

Species composition, diversity and traditional uses of plants in homegardens in Kampung Masjid Ijok, Perak, Malaysia

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Manuscript received: 24 February 2021. Revision accepted: 23 March 2021.

Abstract. Ramli MR, Milow P, Malek S. 2021. Species composition, diversity and traditional uses of plants in homegardens in Kampung Masjid Ijok, Perak, Malaysia. *Biodiversitas* 22: 1902-1911. The aim of present study was to analyze the status, plant diversity and their utilization in homegardens of Kampung Masjid Ijok, Perak, Malaysia. Forty homegardens were selected for detailed study: 9 were large (>1,500m²), 11 medium (901m² to 1500m²) and 20 small (<900m²). A total of 207 plant species belonging to 78 families were recorded. Among the usable components, food plants dominated the homegardens with a proportion of 43.3% followed by ornamental (27.8%) and medicinal (24%) plants. Large homegardens were dominated by food, medicinal and ornamental plant species, medium homegardens food and medicinal plant species, and small homegardens ornamental plant species. Frequency of species occurrences increased with the increasing homegardens size. The highest Shannon-Weiner Index was recorded in the large sized homegardens (3.61) and the lowest one in the small-sized homegardens (1.66). Euphorbiaceae (13 species), Araceae (11 species) and Fabaceae (10 species) were the most represented plant families. Shrubs dominated the plants in all homegardens with a proportion of 42%, followed by trees (29.5%), herbs (23.7%) and climbers (4.8%). *Musa paradisiaca* L. was recorded as a very frequent species, followed by *Cocos nucifera* L., *Nephelium lappaceum* L., *Capsicum frutescens* L., *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Mangifera indica* L., *Curcuma domestica* Valetton, *Garcinia mangostana* L and *Manihot esculenta* Crantz. *Alocasia sanderiana* and *Aquilaria malaccensis* categorized as critically endangered (CR) in (IUCN) Red List were also recorded in the large homegardens. This study suggested that large homegardens are more effective than the small and medium ones for diversification and conservation of plant species.

Keywords: Homegardens, Kampung Masjid Ijok, Perak, plants diversity

INTRODUCTION

Homegardens are less complex agroforests almost similar to natural forest ecosystems but are integrated into agricultural management systems located around houses (Mapongmetsem et al. 2012). According to Bargali et al. (2019), homegarden is a traditional land use practice around a homestead where members of the household maintain several plant species and their products are intended primarily for household consumption. There are many plant species in the homegardens to grow food-bearing plants for household use (Galhena et al. 2013). According to Mattsson et al. (2017), homegardens can provide a stable source of fresh and nutritious food. Some plants have medicinal values that are a less expensive healthcare source and treatment for various illnesses and diseases. Panyadee et al. (2019) recorded 95 medicinal plants in homegardens of indigenous community in Thailand. Infection and infestation, nutritional disorders, and digestive system disorders were the three most important medicinal use categories for plants in the homegardens (Panyadee et al. 2019). In Eastern Himalaya, 53 plant species were utilized for different ethnomedicinal applications (Pala et al. 2019). In addition, the importance of homegardens for the conservation of plant species has also been reported in the literature (Ebert 2020). According to Bardhan et al. (2012), homegardens have the potential to

increase biodiversity in the agricultural landscape while reducing habitat loss and fragmentation. Gachuiri et al. (2017) also indicated that homegardens play an important role in biodiversity conservation while sustaining livelihood.

Some homegardens products are sold as an additional income (Avilez-Lopez et al. 2020). Study by Abdoellah et al. (2020) in West Java, Indonesia indicated that homegardens are highly commercialized, which contributes to the spread of monocultural production in the region. Plants in homegardens are arranged in different configurations and vertically organized in a multi-layered structure (George and Christopher 2020) which resembles neighboring forest ecosystems (Mattsson et al. 2013) and thus provides multiple environmental benefits. The ability of homegardens to store carbon and enhance carbon sequestration is critical for climate change mitigation (Mattsson et al. 2015). Study in Moneragala District, Sri Lanka indicated that homegardens stored 13 Mega grams of carbon per hectare (Mg C ha⁻¹) with a large range among homegardens (1 to 56 Mg C ha⁻¹) due to a variety of tree diversity and composition between individual homegardens. Homegardens are also the perfect habitat for certain insects and pollinators (Liu et al. 2018) which provides essential support for food security and ecosystem stability (Lautenbach et al. 2012). The ability of homegardens to preserve soil structure and prevent soil

erosion (Linger 2014), cycling soil nutrients (Reetsch et al. 2020) and preserving soil organic matter (Mohri et al. 2013) has been documented in the literature. In Malaysia, the research on homegardens is still scanty. Among the studies that had been conducted was by Milow et al. (2013). In this study, 214 plant species and varieties belonging to 76 families were recorded from the 10 Orang Asli villages studied in Negeri Sembilan, Malaysia (Milow et al. 2013). In view of the significant contribution and benefits of homegardens to human well-being and the inadequate exploration of homegardens in Malaysia, this study focuses on providing useful information that can support and encourage local communities to develop their homegardens in a sustainable manner.

