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Comparative assessment of floristic diversity, ethnobotanical practices, and local perceptions in urban, semi-urban, and rural homegardens of East Khasi Hills, India

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Abstract

Homegardens are complex, multifunctional ecosystems that serve a key role in conserving biodiversity, supporting livelihood, and preserving traditional knowledge. This study comparatively assessed floristic diversity, ethnobotanical practices, and local perceptions across urban, semi-urban, and rural homegardens in the East Khasi Hills district of Meghalaya, India. The study was conducted from August 2022 to July 2024 using a field-based exploratory survey covering 90 homegardens, including 30 each from urban, semi-urban, and rural areas. Information was gathered using a combination of semi-structured interviews, free-listing techniques, and field observations to document plant species, their uses, and respondents' socio-economic conditions. The cultural relevance of plant species was calculated through the application of quantitative ethnobotanical indices such as Relative Frequency of Citation (RFC), Use Value (UV), and Fidelity Level (FL). Additionally, floristic diversity across the three homegarden types was assessed using species richness, Menhinick's, Simpson's, and Shannon–Wiener indices. Results revealed that rural homegardens supported the highest species richness (106 species), greater diversity, and wider ethnobotanical utilization of plants for food, medicine, fodder, and other household needs, followed by semi-urban (92 species) and urban homegardens (81 species). In contrast, urban homegardens were largely dominated by ornamental plants with relatively limited use categories (UC). The study further revealed that women are the crucial players in the management and maintenance of homegardens, a pattern shaped by the matrilineal inheritance system prevalent in the Khasi community. Most respondents recognized the role of homegardens in maintaining plant diversity and traditional knowledge, and expressed their willingness to transmit this ethnobotanical knowledge to future generations. The study highlights the ecological and socio-cultural value of homegardens and provides baseline information for conservation efforts, sustainable livelihood strategies, and policy formulation in Northeast India.

***Keywords*:** Ethnobotany, Homegardens, Khasi Hills, Local Perceptions, Medicinal Plants, Traditional Practice

1. Introduction

Homegardens are diverse, multifunctional ecosystems that are closely associated with the daily lives of local communities worldwide and contribute significantly to their social, economic, and nutritional well-being (Kumar and Nair 2004; Marak et al. 2023). These micro-scale land-use systems are often recognized as traditional agroforestry systems, characterized by a multistratal vegetation structure, high species richness, and multiple ecological as well as socioeconomic functions (Akhter et al. 2010; Shimrah et al. 2018; Patel et al. 2022). The composition, diversity, and structure of homegardens are influenced by a range of environmental, socio-economic, and cultural factors (Das and Das 2005). They serve as important reservoirs of plant genetic diversity of both wild and domesticated species (Yang et

al. 2014), including those utilized for food, fodder, fuelwood, medicine, and ornamentation (Sarkar et al. 2023). Many of these plants have medicinal significance, and this knowledge about their uses is preserved within the indigenous knowledge systems of local communities (Kencharaddi et al. 2026).

Ethnobotany deals with the relationships between people and plants, focusing on how diverse cultures utilize plants for food, medicine, and various other purposes (Agbogidi and Adolor 2013). Ethnomedicinal plants are species used in traditional healthcare system by indigenous, tribal, or local communities, based on cultural beliefs, knowledge, and practice (Bhat et al. 2023). These plant resources are vital to rural and tribal populations, where traditional knowledge regarding plant use has been shared orally over generations (Tyngsong and Tiwari 2010; Panmei et al. 2019). In Meghalaya, the practice of collecting, processing, and using plant-based medicines has been maintained by experienced members of the Garo, Khasi, Jaintia, and other minor communities (Kencharaddi et al. 2026). Over the years, the value of traditional ethnobiological knowledge is increasingly being recognized for its use in modern medicine, as well as in pharmacological and nutraceutical research (Yang et al. 2014; Pungjung et al. 2025).

Traditional homegardens in Northeast India are well documented (Saikia et al. 2012; Marak et al. 2023) and valued for their role in rural livelihoods and conserving plant genetic diversity through their complex vegetation structure and high species diversity (Sarkar et al. 2023). The earlier floristic and ethnobotanical studies in the region's home gardens have revealed significant variations in species composition and management practices across short distances within the study areas (Saikia et al. 2012; Marak et al. 2023). These variations are largely influenced by environmental conditions, cultural traditions, socioeconomic factors, and the livelihood needs (Sarkar et al. 2023).

In Meghalaya, the matrilineal social system of land and property inheritance enables indigenous women to serve a strategic role in food production, land stewardship, and the preservation and transmission of traditional knowledge (Marak et al. 2023). As reported in earlier studies from Egypt (El Khateeb et al. 2023) and Nigeria (Daudu et al. 2025), women in this study area also had a significant influence on the selection and cultivation of crops and vegetables in diverse land-use systems, including homegardens (Kencharaddi et al. 2026). At the same time, shifting socio-economic changes, driven by modernization, migration, and urbanization have significantly disrupted traditional knowledge systems and contributed to the diminishing of ethnobotanical knowledge (Arjona-Garcia et al. 2021). This disruption is further reinforced by urbanization, which rapidly transforms land-use systems, including homegardens, thereby influencing ecological patterns, plant diversity, and resource management practices (Bdoor 2017).

The selected study area, the East Khasi Hills district of Meghalaya, located within the Indo-Burma biodiversity hotspot, which is notable for its rich plant diversity and strong heritage of traditional plant use (Bhat et al. 2023). Homegardens in this region contribute to household livelihoods, food security, and the conservation of plant diversity. Although earlier studies have documented ethnobotanical knowledge and plant diversity in Northeast India, most have primarily focused on general ethnobotanical surveys, medicinal plant documentation, or floristic inventories (Saikia et al. 2012; Bdoor 2017; Marak et al. 2023). However, comparative studies examining floristic diversity, ethnobotanical practices, and local perceptions across urban, semi-urban, and rural areas remain limited in the selected study area. Research of this kind are essential for understanding how urbanization and socio-economic changes influence plant diversity, traditional knowledge, and resource management in homegardens.

In this context, the present study was conducted to comparatively assess floristic diversity, ethnobotanical practices, and local perceptions in urban, semi-urban, and rural homegardens of the East Khasi Hills district of Meghalaya, India, with the following objectives: (i) to assess the structure, function, and floristic diversity of urban, semi-urban, and rural homegardens; (ii) to document ethnobotanical practices and patterns of plant use among homegarden owners; and (iii) to evaluate local perceptions regarding the role of homegardens in conserving plant diversity and supporting household livelihoods.

2. Materials and Methods

2.1. Study Area

The present study was conducted in urban, semi-urban, and rural areas of the East Khasi Hills district of Meghalaya, India, from August 2022 to July 2024 (Fig. 1). The district was selected because of its dense population and fast-changing land use patterns associated with urbanization. East Khasi Hills spans approximately 2,748 km^2 and lies between 25°07'–25°41' N latitude and 91°21'–92°09' E longitude (East Khasi Hills District Administration 2024). The district is largely mountainous, characterized by undulating plateaus, steep slopes, and deep gorges, particularly in the southern region.

The climate varies from temperate conditions in the plateau areas to warmer tropical and sub-tropical conditions in the northern and southern pockets. The whole district is strongly influenced by the south-west monsoon, which usually begins in May and continues until September. The region receives high annual rainfall and maintains humid conditions throughout most months, except for a dry period between December and March (East Khasi Hills District Administration 2024). The district is known for its diverse forest vegetation, including subtropical broad-leaved forests that support a wide variety of plant and animal species. Agriculture forms a key component of local livelihoods, with traditional farming and homegarden agroforestry supporting the cultivation of crops such as rice, maize, vegetables, fruits, and various ethnobotanically important plants.

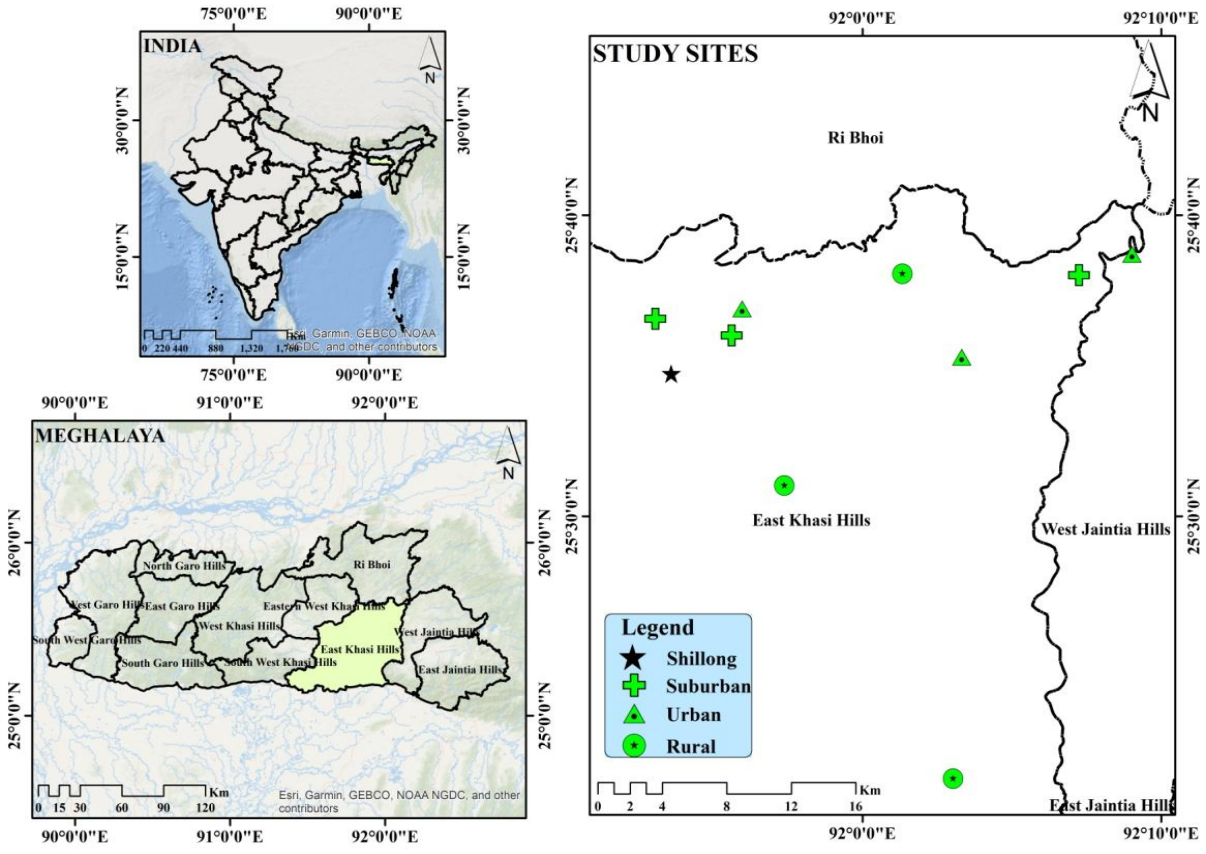


Fig. 1. Map of the study area

2.2. Research Design and Sampling Strategy

A field-based exploratory survey was conducted to examine the structure, floristic diversity, ethnobotanical uses, and local perceptions of homegardens across different levels of urbanization. Based on settlement characteristics and population density, the study locations were classified into three settlement types: urban, semi-urban, and rural areas (Fig. 2).



