenges arising from operational, financial, institutional, environmental, and ecological pressures. As the garden continues to grow in scope and public relevance, these challenges must be addressed through coordinated planning, adequate resourcing, and a clearly articulated management vision.

Maintaining a large and taxonomically diverse living collection requires a high level of horticultural, taxonomic, and ecological expertise. The large physical area of the garden further compounds these challenges, making regular maintenance, pest and disease surveillance, and safety inspections increasingly challenging. Without sufficient human resources and technical support, the long-term health and scientific value of the living collections would be at risk. In recent years, Rimba Ilmu has experienced a steady increase in visitors, including students, researchers, schools, and members of the general public. Visits range from self-guided tours to structured educational and interpretive programmes. Despite this growing demand, many of the garden's amenities such as pathways, seating, interpretive panels, rest areas and safety features are outdated, limited in number, or in need of major refurbishment. The protection of living collections and the safety of visitors require immediate attention. Current security measures are insufficient to address the garden's scale and complexity. Furthermore, the growing demand for guided nature interpretation walks underscores the need to train and hire more qualified nature guides.

As part of the university campus, the garden's operations and long-term direction are sometimes influenced by changing institutional priorities and administrative leadership. However, a botanic garden plays a critical role as a living laboratory, conservation centre, and educational resource. Its function must therefore be clearly defined, formally recognised, and embedded within the university's strategic framework. A comprehensive, long-term management plan developed through consultation and supported at the institutional level is essential to ensure continuity, resilience, and accountability, regardless of governance changes.

As a rainforest garden in an urban setting, Rimba Ilmu is frequently exposed to intense thunderstorms. Lightning strikes have repeatedly killed mature trees, while strong winds during severe storms have caused large-scale destruction. Over the past twenty years, at least three major storm events have uprooted more than a hundred large trees, resulting in significant ecological and financial losses. Wildlife such as long-tailed macaques, and stray dogs often seek refuge in Rimba Ilmu. While their presence reflects the ecological value of the garden, uncontrolled populations can lead to serious management issues. The long-tailed macaques often damage plant collections by grazing and snapping, leaving plants unsightly and weakened. Both macaques and stray dogs also threaten visitors and displace other smaller, but ecologically important species, disrupting the gradual recovery of forest ecosystems within the garden. Effective, ethical, and science-based wildlife management strategies are therefore urgently needed to restore ecological balance and protect both people and plants.

By deepening collaboration with local and international conservation centres, Rimba Ilmu can rise in the ranks as a leading university-based conservation institution, locally and internationally, establishing itself as a centre for tropical biodiversity conservation in urban Malaysia. As a scientific institution, Rimba Ilmu must keep itself intellectually alive through research. Trained and committed personnel with interest and enthusiasm need to be recruited, and funding for such research activities needs to be raised, as pointed out by Mohamed (2000). With its diverse plant collection capturing natural and cultural diversity and its rich scientific knowledge, Rimba Ilmu appeals as a one-stop centre for laypeople and researchers, endures, and continues to flourish. Going forward, stronger financial and human resources will help advance the garden's development.

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