MATERIALS AND METHODS

The study was conducted in the year 2018 in a village known as Kampung Masjid Ijok which lies between $5^{\circ}7'0''\text{N}$ to $5^{\circ}8'15''\text{N}$ latitude and $100^{\circ}49'15''\text{E}$ to $100^{\circ}50'45''\text{E}$ longitude in Selama Municipality, in the State of Perak, Malaysia (Figure 1). The village lies approximately 50 meters above sea level and extends 35.974 km² and only comprises Malay community. It has a tropical climate with temperatures recorded from 28°C to 32°C through the whole year and 2,000 mm to 2,500 mm of precipitation

annually. Land cover includes rubber tree and palm oil plantations and natural forests. The population comprises 200 inhabitants with 60 heads of households. Most of them are working in agriculture sector and also remain strongly dependent on homegardens and forest resources as source of food, income and medicine, owing to the vast traditional knowledge among them. Semi-structured interviews and field surveys were used to gather information on traditional knowledge of plants regarding the utilization of plant species, their usefulness and the utilized part. All of the head family units who managed the homegardens were interviewed, except the households that did not agree to participate. Homegardens were classified into three categories depending upon the size of homegarden holding: large, medium and small. Forty key informants representing 40 homegardens, 24 men and 16 women with ages ranging from 28 to 84 years were interviewed and the research background and purpose were explained prior to each interview. Total species and number of individuals of each useful plant species were also recorded. Plant pictures were taken during the field observation. Shannon-Wiener index (H) (Shannon and Weaver 1949) was used to calculate the species diversity. Principal component analysis (PCA) was used to investigate the relationship between the sizes of homegardens to the species richness by using the Past Software. Details on the traditional knowledge of plant species were summarized in Table 1.

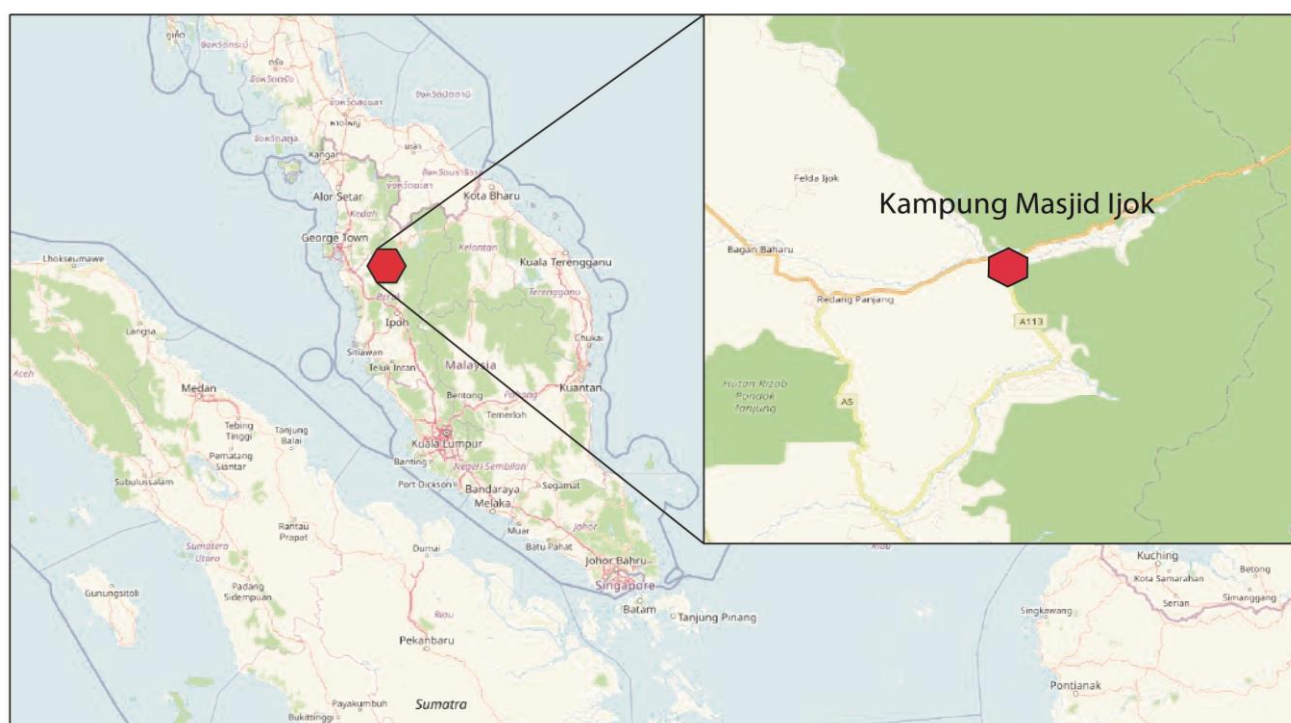


Figure 1. Location of Kampung Masjid Ijok, Perak, Malaysia lies between $5^{\circ}7'0''\text{N}$ to $5^{\circ}8'15''\text{N}$ latitude and $100^{\circ}49'15''\text{E}$ to $100^{\circ}50'45''\text{E}$ longitude

RESULTS AND DISCUSSION

Out of 40 studied homegardens, 9 were large ($>1,500\text{m}^2$), 11 medium (901m^2 to 1500m^2) and 20 small ($<900\text{m}^2$). Food, medicinal and ornamental plants dominated large homegardens, often with high multiple species, mainly used for family nutrition and commercialization, besides for medicinal and aesthetic values and largely represented by *Durio zibethinus* Murr., *Garcinia mangostana* L., *Baccaurea motleyana* Hook. f., *Archidendron jiringa* (Jack) I.C. Nielsen, *Lansium domesticum* Corrêa, *Mangifera foetida* Lour, *Parkia speciosa* Hassk, *Pithecellobium bubalinum* (Jack) Benth, *Areca catechu* L., *Scorodocarpus borneensis* (Baill.) Becc, *Barringtonia racemosa* (L.) Spreng, *Garcinia cambogia* (Gaertn.) Desr and *Musa paradisiaca* L. Medium homegardens were dominated by fruit and medicinal plants, mainly used for complementing the family nutrition and wellbeing, and largely represented by *Pandanus amaryllifolius* Roxb, *Languas galanga* (L.) Stuntz, *Piper sarmentosum* Roxb, *Manihot esculenta* Crantz, *Cassia alata* L, *Ananas comosus* (L.) Merr, *Capsicum frutescens* L, *Cymbopogon citratus* (DC.) Stapf and *Citrus aurantiifolia* (Christm.) Swingle). Small homegardens consisted of many species of ornamental plants and few species of food and medicinal plants. The plants were mostly found in front yards. Examples of the plants were *Hibiscus rosa-sinensis* L, *Ixora javanica* (Blume) DC, *Bougainvillea formosa* W.Bull, *Sansevieria trifasciata* Prain, *Codiaeum variegatum* (L.) A. Juss, *Heliconia psittacorum* L.f, *Euphorbia nerifolia* L, *Allamanda cathartica* L, and *Ruellia tweediana* Griseb).