Fig. 2. Three homegardens categories: rural (a & b), semi-urban (c & d), and urban (e & f), and data collection (g-i).

A preliminary exploration survey was conducted to identify representative locations within each settlement category. A total of nine localities were carefully chosen, covering three urban (Jaiaw, Mawprem, and Laitumkhrah), semi-urban (Umlyngka, Mawpat, and Nongmynsong), and rural (Lumdewsaw, Baniun, and Nohwet) settlements. Thirty home gardens were selected from each settlement category, resulting in a total sample of 90.

The purposive sampling technique was used to select home garden owners who had adequate knowledge about the management and use of plants within their gardens. In addition, the snowball sampling technique was also applied to identify additional respondents through community recommendations. The head of the household or elderly family members actively involved in home garden management were primarily interviewed.

2.3. Socio-Economic and Homegarden Characteristics

Socio-economic information of the respondents and general characteristics of the homegardens were recorded through semi-structured interviews and direct field observations (Table 1). Information collected included the age, gender, education level, and occupation of respondents, as well as household size and landholding status. Homegarden characteristics such as garden size, age of the garden, ownership pattern, and management practices were also

documented, along with changes occurring in the homegardens and the factors responsible for these structural and temporal changes (Table 1).

2.4. Identification of Plants and Stratification of Homegarden Structure

2.4.1. Plant Documentation and Identification

Field surveys were conducted to record the plant species present in each homegarden. All plant species cultivated or maintained within the homegarden area were documented. Information on local names, growth forms, and uses of plant species was documented during the survey. The unidentified specimens were identified with the assistance of other local informants, a checklist of flora of Meghalaya (Haridasan and Rao 1985), and scientists from the Department of Botany, North-Eastern Hill University, Shillong, Meghalaya, and National Bureau of Plant Genetic Resources (NBPGR), New Delhi. The collected herbarium specimens were coded using a standardized format (e.g., NEHU-DOF-DK-001), indicating the institution, department, collector, and serial number, and these coded specimens were stored at the Department of Forestry, North-Eastern Hill University, Tura, Meghalaya, India. Scientific names were cross-verified using authoritative online databases, including the World Flora Online (https://www.worldfloraonline.org/) and Plants of the World Online (https://powo.science.kew.org/) to ensure taxonomic accuracy.

2.4.2. Vegetation Stratification

Homegarden vegetation was categorized into different growth forms, including trees, shrubs, herbs, climbers, palms, and bamboos (Johnson 1983), and every documented species was individually assigned a symbol like T, S, H, Cl, P, and B, respectively. Vertical stratification of vegetation was also observed to understand the structural organization of homegardens, which typically consists of multiple layers ranging from herbaceous plants to tall canopy trees. Based on this the nomenclature of the home garden strata was assigned as ground or bottom stratum (Stratum 1- St1); lower stratum (stratum 2- St2), lower middle stratum (stratum 3- St3), upper middle stratum (stratum 4- St4) and upper or topmost stratum (stratum 5- St5) as following (Mohri et al. 2013).

2.5. Quantitative Vegetation Analysis

2.5.1. Frequency

Frequency (F) is the degree of dispersion of an individual species in a community, i.e. chance of occurrence of a species in a given habitat is frequency and expressed in percent (Johnson 1983).

$$F = \frac{\text{No.of homegardens in which a species occurs}}{\text{Total number of home garden}} \times 100$$

2.5.2. Relative frequency

The frequency of a species relative to the frequency of all other species in a home garden was calculated by using the following formula.

$$RF = \frac{\text{Number of occurrence of a species}}{\text{Number of occurrence of all species}} \times 100$$

2.5.3. Abundance

Individuals of a species present in sampled areas were expressed as the abundance of a species that also reflects the commonality of the species in a studied habitat.

$$A = \frac{\text{Number of individuals of the species in sampled home gardens}}{\text{Number of homegardens in which a species occurred}} \times 100$$

2.5.4. Relative abundance

The abundance of a particular species relative to the total number of individuals of all species in the sampled area.

$$RA = \frac{\text{Abundance of a species}}{\text{Sum of the abundance of all species}} \times 100$$

2.5.5. Density

Abundance of a species in a unit area was expressed as density, which indicated the numerical strength of a species

in its community. The dominance and rarity of a species in a community were also indicated by density. It also reflects the standing biomass or productivity of an ecosystem.

$$D = \frac{\text{Total number of individuals of a species}}{\text{Total number of home garden}} \times 100$$

2.5.6. Relative Density

It is a percentage representation of a species in terms of the number of individuals relative to all other species in a community.

Number of individuals of the species

$$RD = \frac{\text{Number of individuals of the species}}{\text{Number of individuals of all species}} \times 100$$

2.5.7. Importance Value Index

The Importance Value Index (IVI) for each species was calculated by summing the relative density, relative frequency, and relative abundance values. These parameters were used to determine the ecological significance and dominance of plant species within homegarden systems.

2.6 Floristic Diversity Analysis

The diversity and distribution of plant species among urban, semi-urban, and rural homegardens were assessed using the following standard diversity indices.

2.6.1. Species richness

Species richness (S) was calculated as the total number of plant species recorded in each homegarden category.

2.6.2. Shannon-Wiener diversity index

The index ($H' = \sum ni/N\ (lnni/N)$), where 'ni' is the number of individuals of a species, 'N' is the number of individuals of all species, and 'ln' is the natural logarithm. It indicates community structure in terms of complexity of the habitat, i.e. higher the index more diverse the community

2.6.3. Simpson's index

Simpson's index (C) evaluates the level of dominance of a species within a community (Simpson, 1949) and is estimated with the following equation:

$$C = \sum (ni/N)^2$$

where 'ni' is the number of individuals of a species and 'N' is the number of individuals of all species documented from the sampled area, and its value is 0-1. The index indicates the number of chances of a particular species that could be encountered during sampling, which is inversely proportional to the Shannon and Wiener index, i.e. a higher the index less diverse the community.

2.6.4. Species evenness index

This index (EI) indicates the degree of distribution of species in a community or habitat (Pielou 1975) and was estimated using the following equation: $EI = H'/ \ln N$; where 'H'' is Shannon- Wiener diversity index and 'ln N' is the natural logarithm of the number of individuals of all species documented from the sampled area.

2.6.5. Species diversity or Menhinick's index

This index ($D' = S/ \sqrt{N}$) is based on species richness (S) in proportion to the total number of individuals of all species (N) in a home garden.

2.6.6. Sorenson's similarity index

This index (SI) estimates the degree of similarity in species among the different homegardens, and the equation used following Sorenson (1948) was

SI = 3a/3a+b+c+d, where 'a' is the species richness of the total sampled area, while 'b', 'c', and 'd' are the species richness of a particular sampled site. This index helped determine the degree of floristic similarity and variation along the urbanization gradient.

2.7. Ethnobotanical Data Collection

Ethnobotanical information was collected through semi-structured interviews, informal discussions, and field observations with homegarden owners. Respondents were asked about the local names of plant species, parts used, preparation methods, and traditional knowledge related to plant utilization. Free-listing techniques were also used to record commonly used plants and their importance in daily household activities. Based on the information obtained from respondents, plant uses were grouped into several use categories (UC), namely medicine (M), food (F), fodder (FD), fuelwood (FW), fencing (FC), ornamental (O), packing (P), construction (C), fiber (FI), and broomstick (BR).

2.8. Quantitative Ethnobotanical Indices

To assess the relative importance of plant species in local ethnobotanical knowledge systems, the following quantitative ethnobotanical indices were calculated.

2.8.1. Frequency of Citation

Frequency of citation (FC) is the number of informants mentioning the use of the species.

2.8.2. Relative Frequency of Citation

Relative frequency of citation (RFC) is the number of informants reporting the use of species (FC) divided by the total number of informants participating in the survey (N), without consideration of the use categories. (Santayana 2003).

2.8.3. Use Value

Use Value (UV) indicates the importance of a plant species to a community by considering the number of uses reported by informants during ethnobotanical surveys.

$$UV = \sum \frac{\text{Number of uses mentioned by each informant for a species (Ui)}}{\text{Total number of informants or homegardens surveyed (N)}}$$

2.8.4. Fidelity Level

The fidelity level (FL) is the percentage of informants using a certain plant species for the same purpose, calculated as: FL (%) = (Np/N) x 100

Where, Np = number of informants that claim use of a plant species to treat a particular illness; N = number of informants that use the plants as a medicine to treat any given disease (Ugulu et al. 2012). These indices provided quantitative insights into the cultural significance and utilization patterns of plant species within homegarden systems.

2.9. Assessment of Local Perceptions

Local perceptions regarding the role of homegardens in biodiversity conservation and household livelihoods were assessed using a set of structured statements. Respondents were asked to indicate their level of agreement with each statement using a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5). The statements addressed issues such as the importance of homegardens in conserving plant diversity, the role of homegardens in maintaining ethnobotanical knowledge, the contribution of homegardens to food security and household income, and concerns regarding the possible decline of traditional knowledge. Responses were compiled and analyzed to understand community attitudes toward homegardens and their perceived role in biodiversity conservation and livelihood support.

2.10. Statistical Analysis

All data collected during field surveys and interviews were compiled and analyzed using descriptive statistics and diversity indices. Quantitative vegetation parameters and ethnobotanical indices were quantified using standard ecological and ethnobotanical formulas. Comparative analyses were performed to examine variations in floristic diversity, plant use patterns, and local perceptions among urban, semi-urban, and rural homegardens.

3. Results

3.1. Socio-Economic and Homegarden Characteristics

3.1.1. Socio-economic characteristics

The socio-demographic characteristics of respondents across the three home garden types were recorded (Table 1).

Table 1 Socio-economic Profile of the respondents

Variables		Category	Rural	Semi-urban	Urban
Socio-economic Characteristics	Gender (%)	Male	13.3	3.33	6.67
		Female	86.67	96.67	93.33
	Average Age		59.46	52.36	52.30
	Religion (%)	Christian	76.67	93.33	100.00
		Indigenous	23.33	6.67	0.00
	Monthly income		11,300	18,033	58,067
	Occupation (%)	Farmer	73.33	10.00	0.00
		Non-Farmer	26.67	90.00	100
		Illiterate	20.00	10.00	0.00
	Education (%)	Primary	37.00	34.67	6.67
		Secondary	26.67	25.33	23.33
		Pre-University	10.00	6.67	3.33
		Graduation	6.67	20.00	50.00
		Post Graduate	0.00	3.33	16.67
Homegarden Characteristics	Area (ha)	0.00-0.20	76.67	93.33	100
		0.20-0.40	20.00	3.33	0.00
		0.40-0.60	3.33	3.33	0.00
	Age (yr)	0-25	53.33	23.33	60
		26-50	30.00	46.67	16.66
		51-75	6.67	20.00	16.67
		76-100	10.0.	10.00	6.67
	Change in size	Increased (Larger)	20.00	13.33	3.33
		Decreased (Smaller)	33.33	50.00	53.33
		Unchanged (Same)	46.67	36.66	43.33
	Reason for change in the size	Undecided	50.00	20.00	27.00
		Income generation	10.00	13.33	10.00
		Family partition	3.33	3.33	20.00
		Soil fertility issues	13.30	23.00	10.00
		Labour crisis	10.00	33.33	30.00
		Others	13.33	7.00	3.30

A clear dominance of female respondents was observed in all categories. Around 86.67%, 96.67%, and 93.33% of respondents were female in rural, semi-urban, and urban homegardens, respectively. Whereas, only 13.33% of respondents in rural, 3.33% in semi-urban, and 6.67% in urban homegardens were male. The average age of respondents was 59.46 years in rural, 52.36 years in semi-urban, and 52.30 years in urban home gardens. As far as religious composition is concerned, the majority of respondents were Christian in all three categories of HGs. In rural home gardens, 76.67% were Christian, and 23.33% followed indigenous beliefs. Similarly, in semi-urban areas, 93.33% were Christian and 6.67% were indigenous, while in urban areas, 100% of respondents were Christian.

An average monthly income showed a significant variation among the HG types. The highest average income (₹58,067) was observed in urban homegarden, while the lowest (₹11,300) was in rural homegarden. Occupational patterns also varied significantly across three different homegardens. Highest number of farmers were present in rural homegarden (73.33%), followed by semi-urban (10 %), while 100 % respondents were non-farmers in urban homegardens. Regarding the educational status, 36 % of the respondents in rural homegardens were completed primary education followed and 26.67% secondary education. A similar trend was also observed in semi-urban areas, where primary education (34%) was dominant, followed by secondary education (25.33%).

3.1.2. Homegarden characteristics

The distribution of HG sizes varied across rural, semi-urban, and urban areas (Table 1). In rural HGs, the majority (76.66%) were within the size range of 0–0.20 ha, followed by 20.00% in the 0.20–0.40 ha category, and only 3.33% in the 0.40–0.60 ha category. In semi-urban HGs, 93.33% were within 0–0.20 ha, while 3.33% each fell within the 0.20–0.40 ha and 0.40–0.60 ha categories. In contrast, urban HGs were entirely (100%) confined to the smallest size class of 0–0.20 ha (Table 1).

The homegardens age distribution also varied significantly among the three homegarden categories (Table 1). The majority of homegardens (53.33%) in rural areas were 0–25 years old, while 10% were much older (75–100 years). In semi-urban areas, the highest proportion (46.67%) of HGs was observed in the 26–50 years age group, followed by 23.33% were young (0–25). In urban areas, 60 % of homegarden were within 0–25 years, followed by 16.67% in the 51–75 years category, and only 6.67% were in the 76–100 years category (Table 1).

Changes in HG size over the period of time revealed distinct patterns. In rural areas, the majority of HGs (46.67%) remained the same, 33.33% decreased in size, and 20% increased. In semi-urban areas, 50% of HGs decreased in size, while 36.66% remained unchanged and 13.33% increased. In urban areas, 53.33% of HGs decreased in size, 43.33% remained unchanged, and only 3.33% increased in size (Table 1).

The reasons for changes in home garden size varied across the three types of home gardens. In rural areas, 50% of respondents did not report any specific reason. In semi-urban areas, labour shortage was identified as the major reason (33.33%), followed by soil fertility issue (23%). Similarly, in urban areas, labour issues accounted for 30% of the changes, while 27% of respondents did not specify any particular reason (Table 1).

3.2. Identification of Plants and Stratification of Homegarden Structure

3.2.1. Plant species diversity

In the present study area, a total of 162 species belonging to 92 families were recorded (Table 2). Among these, 106 species were documented in rural home gardens, 92 species in semi-urban home gardens, and 81 species in urban home gardens. In rural home gardens, species were distributed across 48 families (Fig. 3). Among them, Asteraceae was the dominant family (12 species), followed by Solanaceae (8), Curbitaceae (6), Apiaceae (6), and Fabaceae (6). In semi-urban home gardens, 47 families were reported, among them Asteraceae (8) and Solanaceae (7) were dominant, followed by Rosaceae (5), and Fabaceae (4). Similarly, in urban home gardens, 45 families were documented. Among

these, Asteraceae (9) was the most dominant family, followed by Solanaceae, Rutaceae, and Rosaceae, each represented by 4 species (Fig. 3).

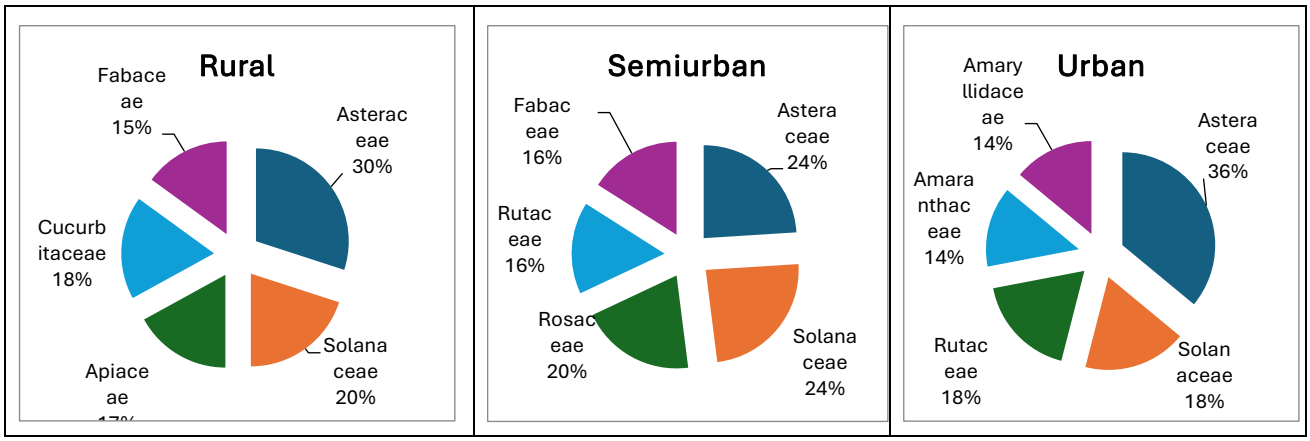


Fig. 3 Five dominant families present in three different urban home gardens

The recorded species were further classified based on their growth habits (Fig. 4). In rural home gardens, herbs were dominant (52 species), followed by trees (22), climbers (13), shrubs (11), creepers (4), grasses (3), and palms (1). In semi-urban homegardens, herbs also dominated (42 species), followed by trees (24), shrubs (11), climbers (7), and other minor categories (Fig. 4). Similarly, in urban home gardens, herbs were the most abundant (40 species), followed by trees (22).

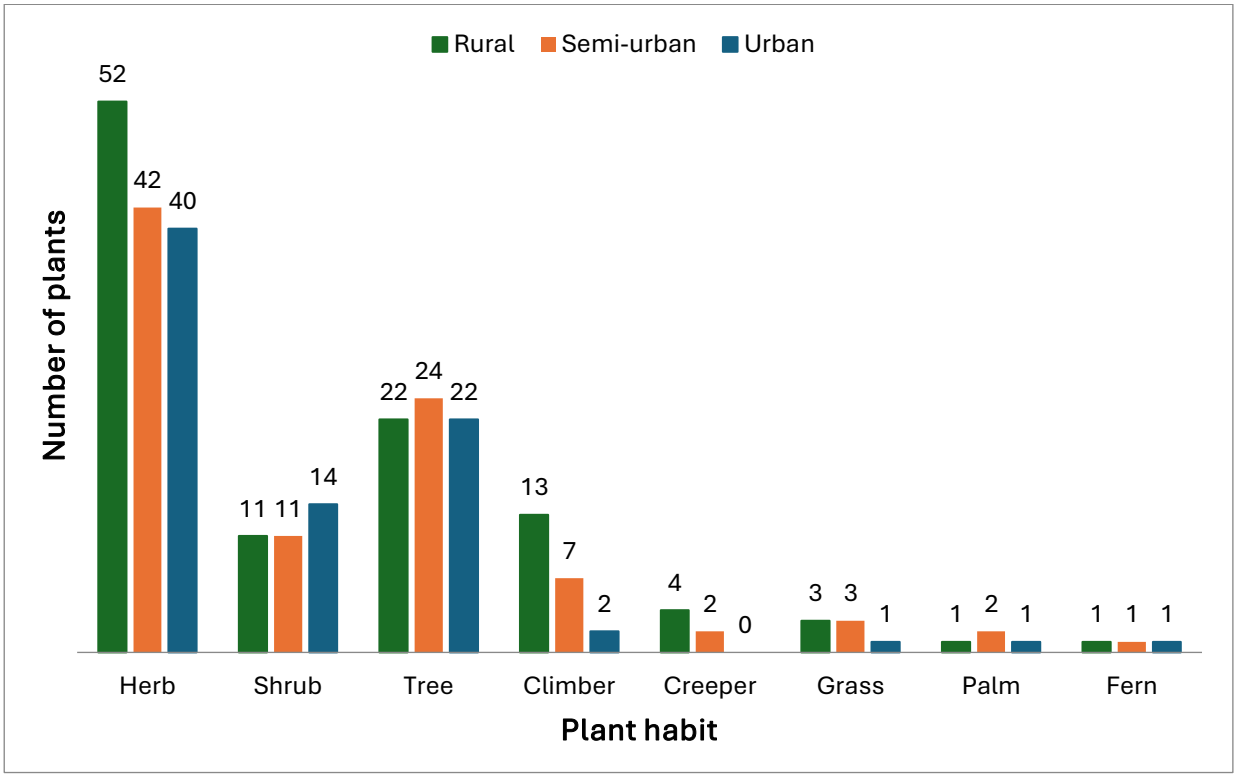


Fig. 4 Habit-wise distribution of plant species in three different home gardens

300 **Table 2** Important value index and relative frequency of citation of the plant species of three different home gardens