Though no specific planting pattern was observed, it was found that herbs and small shrub and ornamental plants were preferred in the front yard, while the boundaries and backyard consisted of shrubs and trees. The homegardens in the study area showed five distinct layers. The emergent layer was composed of big trees (> 20 meters

height), canopy layer middle size trees (between 10 to 20 meters height), understory layer fruit trees (between 5 to 10 meters height), shrub layer shrub (between 1 to 5 meters height) and ground layer herb, seedlings of both tree and shrub species. The common tree species in the emergent layer were *Durio zibethinus* Murr. and *Melia excelsa* Jack. Canopy layer was composed of *Archidendron jiringa* (Jack) I.C.Nielsen, *Areca catechu* L, *Lansium domesticum* Corrêa, *Parkia speciosa* Hassk and *Scorodocarpus borneensis* (Baill.) Becc. Understory layer was composed of *Garcinia mangostana* L, *Baccaurea motleyana* Hook. f., *Mangifera foetida* Lour, *Garcinia cambogia* (Gaertn.) and *Barringtonia racemosa* (L) Spreng. The shrub layer was composed of *Citrus aurantiifolia* (Christm.) Swingle, *Etlingera elatior* (Jack) R.M.Sm, *Murraya koenigii* (L.) Spreng and *Bougainvillea formosa* W.Bull. The ground layer was composed of *Acanthus ebracteatus* Vahl, *Andrographis paniculata* (Burm.f.) Wall. ex Nees, *Amaranthus gangeticus* L and *Allium tuberosum* Rottler ex Spreng.

A total of 207 species of useful plants distributed among 169 genera and 78 families were recorded from 40 homegardens in Kampung Masjid Ijok. The observation indicates the high biodiversity of plant species in a village of Peninsular Malaysia. The numbers of species found in this study are lower compared to other studies in a tropical region. Saikia et al. (2012) reported that there were 294 plant species recorded in 80 homegardens from 17 villages of Upper Assam, India. Blanckaert et al. (2004) recorded 233 different plant species in 30 homegardens from a village of San Rafael Coxcatlan, Mexico. Bhat et al. (2014) reported 210 different plant species in 50 homegardens from 10 villages of Karwar, India. Although the total species is slightly lower than that found in other tropical regions, it is quite impressive given that this study was recorded for homegardens in a single village rather than a few villages.

Table 1. Floristic information of 40 homegardens

Scientific name	Family	Habit/ life form	Use
<i>Abelmoschus esculentus</i> (L.) Moench	Malvaceae	Shrub	Food
<i>Acalypha hispida</i> Burm.f.	Euphorbiaceae	Shrub	Ornamental
<i>Acanthus ebracteatus</i> Vahl	Acanthaceae	Herb	Medicinal
<i>Agave americana</i> L.	Agavaceae	Shrub	Ornamental
<i>Ageratum conyzoides</i> L.	Asteraceae	Herb	Medicinal
<i>Allamanda cathartica</i> L.	Apocynaceae	Shrub	Ornamental
<i>Allium cepa</i> L.	Amaryllidaceae	Herb	Food
<i>Allium tuberosum</i> Rottler ex Spreng.	Amaryllidaceae	Herb	Food
<i>Alocasia denudata</i> Engl.	Araceae	Shrub	Food
<i>Alocasia macrorrhiza</i> (L.) G.Don	Araceae	Shrub	Ornamental
<i>Alocasia macrorrhiza</i> Black Stem	Araceae	Shrub	Food
<i>Alocasia sanderiana</i> (W.Bull) Engl.	Araceae	Herb	Ornamental
<i>Aloe vera</i> (L.) Burm.f.	Xanthorrhoeaceae	Shrub	Ornamental
<i>Alpinia officinarum</i> Hance	Zingiberaceae	Herb	Medicinal
<i>Amaranthus gangeticus</i> L.	Amaranthaceae	Herb	Food
<i>Anacardium occidentale</i> L.	Anacardiaceae	Tree	Food