Sl. No.	Species	Local name	Habit	Use Category	Rural							Semiurban							Urban						
					Diversity indices				Ethnobotanical indices			Diversity indices				Ethnobotanical indices			Diversity indices				Ethnobotanical indices		
					RF	RD	RA	IVI	FC	RFC	UV	RF	RD	RA	IVI	FC	RFC	UV	RF	RD	RA	IVI	FC	RFC	UV
Alstromeriaceae																									
1	*Alstroemeria aurea* Graham	Alstroemeria	H	O	0.41	0.17	0.41	1.00	2	0.07	0.07	2.13	3.33	1.76	7.23	6	0.20	0.27	3.93	7.18	2.39	13.50	10	0.33	0.33
Amaranthaceae																									
2	*Achyranthes aspera* L	Soh-byrthied	H	M, F								0.53	0.30	0.63	1.46	2	0.07	0.07							
3	*Amaranthus cruentus* L.	Sla shipai	H	M,	0.41	0.25	0.59	1.25	1	0.03	0.10														
4	*Beta vulgaris* L.	Bit	H	M, F															0.98	2.01	2.67	5.67	3	0.10	0.20
5	*Celosia argentea var. cristata* (L.) Kuntze	Cockscomb	H	O															0.66	0.38	0.76	1.80	1	0.03	0.07
6	*Chenopodium album* L.	Jarei	H	M,	0.41	0.64	1.50	2.55	2	0.07	0.13														
7	*Spinacia oleraceae* L.	Palong	H	M, F								0.53	0.59	1.26	2.39	2	0.07	0.13	0.66	1.90	3.80	6.36	1	0.03	0.03
Amaryllidaceae																									
8	*Allium cepa* L.	Piat	H	M, F	1.65	2.75	1.61	6.01	5	0.17	0.37	1.60	2.38	1.68	5.65	4	0.13	0.20	1.31	1.47	1.46	4.24	3	0.10	0.13
9	*Allium sativum* L	Rynsun	H	M, F	2.06	3.73	1.75	7.55	8	0.27	1.20	0.80	1.29	1.82	3.90	2	0.07	0.23	0.66	0.98	1.95	3.59	1	0.03	0.10
10	*Allium tuberosum* Rottler ex Spreng	Jyllang	H	M, F	1.03	1.47	1.38	3.88	4	0.13	0.43	1.07	2.58	2.72	6.37	4	0.13	0.43	0.66	1.09	2.17	3.91	2	0.07	0.13
Anacardaceae																									
11	*Mangifera indica* L.	Sohpieng	T	M, FT	0.62	0.10	0.15	0.87	3	0.10	0.17	1.07	0.40	0.42	1.88	2	0.07	0.17	0.33	0.11	0.43	0.87	1	0.03	0.03
12	*Rhus ciliata* Licht. ex Schult	Sohma	T	M, F, FW, FT	0.41	0.06	0.14	0.61	2	0.07	0.27	0.53	0.10	0.21	0.84	2	0.07	0.07	0.33	0.05	0.22	0.60	1	0.03	0.07
Apiaceae																									

13	*Apium graveolens* L.	Sla selery	H	M, F	0.62	1.28	2.00	3.89	2	0.07	0.13	0.53	1.39	2.93	4.85	2	0.07	0.10	0.98	2.01	2.67	5.67	3	0.10	0.13
14	*Centella asiatica* L.	Batpyllon	Cr	M, F	2.68	18.27	6.60	27.56	10	0.33	0.93	0.53	5.61	11.88	18.02	2	0.07	0.13							
15	*Coriandrum sativum* L.	Dhonia	H	M, F	0.21	0.39	1.82	2.41	1	0.03	0.07	2.93	6.93	2.67	12.53	8	0.27	0.33	2.62	6.37	3.17	12.16	6	0.20	0.30
16	*Daucus carota* subsp. sativus L.	Kajor	H	F	0.21	0.48	2.27	2.96	1	0.03	0.03														
17	*Eryngium foetidum* L.	Dhonia khlaw	H	M, F	1.03	0.93	0.87	2.83	3	0.10	0.50								0.66	1.47	2.93	5.05	2	0.07	0.03
18	*Oenanthe javanica* Blume.	Jatira	H	M, F	0.62	1.64	2.57	4.84	2	0.07	0.30														
Apocynaceae																									
19	*Catharanthus roseus* L.	Periwinkle	H	M, O															2.95	2.01	0.89	5.86	1	0.03	0.33
Araceae																									
20	*Colocasia esculenta* (L) Schott.	Shriew	H	M, F, FD	2.68	1.41	0.51	4.60	11	0.37	0.97	1.07	1.02	1.08	3.17	3	0.10	0.23	0.66	0.44	0.87	1.96	1	0.03	0.13
21	*Monstera albo* Liebm.	Variegated Monstera	H	O															0.98	0.49	0.65	2.12	2	0.07	0.07
22	*Monstera deliciosa* Liebm.	Monstera	H	O															0.33	0.27	1.08	1.68	1	0.03	0.13
Araliaceae																									
23	*Hedera helix* L.	Hedera	Cl	O								0.27	0.07	0.28	0.61	1	0.03	0.03							
Araucariaceae																									
24	*Araucaria columnaris* (G.Forst.) Hook.	Diengksehbilat	T	O								1.07	0.20	0.21	1.47	3	0.10	0.13	3.28	1.36	0.54	5.18	8	0.27	0.33
Arecaceae																									
25	*Areca catechu* L	Kwai	P	FT	1.86	2.30	1.20	5.36	7	0.23	0.43	0.53	0.20	0.42	1.15	6	0.16	0.03							
Asparagaceae																									
26	*Agave americana* L.	Agave	H	O	0.41	0.15	0.36	0.93	2	0.07	0.03	0.27	0.07	0.28	0.61	1	0.03	0.03							
27	*Asparagus racemosus* Willd.	Tyrkhangpur	Cl	M, O								0.53	0.13	0.28	0.94	2	0.07	0.10	0.66	0.33	0.65	1.63	2	0.07	0.07

28	*Dracaena angustifolia* (Medik.) Roxb.	Paitjaw	H	O, F	1.03	1.33	1.25	3.62	4	0.13	0.23								1.31	0.82	0.81	2.94	3	0.10	0.13
29	*Dracaena trifasciata (Prain)* Mabb.	Snake plant	S	O	1.24	0.48	0.38	2.10	5	0.17	0.10	1.33	1.45	1.23	4.02	3	0.10	0.17	0.98	0.98	1.30	3.26	2	0.07	0.30
Asphodelaceae																									
30	*Aloe barbadensis* Mill.	Aloe vera	H	M, O	0.62	0.37	0.58	1.56	2	0.07	0.13	3.20	1.49	0.52	5.21	10	0.33	0.97	2.95	2.28	1.01	6.25	7	0.23	0.50
31	*Aristaloe aristata* Haw.	Aloe vera rit	H	M, O	0.41	0.25	0.59	1.25	2	0.07	0.17	0.27	0.33	1.40	1.99	2	0.07	0.07	0.98	1.25	1.66	3.90	2	0.07	0.70
Asteraceae																									
32	*Ageratum conyzoides* L.		H	M	0.62	0.58	0.91	2.11	2	0.07	0.10														
33	*Biden pilosa* L	Sohbyrthit	S	M	0.21	0.15	0.73	1.09	1	0.03	0.03														
34	*Chrysanthemum sps*	Tiewjaiaw	H	O	0.41	0.19	0.45	1.06	1	0.03	0.03								0.66	0.98	1.95	3.59	1	0.03	0.07
35	*Crassocephalum crepidioides (*Benth) S.Moore	Bataeroplane	H	M, F	0.21	0.12	0.55	0.87	1	0.03	0.07	0.27	0.17	0.70	1.13	1	0.03	0.10							
36	*Curio radicans* (L.f) P.V.Heath	Succulent	H	O															0.33	0.27	1.08	1.68	1	0.03	0.03
37	*Dahlia pinnata* Cav.	Tiewphan	H	O	0.41	0.21	0.50	1.12	2	0.07	0.07								0.66	0.60	1.19	2.45	1	0.03	0.10
38	*Erigeron sps*	Jaiawrit	H	M								0.27	0.33	1.40	1.99	1	0.03	0.07							
39	*Eupatorium adenophorum* Spreng.	Bationg	H	M, FD	2.47	1.26	0.49	4.22	9	0.30	0.67	2.93	1.12	0.43	4.49	7	0.23	0.77							
40	*Galinsoga parviflora* Cav.		H	M	0.21	0.44	2.09	2.74	1	0.03	0.03														
41	*Gerbera jamesonii* Bolus ex Hooker f.	Gerbera	H	O								0.53	0.36	0.77	1.66	2	0.07	0.07	0.33	0.54	2.17	3.04	1	0.03	0.07
42	*Helianthus annuus* L	Tiewsngi	S	M, F															0.98	1.09	1.45	3.52	2	0.07	0.10
43	*Lactuca sativa* L	Salad	H	M, F								1.33	1.49	1.26	4.08	3	0.10	0.20	2.62	5.01	2.49	10.12	6	0.20	0.23
44	*Lactuca saligna* L	Jalingshir	H	M, F	0.82	1.02	1.20	3.05	2	0.07	0.37	2.40	4.13	1.94	8.47	7	0.23	0.83							
45	*Tagetes patula* L	Tiewmongor	H	M, O	0.82	0.39	0.45	1.67	2	0.07	0.30	0.53	0.36	0.77	1.66	2	0.07	0.07							
46	*Taraxacum officinale* L.	Jakhian	H	M	0.82	0.66	0.77	2.25	3	0.10	0.40	0.53	0.23	0.49	1.25	2	0.07	0.07	0.33	0.27	1.08	1.68	1	0.03	0.10