<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	Shrub	Food
<i>Ananas nanus</i> L.B.Sm.	Bromeliaceae	Shrub	Medicinal
<i>Andrographis paniculata</i> (Burm.f.) Wall. ex Nees	Acanthaceae	Herb	Medicinal
<i>Annona muricata</i> L.	Annonaceae	Tree	Medicinal
<i>Aquilaria malaccensis</i> Benth.	Thymelaeaceae	Tre	Miscellaneous
<i>Archidendron jiringa</i> (Jack) I.C.Nielsen	Fabaceae	Tree	Food
<i>Ardisia crenata</i> Sims.	Primulaceae	Shrub	Food
<i>Areca catechu</i> L.	Arecaceae	Tree	Miscellaneous
<i>Artocarpus altilis</i> (Parkinson) Fosberg	Moraceae	Tree	Food
<i>Artocarpus heterophyllus</i> Lam.	Moraceae	Tree	Food
<i>Artocarpus integer</i> (Thunb.) Merr.	Moraceae	Tree	Food
<i>Arundina graminifolia</i> (D.Don) Hochr.	Orchidaceae	Shrub	Ornamental
<i>Averrhoa bilimbi</i> L.	Oxalidaceae	Tree	Food
<i>Averrhoa carambola</i> L.	Oxalidaceae	Tree	Food
<i>Baccaurea macrocarpa</i> Mull. Arg.	Phyllanthaceae	Tree	Food
<i>Baccaurea motleyana</i> Hook. f.	Phyllanthaceae	Tree	Food
<i>Barringtonia racemosa</i> (L.) Spreng	Lecythidaceae	Tree	Food
<i>Begonia venosa</i> Skan ex Hook.f	Begoniaceae	Herb	Ornamental
<i>Blumea balsamifera</i> (L.) DC.	Asteraceae	Shrub	Medicinal
<i>Bouea macrophylla</i> Griff.	Anacardiaceae	Tree	Food
<i>Bougainvillea formosa</i> W.Bull	Nyctaginaceae	Shrub	Ornamental
<i>Caladium bicolor</i> (Aiton) Vent.	Araceae	Herb	Ornamental
<i>Caladium humboldtii</i> Vent.	Araceae	Herb	Ornamental
<i>Caladium lindenii</i> (Andre) Madison	Araceae	Herb	Ornamental
<i>Calamus manan</i> Miq.	Arecaceae	Tree	Ornamental
<i>Calathea metallica</i> Planch. & Linden	Marantaceae	Shrub	Ornamental
<i>Calathea zebrina</i> (Sims) Lindl.	Marantaceae	Shrub	Ornamental
<i>Capsicum frutescens</i> L.	Solanaceae	Climber	Medicinal
<i>Carica papaya</i> L.	Caricaceae	Shrub	Food
<i>Cassia alata</i> L.	Fabaceae	Shrub	Medicinal
<i>Catharanthus roseus</i> (L.) G. Don	Apocynaceae	Shrub	Ornamental
<i>Ceiba pentandra</i> (L.) Gaertn.	Malvaceae	Tree	Miscellaneous
<i>Chassalia curviflora</i> (Wall.) Thwaites	Rubiaceae	Shrub	Medicinal
<i>Chrysothemis pulchella</i> (Donn ex Sims) Decne.	Gesneriaceae	Herb	Ornamental
<i>Cinnamomum iners</i> Reinw. ex Bl.	Lauraceae	Tree	Medicinal
<i>Citrus aurantiifolia</i> (Christm.) Swingle	Rutaceae	Tree	Food
<i>Citrus hystrix</i> DC.	Rutaceae	Tree	Food
<i>Citrus maxima</i> (Burm. f.) Merr.	Rutaceae	Tree	Food
<i>Citrus medica</i> (Christm. & Panzer) Swingle	Rutaceae	Tree	Food
<i>Citrus suhuiensis</i> Hayata	Rutaceae	Tree	Food
<i>Citrus x microcarpa</i>	Rutaceae	Tree	Food
<i>Claoxylon longifolium</i> (Blume) Endl. Sx Hassk	Euphorbiaceae	Shrub	Food
<i>Clerodendron paniculatum</i> L.	Verbenaceae	Shrub	Medicinal
<i>Clidemia hirta</i> (L.) D. Don	Melastomataceae	Shrub	Medicinal
<i>Clinacanthus nutans</i> (Burm. fil.) Linda	Acanthaceae	Shrub	Medicinal
<i>Cocos nucifera</i> L.	Arecaceae	Tree	Food
<i>Codiaeum variegatum</i> (L.) A. Juss.	Euphorbiaceae	Shrub	Ornamental
<i>Coffea canephora</i> Pierre ex A.Froehner	Rubiaceae	Shrub	Food
<i>Coleus blumei</i> Benth.	Lamiaceae	Herb	Medicinal
<i>Colocasia esculenta</i> (L.) Schott.	Araceae	Shrub	Food
<i>Colocasia gigantea</i> (Blume ex Hassk.) Hook.f.	Araceae	Shrub	Food
<i>Cordyline terminalis</i> Linn.Kunth	Agavaceae	Shrub	Ornamental
<i>Cosmos caudatus</i> Kunth	Asteraceae	Herb	Food
<i>Costus speciosus</i> (J.Konig) C.Specht	Costaceae	Shrub	Ornamental
<i>Costus spiralis</i> (Jacq.) Roscoe.	Costaceae	Shrub	Ornamental
<i>Crinum asiaticum</i> L.	Amaryllidaceae	Shrub	Ornamental
<i>Crinum pedunculatum</i> R.Br.	Amaryllidaceae	Shrub	Ornamental
<i>Cucumis sativus</i> L.	Cucurbitaceae	Climber	Food
<i>Cucurbita moschata</i> Duchesne ex Poir.	Cucurbitaceae	Climber	Food
<i>Curcuma domestica</i> Valetton	Zingiberaceae	Herb	Food
<i>Cycas macrocarpa</i> Griff.	Cycadaceae	Shrub	Ornamental
<i>Cymbopogon citratus</i> (DC.) Stapf	Poaceae	Shrub	Food
<i>Cymbopogon nardus</i> (L.) Rendle	Poaceae	Shrub	Medicinal
<i>Cynometra cauliflora</i> L.	Fabaceae	Tree	Food
<i>Cyperus alternifolius</i> L.	Cyperaceae	Shrub	Medicinal
<i>Dieffenbachia maculate</i> (Lodd.) G.Don.	Araceae	Shrub	Ornamental
<i>Dillenia suffruticosa</i> (Griff.) Martelli.	Dilleniaceae	Tree	Ornamental