47	*Zinnia elegans* Jacq.	Zinnia	H	O	0.21	0.19	0.91	1.31	1	0.03	0.03								0.66	0.98	1.95	3.59	2	0.07	0.07
Begoniaceae																									
48	*Begonia sps*	Begonia	H	O															0.66	0.71	1.41	2.77	1	0.03	0.07
Bignoniaceae																									
49	*Jacaranda mimosifolia* D.Don	Jacarannda	T	O															0.33	0.11	0.43	0.87	1	0.03	0.07
Betulaceae																									
50	*Alnus nepalensis* D. Don.	Dienglingiong	T	FD, FW, FT	1.03	0.23	0.22	1.48	3	0.10	0.33														
Brassicaceae																									
51	*Brassica oleracea* var. *capitata* L.	Kubi	H	F	0.41	0.48	1.14	2.03	2	0.07	0.03														
52	*Brassica juncea* (L.) Czern.	Tyrso	H	F	1.86	2.05	1.07	4.98	7	0.23	0.37	4.27	6.64	1.76	12.66	13	0.43	0.53	1.97	3.92	2.60	8.49	4	0.13	0.20
53	*Brassica oleracea var. botrytis* L.	Phul	H	F	1.03	1.43	1.34	3.81	3	0.10	0.20	2.13	3.04	1.61	6.78	5	0.17	0.27	1.31	2.61	2.60	6.53	3	0.10	0.20
54	*Eruca sativa* Mill.	Salad phareng	H	M															0.66	1.36	2.71	4.73	1	0.03	0.03
55	*Raphanus sativus* L.	Muli	H	M, F	0.82	1.59	1.86	4.27	3	0.10	0.30	2.13	3.63	1.92	7.69	7	0.23	0.47							
Bromeliaceae																									
56	*Ananas comosus* (L) Merr.	Sohtrun	H	M, F	0.82	0.95	1.11	2.89	3	0.10	0.13	0.27	0.53	2.24	3.03	1	0.03	0.03	0.33	0.27	1.08	1.68	1	0.03	0.03
Cactaceae																									
57	*Echinopsis chamaecereus* H.Friedrich & Glaetzle	Peanut cactus	H	O															0.66	0.44	0.87	1.96	2	0.07	0.03
58	*Selenicereus undatus* (Haw.) D. R. Hunt	Dragon fruit	H	M, F								0.27	0.07	0.28	0.61	1	0.03	0.13	0.33	0.16	0.65	1.14	1	0.03	0.03
Caricaceae																									
59	*Carica papaya* L.	Sohkynphoreit blang	T	M, F	0.82	0.14	0.16	1.12	3	0.10	0.23	2.40	0.56	0.26	3.23	6	0.20	0.37	1.97	0.49	0.33	2.78	5	0.17	0.50
Caryophyllaceae																									

60	*Drymaria cordata* (L.) Willd. ex Schult.	Batnongrim	H	M, F	0.21	1.55	7.27	9.02	1	0.03	0.03														
Convolvulaceae																									
61	*Ipomea batatas* Lam.	Phankaro	H	M, F, FD	0.82	1.28	1.50	3.60	4	0.13	0.43	0.80	1.12	1.58	3.51	2	0.07	0.27							
Crassulaceae																									
62	*Echeveria elegans* Rose	Succulent	H	O															0.66	0.49	0.98	2.12	1	0.03	0.07
Cucurbitaceae																									
63	*Cucumis sativus* L.	Sohkhia	Cl	M, F	1.24	1.12	0.88	3.24	4	0.13	0.47														
64	*Cucurbita ficifolia* Bouchĕ	Pathawsniang	Cr	M, F, P	0.21	0.06	0.27	0.54	1	0.03	0.07														
65	*Cucurbita pepo* L.	Pathaw	Cr	F, FD, P	1.86	0.44	0.23	2.53	7	0.23	0.30	1.87	0.59	0.36	2.82	5	0.17	0.27							
66	*Cyclanthera pedata* L.	Sohthliem	Cl	F	0.82	0.19	0.23	1.25	2	0.07	0.23														
67	*Luffa acutangula* (L.) Roxb.	Sohprew	Cl	F	0.41	0.15	0.36	0.93	2	0.07	0.03														
68	*Momordica charantia* L.	Karela	Cl	M, F	0.21	0.10	0.45	0.76	1	0.03	0.07														
69	*Sechium edule* (Jacq) Sw.	Biskot	Cl	M, F	1.03	0.35	0.33	1.71	3	0.10	0.23	1.07	0.23	0.24	1.54	3	0.10	0.20	0.33	0.11	0.43	0.87	1	0.03	0.03
Cupressaceae																									
70	*Cryptomeria japonica* D. Don.	Diengksehbilat	T	O, FT	0.41	0.04	0.09	0.54	1	0.03	0.03								0.66	0.22	0.43	1.31	2	0.07	0.07
71	*Cupressus macrocarpa* Hartw. ex Gordon.	Lemon pine	T	O								0.53	0.30	0.63	1.46	2	0.07	0.13	1.64	0.87	0.69	3.20	4	0.13	0.13
72	*Thuja occidentalis* L.	Ksehrit	T	O								1.33	0.26	0.22	1.82	3	0.10	0.17	2.30	1.20	0.68	4.17	5	0.17	0.23
Cycadaceae																									
73	*Cycas revoluta* Thunb.	Cycas	P	O								1.07	0.40	0.42	1.88	3	0.10	0.13	0.33	0.16	0.65	1.14	1	0.03	0.03
Dioscoraceae																									
74	*Dioscorea bulbifera* L.	Phankyrsiew	Cl	M, F	0.21	0.04	0.18	0.43	1	0.03	0.10	0.27	0.07	0.28	0.61	1	0.03	0.03							

Elaeagnaceae																									
75	*Elaeagnus commutata* Bernh. ex Rydb	Sohshang	S	M, F	0.21	0.02	0.09	0.32	1	0.03	0.20														
Elaeocarpaceae																									
76	*Elaeocarpus floribundus* Blume.	Sohkyllam	T	M, F	0.82	0.08	0.09	0.99	3	0.10	0.27														
Ericaceae																									
77	*Rhododendron arboreum* Sm.	Diengtiewsaw	T	O								1.60	0.26	0.19	2.05	5	0.17	0.23	0.33	0.11	0.43	0.87	1	0.03	0.07
78	*Rhododendron kiusianum* Makino.	Diengtiewsawrit	S	O															0.98	0.65	0.87	2.50	2	0.07	0.10
Euphorbiaceae																									
79	*Manihot esculenta* Crantz	Phandieng	S	F	0.41	0.12	0.27	0.80	2	0.07	0.07														
80	*Euphorbia pulcherrima* Willd. ex Klotzsch.	Euphorbia	S	O															4.59	1.52	0.43	6.55	11	0.37	0.50
81	*Ricinus communis* L.	Slaryndi	S	M								1.33	0.23	0.20	1.76	4	0.13	0.20							
Fabaceae																									
82	*Bauhinia sps*	Jalong	T	F, FD, O	0.62	0.12	0.18	0.92	2	0.07	0.07														
83	*Glycine max (*L.) Merrill	Rymbai ktung	Cl	F	0.41	0.27	0.64	1.32	2	0.07	0.10														
84	*Lablab purpureus* L.	Risaw	Cl	F	1.86	2.67	1.39	5.92	7	0.23	0.37	1.60	1.91	1.35	4.87	4	0.13	0.13							
85	*Phaseolus vulgaris* L.	Ri phrisbin	Cl	F	1.65	2.36	1.39	5.39	5	0.17	0.13	0.53	0.43	0.91	1.87	2	0.07	0.07							
86	*Pisum sativum* L.	Mator	Cl	FT								0.80	0.79	1.12	2.71	2	0.07	0.10							
87	*Trifolium repens* L.		H	M	0.62	3.00	4.69	8.31	2	0.07	0.20														
Fagaceae																									
88	*Castanea sativa* Mill.	Chestnut	T	M								0.27	0.03	0.14	0.44	1	0.03	0.07	0.33	0.05	0.22	0.60	7	0.23	0.07
Geranaceae																									

89	*Pelargonium x hortorum* L.H. Bailey.	Tiew sying	H	O	0.41	0.23	0.55	1.19	2	0.07	0.07	1.07	1.58	1.68	4.33	3	0.10	0.13	3.61	4.84	1.75	10.20	9	0.30	0.40
Hamamelidaceae																									
90	*Exbucklandia populnea* R.Br. ex Griff	Diengdoh	T	FT, O								0.27	0.07	0.28	0.61	1	0.03	0.03							
Lamiaceae																									
91	*Duranta repens* L.	Forget me not plant	S	FC, O	0.21	0.19	0.91	1.31	1	0.03	0.13	0.53	0.50	1.05	2.08	2	0.07	0.13	1.64	2.07	1.65	5.35	3	0.10	0.33
92	*Lantana camara* L.	Sohpongkhlieh	S	M, O	0.21	0.10	0.45	0.76	1	0.03	0.07														
93	*Leucosceptrum canum* Sm.	Dienglymmuh	T	FW, FT								1.31	0.38	0.38	2.07	3	0.10	0.07							
94	*Holmskioldia sanguinea* Retz.	Cup and Saucer plant	S	M															0.98	0.54	0.72	2.25	2	0.07	0.03
95	*Mentha spicata* L.	Pudina	H	M, F	1.03	2.61	2.45	6.09	4	0.13	0.47	5.07	13.27	2.96	21.29	15	0.50	1.47	3.93	7.73	2.57	14.23	10	0.33	0.60
Lauraceae																									
96	*Laurus nobilis* L.	Diengslatyrpad	T	F	0.62	0.08	0.12	0.82	2	0.07	0.13	0.27	0.07	0.28	0.61	1	0.03	0.03							
97	*Litcea cubeba* (Lour.) Pers.	May Chang	T	M, FT	0.62	0.08	0.12	0.82	1	0.03	0.23														
98	*Persea americana* Mill.	Avocado	T	M, FT															0.33	0.11	0.43	0.87	1	0.03	0.07
Malvaceae																									
99	*Hibiscus × rosa-sinensis* L.	Hibiscus	S	FC, O								2.47	0.60	0.23	3.31	9	0.30	0.17	0.62	0.30	0.65	1.46	2	0.07	0.13
Marantaceae																									
100	*Ctenanthe oppenheimiana* (E.Morren).K. Schum.	Bamburanta	H	O								0.27	0.20	0.84	1.30	1	0.03	0.03							
Moraceae																									
101	*Artocarpus heterophyllus* Lam.	Sohphan	T	M, F, FT	0.82	0.14	0.16	1.12	3	0.10	0.23														
102	*Artocarpus lakoocha* Roxb.		T	FD, F	0.62	0.08	0.12	0.82	3	0.10	0.20														

103	*Morus alba* L	Sohlingdhur	T	M, F, FT	0.41	0.10	0.23	0.74	2	0.07	0.27								1.64	0.33	0.26	2.23	4	0.13	0.13
Musaceae																									
104	*Musa spp.*	Kait	H	M, F, FT, FD	1.65	0.75	0.44	2.85	6	0.20	0.67	1.33	0.66	0.56	2.55	3	0.10	0.50	0.21	0.12	1.26	1.82	1	0.03	0.07
Myricaceae																									
105	*Myrica esculenta* Buch-Ham.	Sohphie	T	M, F, FW, FT	1.24	0.52	0.41	2.17	5	0.17	0.43														
Myrtaceae																									
106	*Callistemon citrinus* (Curtis) Skeels	Diengsnad	T	M, F, O								0.80	0.26	0.37	1.44	2	0.07	0.13	1.97	0.60	0.40	2.96	4	0.13	0.20
107	*Psidium guajava* L	Sohpriam	T	M, F	1.44	0.21	0.14	1.80	5	0.17	0.43	2.40	0.69	0.33	3.42	6	0.20	0.47	2.62	0.65	0.33	3.60	6	0.20	0.43
Nephrolepidaceae																									
108	*Nephrolepis cordifolia* L.	Tyrkhang	F	M, O								0.53	0.73	1.54	2.80	2	0.07	0.13	0.98	2.28	3.04	6.30	2	0.07	0.10
Nyctaginaceae																									
109	*Bougainvillea glabra* Choisy.	Bougain villa	S	O								0.80	0.20	0.28	1.28	2	0.07	0.07	0.98	0.60	0.80	2.38	2	0.07	0.07
Oleaceae																									
110	*Jasminum officinale* L.	Jasmine	S	M, O															1.08	1.58	1.68	4.34	3	0.10	0.07
Orchidaceae																									
111	*Orchid sps*	Tiewdieng	H	O								1.87	1.45	0.88	4.20	5	0.17	0.27	4.26	5.06	1.55	10.87	9	0.30	0.57
Oxalidaceae																									
112	*Oxalis corniculata* L.	Kaitdkhiew	H	M	0.82	4.83	5.68	11.34	2	0.07	0.17	0.27	1.65	6.99	8.90	1	0.03	0.03							
Passifloraceae																									
113	*Passiflora edulis* Sims.	Sohbrab	Cl	M, F	1.03	0.23	0.22	1.48	4	0.13	0.33														
Pinaceae																									
114	*Pinus kesiya* Royle ex Gordon	Diengksehkhasi	T	M, FW, FT	2.06	0.46	0.22	2.74	7	0.23	0.97	1.07	0.36	0.38	1.81	3	0.10	0.23							

Piperaceae																									
115	*Piper betle* L.	Tympew	Cl	M, F	1.86	1.43	0.75	4.03	6	0.20	0.80														
116	*Piper nigrum* L.	Sohmarit	Cl	M, F	0.82	0.08	0.09	0.99	4	0.13	0.60														
Plantaginaceae																									
117	*Plantago asiatica* L.	Shkorblang	H	M	0.41	0.35	0.82	1.58	2	0.07	0.03	0.27	0.33	1.40	1.99	1	0.03	0.10							
Poaceae																									
118	*Bambusa jaintiana* R.B. Majumdar	Siej Shken	G	FC, B	0.21	0.10	0.45	0.76	1	0.03	0.07														
119	*Cymbopogon citratus* Stapf.	Lemon grass	G	M, FD, O															0.98	0.49	0.65	2.12	2	0.07	0.17
120	*Phyllostachys mannii* Gamble.	*Siej Naga*	G	FC, B, O	0.82	1.39	1.64	3.85	3	0.10	0.20	0.80	1.39	1.96	4.14	2	0.07	0.20							
121	*Saccharum officinarum* L.	Pai	G	FD								0.53	0.36	0.77	1.66	1	0.03	0.07							
122	*Thysanolaena latifolia* (Roxb. ex Hornem.)	Synsar	G	BR	3.71	3.42	0.89	8.03	15	0.50	0.10	1.07	1.55	1.64	4.26	3	0.10	0.13							
123	*Zea mays* L.	Riewhadem	G	F, FD	0.62	1.22	1.91	3.74	2	0.07	0.20														
Polygonaceae																									
124	*Fagopyrum esculentum* Moench	*Jarian*	H	M	0.82	0.08	0.09	0.99	3	0.10	0.33	1.33	2.58	2.18	6.09	4	0.13	0.33							
125	*Rumex x acutus* L.	*Jabar*	H	M, FD	0.21	0.39	1.82	2.41	1	0.03	0.07	0.27	0.46	1.96	2.68	1	0.03	0.03							
Pontederiaceae																									
126	*Eichhornia crassipes* (Mart.) Solms.	Succulent	H	O															0.33	0.27	1.08	1.68	1	0.03	0.03
Primulaceae																									
127	*Ardisia crenata* Sims.		S	O								0.27	0.10	0.42	0.78	1	0.03	0.03							
Punicaceae																									
128	*Punica granatum* L.	Sohksiar	T	M, FT								0.53	0.10	0.21	0.84	1	0.03	0.10	1.97	0.54	0.36	2.87	4	0.13	0.40
Ranunculaceae																									

129	*Anemone rivularis* Buch-Ham. ex DC.	*Sohpliah*	H	M	0.41	0.29	0.68	1.38	1	0.03	0.07														
Rosaceae																									
130	*Fragaria x ananassa (*Weston) Duchesne ex Rozier	Strawberry	Cr	M, F	0.21	0.12	0.55	0.87	1	0.03	0.03								0.98	2.01	2.67	5.67	2	0.07	0.13
131	*Prunus cerasoides* D.Don.	Diengcherry	T	FT								1.07	0.20	0.21	1.47	3	0.10	0.27							
132	*Prunus domestica* L	Sohplom	T	FT	2.47	0.60	0.23	3.31	9	0.30	0.40	0.80	0.23	0.33	1.36	2	0.07	0.07	0.66	0.11	0.22	0.98	2	0.07	0.03
133	*Prunus persica* L	Sohphareng	T	FT	2.06	0.37	0.17	2.60	8	0.27	0.33	0.27	0.07	0.28	0.61	2	0.07	0.10							
134	*Pyrus pyrifolia* (Burm.f.) Nakai.	Sohphohnong khlaw	T	FT								0.27	0.07	0.28	0.61	1	0.03	0.10	0.66	0.16	0.33	1.14	2	0.07	0.07
135	*Rosa rubiginosa* L.	Tiewkulab	S	O								1.07	0.73	0.77	2.56	3	0.10	0.13	3.61	3.21	1.16	7.98	1	0.03	0.40
Rubiaceae																									
136	*Coffea canephora* Pierre ex A. Froehner	Coffee	S	M, FT	0.62	0.08	0.12	0.82	3	0.10	0.33														
137	*Coffea khasiana* Hook.f.	Coffee	S	M, FT															0.33	0.11	0.43	0.87	1	0.03	0.03
Rutaceae																									
138	*Citrus grandis* L.	Sohbah	T	M, F	0.62	0.06	0.09	0.77	2	0.07	0.17	1.33	0.23	0.20	1.76	3	0.10	0.17							
139	*Citrus limon* L.	Sohjew dkhar	T	M, F	0.41	0.15	0.25	0.76	2	0.07	0.07	1.87	0.53	0.32	2.71	5	0.17	0.37	0.66	0.16	0.33	1.14	2	0.07	0.10
140	*Citrus sinensis* (L.) Osbeck.	Sohniamtra	T	M, F	1.44	0.29	0.19	1.93	5	0.17	0.17	2.40	0.96	0.45	3.81	7	0.23	0.30	2.30	0.60	0.34	3.23	5	0.17	0.23
141	*Murraya koenigii* (L.) Spreng.	Curry leave	T	M, F															0.98	0.22	0.29	1.49	1	0.03	0.20
142	*Zanthoxylum armatum* DC.	*Jaiur*	T	M, F, O	1.03	0.14	0.13	1.29	4	0.13	0.50	1.07	0.13	0.14	1.34	2	0.07	0.40	0.33	0.05	0.22	0.60	1	0.03	0.03
Saxifragaceae																									
143	*Bergenia ciliata* (Haw.) Sternb.	Berginia	H	M															0.98	1.85	2.46	5.29	2	0.07	0.17
Saururaceae																									
144	*Houttuynia cordata* Thunb.	Jamyrdoh	H	M, F, C	2.27	2.24	0.96	5.47	8	0.27	1.13	2.40	3.99	1.88	8.27	6	0.20	0.77	0.66	1.80	3.58	6.03	1	0.03	0.17

Solanaceae																									
145	*Capsicum annuum* L.	Sohmynken jhur	S	FT	0.41	0.31	0.73	1.45	2	0.07	0.17	0.27	0.30	1.26	1.82	1	0.03	0.10							
146	*Petunia x hybrida* (Hook.) Regel.	Petunia	H	FT								0.53	0.73	1.54	2.80	2	0.07	0.07							
147	*Solanum betaceum* Cav.	Sohsawdieng	S	FT	0.82	0.12	0.14	1.08	2	0.07	0.13	2.13	0.40	0.21	2.74	7	0.23	0.27							
148	*Solanum frutescens* L.	Sohmynken shana	S	FT	1.24	0.56	0.44	2.24	5	0.17	0.20	1.07	0.33	0.35	1.75	3	0.10	0.10							
149	*Solanum khasianum* C. B. Clarke	*Sohpdok*	S	M	0.41	0.10	0.23	0.74	2	0.07	0.07														
150	*Solanum lycopersicum* L.	Sohsaw	S	F	0.62	0.37	0.58	1.56	2	0.07	0.10	0.80	0.17	0.23	1.20	2	0.07	0.10							
151	*Solanum muricatum* W.T. Aiton	*Sohshini*	H	M, F	0.82	0.39	0.45	1.67	3	0.10	0.33	0.53	0.17	0.35	1.05	1	0.03	0.07							
152	*Solanum nigrum* L.	Sohngangrit	H	M, FT								0.80	0.20	0.28	1.28	2	0.07	0.13	0.21	0.12	1.26	1.82	1	0.03	0.17
153	*Solanum tuberosum* L.	*Phan*	H	M, F, FD	2.27	2.69	1.15	6.10	8	0.27	0.80	1.07	0.50	0.52	2.09	3	0.10	0.27							
Theaceae																									
154	*Camellia spp.*	Japanese camellia	T	O								0.27	0.07	0.28	0.61	1	0.03	0.03	0.33	0.11	0.43	0.87	1	0.03	0.03
155	*Schima wallichi* (DC.) Korth.	*Diengngan*	T	F, FT	0.21	0.06	0.27	0.54	1	0.03	0.07														
Urticaceae																									
156	*Pouzolzia hirta* (Blume) Hassk.	Jamynsleh	H	M	0.21	0.77	3.63	4.61	1	0.03	0.07														
157	*Urtica spp.*	Sainthap	S	M															0.66	0.82	1.63	3.10	2	0.07	0.03
Vitaceae																									
158	*Vitis vinifera* L.	*Sohgrape*	Cl	FT	0.21	0.02	0.09	0.32	1	0.03	0.03														
Zingeberaceae																									
159	*Curcuma caesia* Roxb.	Shynrai iong	H	M, F	0.62	0.29	0.45	1.36	1	0.03	0.13														
160	*Curcuma longa* L.	Shyrai	H	M, F	3.09	1.18	0.37	4.64	13	0.43	1.87	1.33	0.56	0.48	2.37	3	0.10	0.63							