<i>Dimocarpus longan</i> Lour	Sapindaceae	Tree	Food
<i>Durio zibethinus</i> Murr	Malvaceae	Tree	Food
<i>Dypsis lutescens</i> (H.Wendl.) Beentje & J.Dransf.	Arecaceae	Tree	Ornamental
<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	Herb	Ornamental
<i>Elaeis guineensis</i> Jacq.	Arecaceae	Tree	Miscellaneous
<i>Episcia cupreata</i> (Hook.) Hanst.	Lamiales	Herb	Ornamental
<i>Ervatamia coronaria</i> (Jacq.) Stapf	Apocynaceae	Shrub	Ornamental
<i>Etlingera coccinea</i> (Blume) S.Sakai & Nagam.	Zingiberaceae	Herb	Medicinal
<i>Etlingera elatior</i> (Jack) R.M.Sm.	Zingiberaceae	Shrub	Food
<i>Etlingera megalocheilos</i> (Griff.) A.D.Poulsen	Zingiberaceae	Shrub	Food
<i>Eugenia aquea</i> Burm. f.	Myrtaceae	Tree	Food
<i>Euphorbia hirta</i> L.	Euphorbiaceae	Herb	Medicinal
<i>Euphorbia mili</i> Des Moul.	Euphorbiaceae	Shrub	Ornamental
<i>Euphorbia nerifolia</i> L.	Euphorbiaceae	Shrub	Ornamental
<i>Eurycoma longifolia</i> Jack	Simaroubaceae	Tree	Food
<i>Ficus schwarzii</i> Koord	Moraceae	Tree	Food
<i>Garcinia cambogia</i> (Gaertn.) Desr.	Clusiaceae	Tree	Food
<i>Garcinia mangostana</i> L.	Clusiaceae	Tree	Food
<i>Gigantochloa albociliata</i> (Munro) Kurz	Poaceae	Tree	Food
<i>Gomphrena globosa</i> L.	Amaranthaceae	Herb	Ornamental
<i>Gynura sarmetosa</i> (Blume) DC.	Compositae	Herb	Medicinal
<i>Heliconia bicolor</i> Benth.	Heliconiaceae	Shrub	Ornamental
<i>Heliconia psittacorum</i> L.f.	Heliconiaceae	Shrub	Ornamental
<i>Hevea brasiliensis</i> (Willd. ex A.Juss.) Mull. Arg.	Euphorbiaceae	Tree	Miscellaneous
<i>Hibiscus rosa-sinensis</i> L.	Malvaceae	Shrub	Ornamental
<i>Hibiscus sabdariffa</i> L.	Malvaceae	Shrub	Ornamental
<i>Huperzia carinata</i> Desv. Ex Poir) Trevisan	Huperziaceae	Herb	Ornamental
<i>Hylocereus undatus</i> (Haw.) Britton & Rose	Cactaceae	Shrub	Food
<i>Impatiens balsamina</i> L.	Balsaminaceae	Herb	Ornamental
<i>Ipomoea aquatica</i> Forssk.	Convolvulaceae	Herb	Food
<i>Ipomoea batatas</i> (L.) Lam.	Convolvulaceae	Herb	Food
<i>Ixora javanica</i> (Blume) DC.	Rubiaceae	Shrub	Ornamental
<i>Kalanchoe pinnata</i> (Lam.) Pers.	Crassulaceae	Herb	Medicinal
<i>Languas galanga</i> (L.) Stuntz	Zingiberaceae	Shrub	Food
<i>Lansium domesticum</i> Correa	Meliaceae	Tree	Food
<i>Laurentia longiflora</i> (Linn) Patern	Campanulaceae	Herb	Medicinal
<i>Lawsonia inermis</i> L.	Lythraceae	Shrub	Miscellaneous
<i>Lepisanthes rubiginosa</i> (Roxb.) Leenh	Sapindaceae	Tree	Food
<i>Leucaena leucocephala</i> (Lamk) De Wit	Fabaceae	Tree	Medicinal
<i>Licuala peltata</i> Roxb. ex Buch.	Arecaceae	Shrub	Ornamental
<i>Licuala spinosa</i> Roxb.	Arecaceae	Shrub	Miscellaneous
<i>Limnocharis flava</i> (L.) Buchenau	Alismataceae	Herb	Food
<i>Lycopodium phlegmaria</i> A. Cunn.	Huperziaceae	Herb	Ornamental
<i>Mallotus barbatulus</i> Mull. Arg.	Euphorbiaceae	Tree	Medicinal
<i>Mangifera foetida</i> Lour.	Anacardiaceae	Tree	Food
<i>Mangifera indica</i> L.	Anacardiaceae	Tree	Food
<i>Manihot esculenta</i> Crantz	Euphorbiaceae	Shrub	Food
<i>Manilkara zapota</i> (L.) P.Royen	Sapotaceae	Tree	Food
<i>Melastoma decemfidum</i> Roxb.	Melastomataceae	Shrub	Medicinal
<i>Melia excelsa</i> Jack	Meliaceae	Tree	Food
<i>Metroxylon sagu</i> Rottb.	Arecaceae	Tree	Food
<i>Mimosa pudica</i> L.	Fabaceae	Herb	Medicinal
<i>Mirabilis longiflora</i> L.	Nyctaginaceae	Herb	Ornamental
<i>Molineria latifolia</i> (Dryand. ex W.T.Aiton) Herb. ex Kurz	Hypoxidaceae	Herb	Medicinal
<i>Momordica charantia</i> L.	Cucurbitaceae	Climber	Food
<i>Morinda citrifolia</i> L.	Rubiaceae	Tree	Medicinal
<i>Murraya koenigii</i> (L.) Spreng.	Rutaceae	Tree	Food
<i>Musa paradisiaca</i> L.	Musaceae	Shrub	Miscellaneous
<i>Nepenthes gracilis</i> Korth.	Nepenthaceae	Herb	Ornamental
<i>Nephelium lappaceum</i> L.	Sapindaceae	Tree	Food
<i>Nephelium mutabile</i> Bl.	Sapindaceae	Tree	Food
<i>Ocimum gratissimum</i> Forssk.	Labiatae	Shrub	Medicinal
<i>Oenanthe javanica</i> (Blume) DC.	Apiaceae	Herb	Food
<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	Tree	Medicinal
<i>Orthosiphon aristatus</i> (Blume) Miq.	Labiatae	Shrub	Medicinal
<i>Oxalis barrelieri</i> L.	Oxalidaceae	Herb	Medicinal
<i>Oxalis triangularis</i> A.St.-Hil.	Oxalidaceae	Herb	Ornamental

<i>Pachyrhizus erosus</i> (L.) Urb.	Fabaceae	Climber	Food
<i>Pandanus amaryllifolius</i> Roxb.	Pandanaceae	Shrub	Food
<i>Pandanus caricosus</i> Spreng.	Pandanaceae	Shrub	Miscellaneous
<i>Parkia speciosa</i> Hassk.	Fabaceae	Tree	Food
<i>Passiflora edulis</i> Sims	Passifloraceae	Climber	Food
<i>Pedilanthus tithymaloides</i> (L.) Poit.	Euphorbiaceae	Shrub	Ornamental
<i>Peperomia pellucida</i> Kunth	Piperaceae	Herb	Food
<i>Persicaria hydropiper</i> L.	Polygonaceae	Herb	Food
<i>Phyllanthus niruri</i> L.	Phyllanthaceae	Herb	Medicinal
<i>Phyllanthus pulcher</i> Wall.ex Mull.Arg.	Euphorbiaceae	Shrub	Medicinal
<i>Phyllanthus pulcher</i> Wall.ex Mull.Arg.	Euphorbiaceae	Shrub	Medicinal
<i>Physalis minima</i> L.	Solanaceae	Climber	Medicinal
<i>Physalis minima</i> L.	Solanaceae	Climber	Medicinal
<i>Piper betle</i> L.	Piperaceae	Climber	Medicinal
<i>Piper sarmentosum</i> Roxb.	Piperaceae	Herb	Food
<i>Pithecellobium bubalinum</i> (Jack) Benth.	Fabaceae	Tree	Food
<i>Platycerium coronarium</i> (D. König" ex O.F. Mull".) Desv.	Polypodiaceae	Shrub	Ornamental
<i>Plumeria rubra</i> L.	Apocynaceae	Tree	Ornamental
<i>Portulaca grandiflora</i> Hook.	Portulacaceae	Herb	Ornamental
<i>Psidium guajava</i> L.	Myrtaceae	Tree	Food
<i>Psophocarpus tetragonolobus</i> (L.) D.C	Fabaceae	Climber	Food
<i>Pteris ensiformis</i> Burm.	Pteridaceae	Herb	Ornamental
<i>Punica granatum</i> L.	Lythraceae	Shrub	Food
<i>Pyrrosia piloselloides</i> (L.) M.G.Price	Polypodiaceae	Herb	Medicinal
<i>Rhinacanthus communis</i> Nees	Acanthaceae	Herb	Medicinal
<i>Ricinus communis</i> L.	Euphorbiaceae	Shrub	Medicinal
<i>Ricinus communis</i> L.	Euphorbiaceae	Shrub	Medicinal
<i>Rosa</i> L.	Rosaceae	Shrub	Ornamental
<i>Ruellia tweediana</i> Griseb.	Acanthaceae	Shrub	Ornamental
<i>Saccharum officinarum</i> L.	Poaceae	Shrub	Food
<i>Salacca zalacca</i> (Gaertn.) Voss.	Arecaceae	Shrub	Food
<i>Sansevieria cylindrical</i> Bojer ex Hook.	Asparagaceae	Shrub	Ornamental
<i>Sansevieria trifasciata</i> Prain	Asparagaceae	Shrub	Ornamental
<i>Sauropus androgynus</i> (L.) Merr.	Euphorbiaceae	Shrub	Food
<i>Sauropus androgynus</i> (L.) Merr.	Euphorbiaceae	Shrub	Food
<i>Scorodocarpus borneensis</i> (Baill.) Becc.	Olaceae	Tree	Medicinal
<i>Sida rhombifolia</i> L.	Malvaceae	Herb	Medicinal
<i>Smilax myosotiflora</i> A.DC.	Smilacacaceae	Tree	Medicinal
<i>Solanum ferox</i> L.	Solanaceae	Shrub	Food
<i>Solanum ferox</i> L.	Solanaceae	Shrub	Food
<i>Solanum lasiocarpum</i> Dunal	Solanaceae	Shrub	Food
<i>Solanum lasiocarpum</i> Dunal	Solanaceae	Shrub	Food
<i>Solanum melongena</i> L.	Solanaceae	Shrub	Food
<i>Solanum melongena</i> L.	Solanaceae	Shrub	Food
<i>Solanum torvum</i> Sw.	Solanaceae	Shrub	Medicinal
<i>Solanum torvum</i> Sw.	Solanaceae	Shrub	Medicinal
<i>Spathoglottis plicata</i> Blume	Orchidaceae	Shrub	Ornamental
<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae	Tree	Food
<i>Stachytarpheta jamaicensis</i> (L.) Vahl	Verbenaceae	Shrub	Medicinal
<i>Syzygium jambos</i> L. (Alston)	Myrtaceae	Tree	Food
<i>Syzygium malaccense</i> (L.) Merr. & L.M.Perry	Myrtaceae	Tree	Food
<i>Tacca integrifolia</i> Ker Gawl.	Dioscoreaceae	Herb	Medicinal
<i>Talinum paniculatum</i> (Jacq.) Gaertn.	Portulacaceae	Shrub	Medicinal
<i>Theobroma cacao</i> L.	Malvaceae	Tree	Food
<i>Tunera ulmifolia</i> L.	Turneraceae	Shrub	Ornamental
<i>Urena lobata</i> L.	Malvaceae	Shrub	Ornamental
<i>Vernonia amygdalina</i> Delile	Asteraceae	Shrub	Medicinal
<i>Vernonia cinera</i> (Linn). Less.	Asteraceae	Herb	Medicinal
<i>Vigna sesquipedalis</i> (L.)Fruwirth	Fabaceae	Climber	Food
<i>Vitex pubescens</i> Vahl.	Verbenaceae	Tree	Medicinal
<i>Wedelia trilobata</i> (L.) A.S. Hitchc.	Asteraceae	Herb	Ornamental
<i>Xanthosoma sagittifolium</i> (L.) Schott.	Araceae	Shrub	Food
<i>Zea mays</i> L.	Poaceae	Shrub	Food
<i>Zingiber officinale</i> Roscoe	Zingiberaceae	Shrub	Food
<i>Zingiber zerumbet</i> (L.) Smith	Zingiberaceae	Shrub	Medicinal