161	*Zingiber rubens* var. rubrum	Syingmakhir	H	M, F	1.24	0.66	0.51	2.41	4	0.13	0.73														
162	*Zingiber officinale* Rosc.	Sying	H	M, F	4.33	2.42	0.54	7.29	18	0.60	2.10	0.80	0.23	0.33	1.36	15	0.50	0.27	2.27	2.24	1.17	5.10	8	0.27	0.07

UC= Use category, H=Herb, S=Shrub, T=Tree, Cl= Climber, Cr= Creeper, P= Palm, F= Fern, G= Grass, M= Medicine, F=Food, FD= Fodder, FW=Fuelwood, FC=Fencing, O= Ornamental, P=Packing, C= Construction, FI= Fiber, BR= Broomstick, RF=Relative Frequency, RD=Relative Desity, RA=Relative Abundance, IVI= Important Value Index, FC= Frequency of citation, RFC=Relative Frequency of Citation, UV= Use value

3.2.2. Vegetation stratification

A complex horizontal and vertical stratification was observed across all HG types (Fig. 5). In rural HGs, a total of five vertical strata were identified. The lower stratum consisted of 66 species, including *Allium sativum*, *Ageratum conyzoides*, and *Brassica juncea*. The second stratum comprised 12 species, including *Duranta repens*, *Lantana camara*, and *Hibiscus syriacus*. The third stratum also included 12 species, represented by *Prunus domestica* and *Prunus persica*. The fourth stratum contained 6 species, including *Rhus ciliata*, *Mangifera indica*, *Areca catechu*, and *Phyllostachys mannii*. The fifth stratum consisted of 10 species, such as *Artocarpus heterophyllus*, *Elaeocarpus floribundus*, *Cryptomeria japonica*, and *Alnus nepalensis* (Fig. 5).

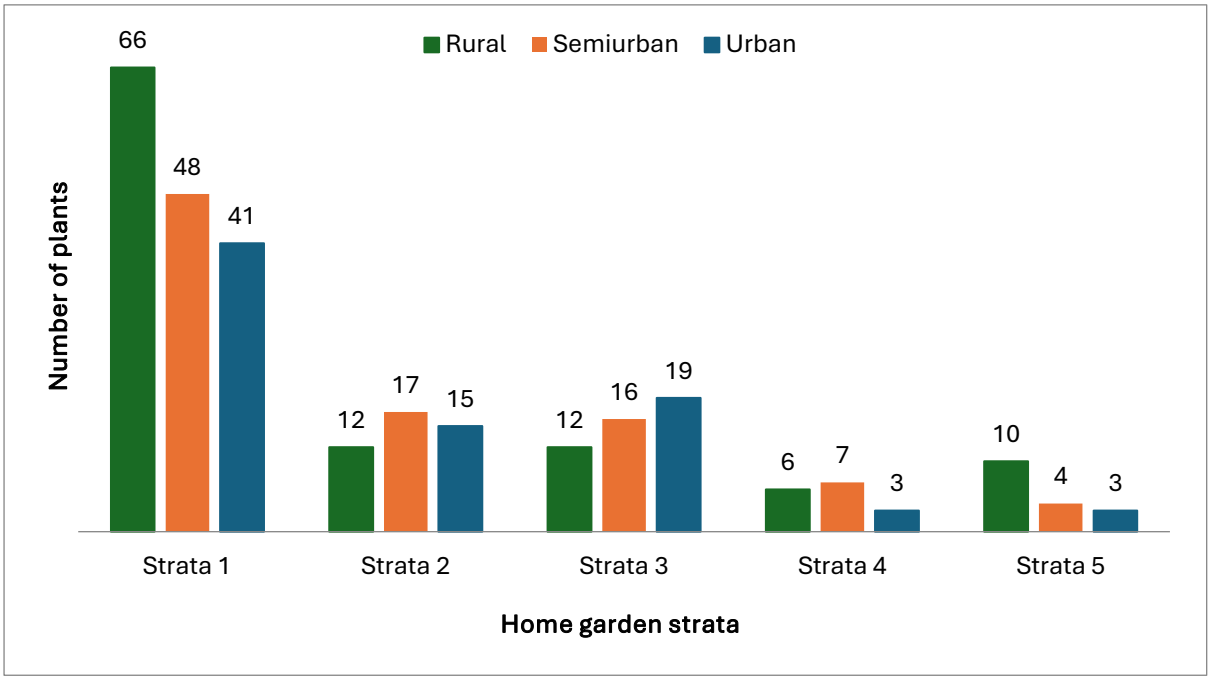


Fig. 5. Strata in three different homegardens

In semi-urban HGs, 48 species were recorded in the lower stratum, including *Achyranthes aspera*, *Alstroemeria aurea*, and *Apium graveolens*. The second stratum had 17 species, such as *Bougainvillea*, *Cycas revoluta*, and *Duranta repens*. The third stratum included 16 species, including *Zanthoxylum armatum*, *Prunus domestica*, and Prunus persica. The fourth stratum contained 7 species, such as *Prunus cerasoides* and *Mangifera indica*. The fifth stratum had 4 species, including *Rhus ciliata*, *Pinus kesiya*, and *Exbucklandia populnea* (Fig. 5).

In urban HGs, 41 species were found in the first stratum, including *Eruca sativa*, *Eryngium foetidum*, and *Gerbera jamesonii*. The second stratum consisted of 15 species, such as *Duranta repens*, *Hibiscus rosa-sinensis*, and *Dracaena angustifolia*. The third stratum comprised 19 species, including *Persea americana*, *Prunus domestica*, and *Euphorbia pulcherrima*. The fourth stratum included 3 species, such as *Jacaranda mimosifolia*, *Mangifera indica*, and *Rhus ciliata*. The fifth stratum also contained 3 species, including *Cryptomeria japonica*, *Castanea sativa*, and *Araucaria columnaris* (Fig. 5).

3.3. Quantitative Vegetation Analysis

The Importance Value Index (IVI) of species recorded in different HGs is presented (Table 2). In rural HGs, the highest IVI was recorded for *Centella asiatica* (27.56), followed by *Oxalis corniculata* (11.34) and *Drymaria cordata* (9.02). In semi-urban HGs, *Mentha spicata* (21.29) showed the highest IVI, followed by *Centella asiatica*

(18.02) and *Brassica juncea* (12.66). In urban HGs, the highest IVI was recorded for *Mentha spicata* (14.23), followed by *Alstroemeria aurea* (13.5) and Coriandrum sativum (12.16).

3.4 Floristic Diversity Analysis

The diversity indices of the recorded species from three different types of HGs are presented (Table 3). Higher species richness (S) was recorded in rural HGs (106), followed by semi-urban (92), while the lowest was observed in urban HGs (81). Menhinick's index (D') was 1.474 in rural, 1.674 in semi-urban, and 1.889 in urban home gardens. The Simpson index (C) was highest in rural HGs (0.05) while lowest in urban HGs (0.03). The Shannon–Wiener index (H') was 3.792 in rural, 3.721 in semi-urban, and 3.802 in urban HGs. Species evenness (E) was highest in urban HGs (0.505) and lowest in rural HGs (0.443). The Sorensen similarity index indicated 75% similarity among the three types of HGs (Table 3).

Table 3 Diversity indices of three different homegardens

Sl. No.	Species indices	Home garden type		
		Rural	Semiurban	Urban
1	Species richness (*S*)	106	92	81
2	Menhinick's index (D')	1.474	1.674	1.889
3	Simpson's index (C)	0.050	0.040	0.030
4	Shannon-Wiener index (*H'*)	3.792	3.721	3.802
5	Species evenness (*E*)	0.443	0.464	0.505
6	Sorenson's similarity index	75% of similarity		

3.5. Ethnobotanical Data Collection

3.5.1. Use Category

Significant variation in plant use categories (UCs) was observed among the three types of HGs (Fig. 6). In rural HGs, the highest number of species was used for food (67 species), followed by medicinal uses (60 species). Other UCs included furniture (16 species), followed by aesthetic purposes (16 species), and fuelwood (15 species). In semi-urban HGs, 50 species were used for food and 44 species for medicinal purposes. Aesthetic use was recorded for 30 species, followed by fodder (7 species), furniture (6 species), and fuelwood (5 species). In urban HGs, aesthetic plants dominated with 42 species, followed by food (37 species), medicinal plants (33 species), and fencing (3 species). Only one species was used for furniture, fuelwood, and fodder purposes (Fig. 6).

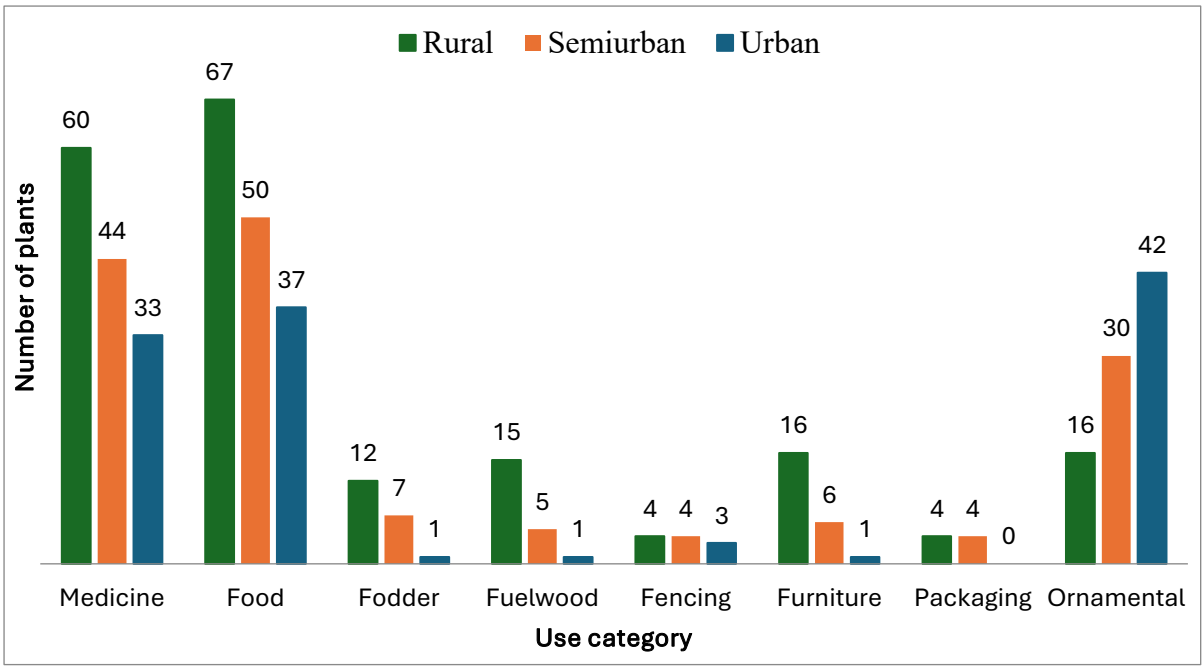


Fig. 6. Use category of plants in different homegardens

3.5.2. Part used for Medicinal purposes

The plant parts used for medicinal purposes varied across rural, semi-urban, and urban HGs (Fig. 6). In rural HGs, leaves constituted the highest proportion (47%), followed by fruits (24%), shoots (4%), stems and branches (3%), bark (3%), and bulbs (3%). Similarly, in semi-urban HGs, leaves were also the most commonly used plant part (50%), followed by fruits/seeds (18%), whole plant (7%), shoots (7%), rhizomes (5%), and bulbs (5%). In urban HGs, leaves accounted for the highest usage (47%), followed by fruits/seeds (22%), roots (10%), rhizomes (9%), whole plant (3%), and bulbs (3%). Across all HGs, leaves were the dominant plant part used medicinally, in contrast-to tubers and bulbs, which were the least used. In total, leaves from 19 species were most frequently utilized, followed by fruits (12 species), bark (9 species), roots (7 species), and whole plant (4 species).