In this study, the most frequent species recorded (*Musa paradisiaca* L., *Cocos nucifera* L., *Nephelium lappaceum* L., *Capsicum frutescens* L., *Carica papaya* L., *Cymbopogon citratus* (DC.) Stapf, *Mangifera indica* L., *Curcuma domestica* Valetton, *Garcinia mangostana* L., *Manihot esculenta* Crantz, *Lansium domesticum* Correa, *Areca catechu* L.) are consistent with literature reported on homegardens in tropical region. Caballero-Serrano et al. (2016) reported that the most common species documented in homegardens of Ecuador were *Musa* spp., *Colocasia esculenta*, *Manihot esculenta*, *Mouriri* spp. and *Ananas comosus*. In Tuyen Quang, Vietnam, *Musa* spp., *Zingiber officinale* and *Colocasia esculenta* were among the most common plants recorded in homegardens (Timsuksai et al. 2015). In Karen, Thailand, Panyadee et al. (2018) concluded that the most common species documented in homegardens were *Mangifera indica*, *Artocarpus heterophyllus*, *Psidium guajava*, and *Colocasia esculenta*.

The common occurrence of plant species in this study with the other homegardens in tropical regions was probably due to similar climatic conditions, but the differences in their frequencies and abundance could be due to the variation in the social-cultural characteristics and biophysical condition. For example, the high frequencies of *Capsicum frutescens* L., *Cymbopogon citratus* (DC.) Stapf and *Curcuma domestica* Valetton in this study could be due primarily to its usage as a main ingredient in most Malay traditional cuisine. *Cymbopogon citratus* (DC.) Stapf was also recorded in homegardens of Paraiba, Northeastern Brazil (Carvalho et al. 2013) and Mayan homegardens, Mexico (de Clerck and Negreros-Castillo 2000) but *Curcuma domestica* Valetton which was highly recorded in this study was not found in their homegardens. At the family level, Euphorbiaceae (13 species), Araceae (11 species), Fabaceae (10 species), Arecaceae (9 species), Malvaceae (8 species), Zingiberaceae (8 species), and Rutaceae (7 species) demonstrated the highest species composition of useful plants in homegardens. In terms of habit, shrubs dominated the plants in all homegardens with a portion of 42 %, followed by trees (29.5%), herbs (23.7%) and climbers (4.8%) as shown in Figure 2. As many as 43.3% of the useful plant species were exclusively used as food. 27.8% and 24% of the species as ornamental and medicine. The remaining 4.9% of the plant species had other uses, and were grouped under the category miscellaneous. Figure 3 shows the usage of plants in the homegardens.

According to Fernandes and Nair (1986) homegardens are an important source of subsistence products due to unavailability of the products in the market, leading to higher species diversity in remote villages. In this study, the highest frequency of *Musa Paradisiaca* indicates the importance of this plant for household consumption and the economy as the excess production of the product is sold to increase their household income. Fruit plant species in particular, dominated the biodiversity found in the homegardens, accounting for 43.3% of the total species. The ten most frequently found species in homegardens also fall under this category. A similar observation was also

reported by George and Christopher (2020) in Kerala, India, Sujarwo and Caneva (2015) in Bali, Indonesia, Srithi et al. (2012) in Thailand and Roy et al. (2013) in Bangladesh. It has been reported that fruit plants make an important contribution to the nutrition of households (Nair 1993). A few species of useful plants are recorded in the homegardens that are observed to be found in the forests surrounding the homegardens, i.e., *Scorodocarpus borneensis* (Baill) Becc and *Eurycoma longifolia* Jack, which are used for medicinal purposes by the local community. *Scorodocarpus borneensis* (Baill) Becc has been traditionally used by the local community in Kampung Masjid Ijok to treat indigestion problems, while *Eurycoma longifolia* Jack is used to treat low sexual energy. According to Lim (2012), *Scorodocarpus borneensis* (Baill) Becc is found in undisturbed to slightly disturbed (open) mixed dipterocarp forests up to 900m altitudes, while *Eurycoma longifolia* Jack is a slender, evergreen flowering tree, occurring naturally in jungles of Malaysia and Indonesia (Wernsdorfer et al. 2009). Besides medicinal purposes, some of the plants are also domesticated for their fruit. Such plants are *Parkia speciosa* Hassk which has been reported to be distributed in the Malaysian forests (Huey et al. 2014) and *Garnia cambogia* (Gaertn), naturally found in the lowland tropical rainforest (Lim 2012). Homegardens at the study site also contribute to the conservation of plant species. There were two species of plants categorized as critically endangered (CR) in (IUCN) Red List namely *Aquilaria malaccensis* and *Alocasia sandariana*.

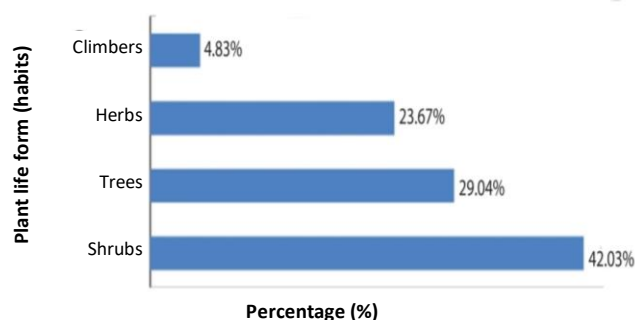


Figure 2. Diversity of life forms (habits) of plants in homegardens

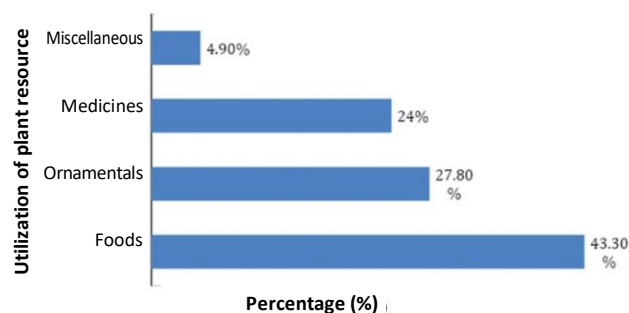


Figure 3. Uses of homegarden plants

According to Kumar and Nair (2004) the diversity of plants in homegardens is closely related to how the homegardens are being managed. The integration of multiple plant species with different life forms (tree, shrub, herb, climbers) has created proper dynamics in homegardens. It has been reported in the literature, most homegardens are made up of plants in multiple life-forms, but slightly different in composition and dominance. Sujarwo and Caneva (2015) reported that tree-dominated homegardens of Bali, Indonesia, followed by shrub, herb, and climber. In homegardens of Ethiopia, Mekonen et al. (2015) reported that herb dominated, followed by tree, shrub and climber, while a study by Barbhuiya et al. (2016) reported that tree dominated homegardens of Northeastern India, followed by shrub and herbs. The interaction between plants with multiple life-forms provides benefits to the environment. It has been reported that trees could dry and aerate soils by intercepting rainfall and transferring water from the soil to atmosphere through transpiration, increase soil nutrient availability by litterfall and reduce irradiance by shading (Holmgren et al. 2015). Molder et al. (2008) reported a significant correlation between tree-herb layers and environmental parameters like pH, light, and humus thickness. In this study, the tree constituted 29.47% of the total species recorded. The average trees recorded were between 6 to 20 species per homegardens. A nitrogen-fixing tree in this study, namely *Leucaena leucocephala* (Lam.) de Wit., can enrich the soil with nitrogen (Liu et al.

2018). The highest Shannon-Weiner Index was recorded in the large-sized homegardens (3.61) and the lowest in small-sized homegardens (1.66). Principle Component Analysis (PCA) incorporating several variables (size of homegardens, total species and Shannon-Weiner index) indicated that large homegardens corresponds to the high total number of species and Shannon-Weiner index (Figure 4). This study suggested that large homegardens are more effective for the conservation of plant diversity than small and medium ones. This result is consistent with the findings by Mekonen et al. (2015), who noted that diversity of plant species is correlated with the size of homegardens.

To conclude, this current floristic survey of 40 homegardens in the Kampung Masjid Ijok, Perak, Malaysia reveals that many food plants, ornamental and medicinal plants are still widely found and used by the community. The high diversity of plant species recorded in this study provides a lot of benefits to the environment and the economy and social of the local community. *Alocasia sanderiana* and *Aquilaria malaccensis* categorized as critically endangered (CR) in (IUCN) Red List were also recorded in the study site. These findings indicate that homegardens are suitable places for conservation of these plants. Given the significant contribution and benefits of home gardens to human well-being and the lack of exploration of home gardens in Malaysia, this study could provide useful information that can support and encourage local communities to develop their home gardens in a sustainable manner.

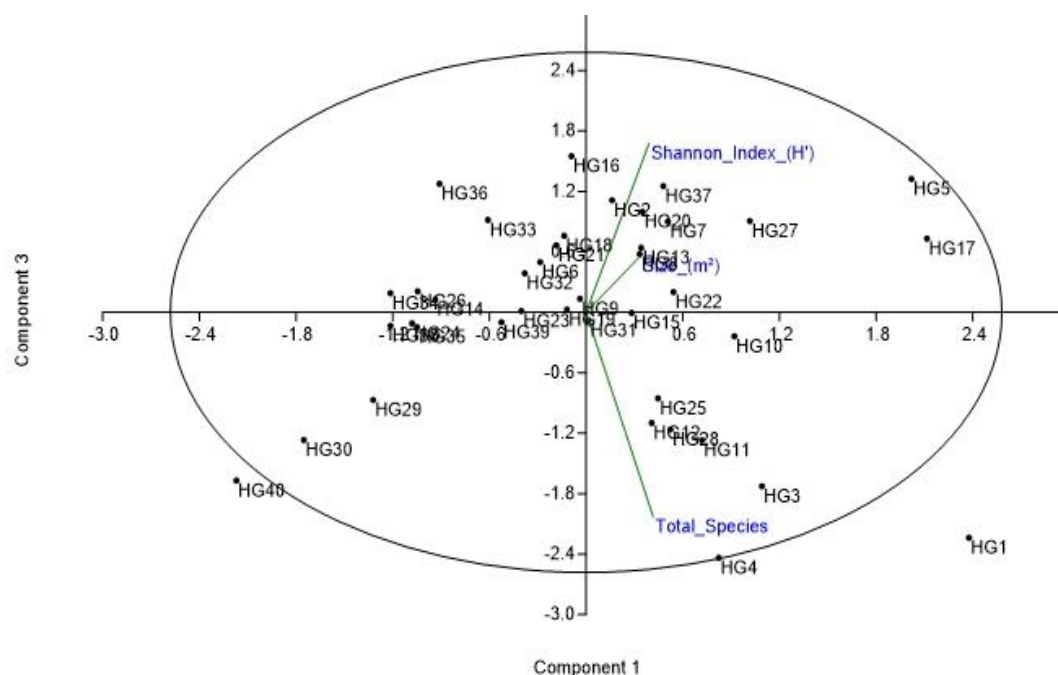


Figure 4. PCA indicates correlation between size of homegardens, total species and Shannon-Wiener index

ACKNOWLEDGEMENTS

We thank the University Malaya and the Ministry of Education of Malaysia for providing facilities and funds that enable this study to be carried out. Publication of this article was funded by PG072-2013A, RF193-12SUS and LL023-16SUS provided by University of Malaya and MyBrain 15 Scholarship provided by Ministry of Education of Malaysia. This study is also to be a part of a Ph.D. contribution of the first author.

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