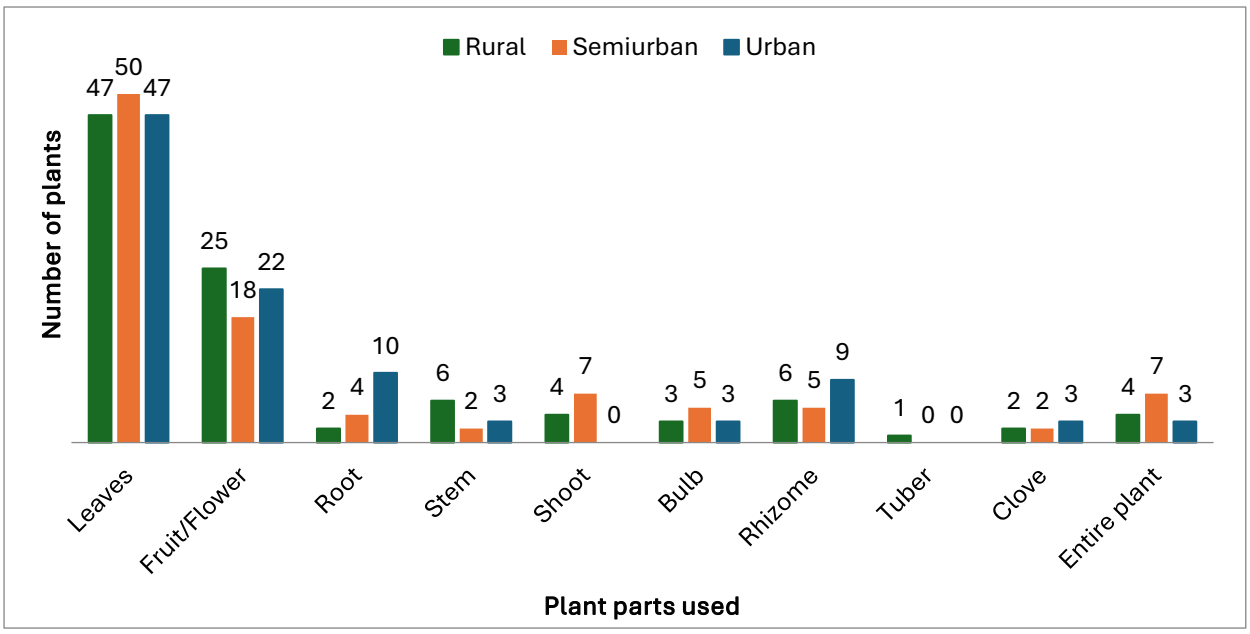


Fig. 7. Plant parts used medicinally in different Homegardens

3.6. Quantitative Ethnobotanical Indices

3.6.1. Frequency of citation, relative frequency of citation, and use value

The ethnobotanical indices revealed considerable variation in the frequency of citation (FC), relative frequency of citation (RFC), and use value (UV) of plant species across rural, semi-urban, and urban homegardens (Table 2). In rural areas, species such as *Zingiber officinale* showed the highest FC (18), RFC (0.60), and UV (2.10), indicating its high importance and widespread use among respondents. Similarly, *Curcuma longa* (FC = 13, RFC = 0.43, UV = 1.87) and *Thysanolaena latifolia* (FC = 15, RFC = 0.50) were also highly cited, reflecting their cultural and utilitarian significance. Species like *Centella asiatica* and *Colocasia esculenta* also exhibited relatively high FC and RFC values (Table 2).

In semi-urban homegardens, *Mentha spicata* recorded the highest FC (15), RFC (0.50), and UV (1.47), followed by *Brassica juncea* (FC = 13, RFC = 0.43). Additionally, *Curcuma longa* and *Houttuynia cordata* showed moderate to high use values, indicating their continued relevance in semi-urban settings. In urban areas, *Mentha spicata* again showed high importance with FC (10), RFC (0.33), and UV (0.60), along with species such as *Aloe vera* (FC = 7, RFC = 0.23, UV = 0.50) and *Coriandrum sativum* (FC = 6, RFC = 0.20, UV = 0.30). Overall, medicinal and food plants noted higher FC, RFC, and UV values across all homegarden types. Ornamental species showed lower values, suggesting limited functional use. Rural areas exhibited higher citation and use values compared to urban and semi-urban areas (Table 2).

3.6.2. Fidelity Level

A total of 25 species with 100% fidelity level (FL) were recorded in rural home gardens, while semi-urban and urban home gardens recorded 18 and 16 species, respectively (Table 4). A 100% fidelity level shows that all respondents reported the same use for those plants. For instance, Spinacia *oleracea* for low blood pressure, *Allium cepa* for hair loss, *Mangifera indica* for stomach problems, and *Carica papaya* for stomach disorders across all three homegardens. Likewise, species such as *Momordica charantia*, *Passiflora edulis*, *Piper betle*, *Piper nigrum*, and *Solanum khasianum* also exhibited complete fidelity for specific disorders (Table 4).

Several medicinal plants, such as *Asparagus racemosus* for constipation in babies, *Ageratum conyzoides* for wound healing, *Biden pilosa* for boils, and *Tagetes patula* for ear infection showed high FL values, highlighting strong traditional knowledge and consistent usage patterns. On the other hand, several species exhibited low to moderate FL values, representing their use for several disorders and lower specificity. For example, *Centella asiatica*, *Colocasia esculenta*, *Eupatorium adenophorum*, and *Plantago asiatica* were reported for a wide-range of health conditions with lower FL values (Table 4). This recommends that these plants are multipurpose medicinal species with diverse therap0065utic applications.

394 **Table 4** Procedure of herbal medicine preparation and fidelity level of the ethno medicinal plants across three home gardens

Sl. No.	Botanical name	Local name	Common name	Plant part used	Ailment treated	Fidelity Level (%)			Preparation method	Mode of application	Supporting Literature
						Rural	Semi-urban	Urban			
1	*Amaranthus cruentus* L.	Sla shipai	Blood amaranth	Fresh leaves	Low blood pressure	50.0			Eaten raw or boiled in water to obtain an extract	Oral	Bhat et al., 2023
					Blood deficiency	50.0					
2	*Beta vulgaris* L.	Bit	Beet	Root; Leaves	Blood deficiency			60.0	Eaten raw or boiled in water to obtain an extract	Oral	Bdoor, 2017
					Low blood pressure			40.0	Eaten raw		
3	*Chenopodium album* L.	Jarei	White goosefoot	Leaves; Stems	Blood deficiency	66.7			Eaten raw or cooked as a vegetable	Oral	Bhat et al., 2023
					Low blood pressure	33.3			Cooked as a vegetable		
4	*Spinacia oleracea* L.	Palong	Spinach	Leaves	Low blood pressure		100.0	100.0	Leaves are boiled in water to prepare a juice	Oral	Iangrai et al., 2023
5	*Allium sativum* L.	Rynsun	Garlic	Garlic cloves	Gastric	38.1	37.5		Chopped and deep-fried in oil until reddish-brown	Oral	Bhat et al., 2023
				Garlic cloves	Cough	47.6	37.5	100.0	Eaten raw	Oral	Panmei et al., 2019; Iangrai et al., 2023
				Garlic	Heart	4.7			Crushed/ground into a fine paste	Topical	
					Bone fracture	9.6	25.0				
6	*Allium cepa* L.	Piat	Onion	Onion bulb	Hair loss	100.0			Cut into halves	Rubbed directly	Bdoor, 2017
7	*Allium tuberosum* Rottler ex Spreng.	Jyllang	Garlic chives	Onion bulb	Tonsil	100.0	100.0		Eaten raw	Oral	Kayang et al., 2005
8	*Rhus ciliata* Licht. ex Schult	Diengsohma	Nutgall	Ripe fruit	Stomach problem	33.3	100.0		Dried/ground into powder and mixed with water to prepare a juice	Oral	Panmei et al., 2019; Iangrai et al., 2023
					Gastric	66.7					
9	*Mangifera indica* L.	u sohpieng	Mango	Leaves	Stomach problem	100			Crushed/ground into a fine paste	Oral	Iangrai et al., 2023
10	*Apium graveolens* L.	Selery	Chinese celery	Leaves	Stomach problem	50.0			Eaten raw	Oral	Iangrai et al., 2023
					Low blood pressure	33.3	100.0				
					Heart	16.7					
11	*Centella asiatica* L.	Batpyllon	Indian pennywort	Whole plant; Leaves	Dysentery	41.5			Whole plant consumed raw or leaves ground with water to obtain juice	Oral	Iangrai et al., 2023
					Diarrhea	34.5					

				Leaves	Boils	13.7			Crushed/ground into a paste	Topical	Panmei et al., 2019
				Leaves	Cancer	10.3			Eaten raw	Oral	
12	*Eryngium foetidum* L.	Dhonia Khlaw		Leaves	Bad breath			50.0	Eaten raw	Oral	Panmei et al., 2019
				Leaves	Tooth cavities	100.0		50.0	Grounded into paste	Topical	
13	*Oenanthe javanica* L.	Jatira	Water celery	Leaves	Cancer	60.0			Eaten raw	Oral	Bdoor, 2017
					Low blood pressure	40.0			Eaten raw or boiled in water		
14	*Colocasia* esculenta (L) Schott	Shriew	Taro	Rhizome	Calcium deficiency	23.1			Rhizome is boiled and consumed	Oral	Panmei et al., 2019
				Rhizome	Cancer	23.1			Eaten raw	Oral	
				Leaves	Fever	53.8			Covered over the child's head for a few minutes until sweating occurs; repeated 3–4 times	Topical	Kayang et al., 2005; Iangrai et al., 2023
15	*Asparagus racemosus* Willd.	Tyrkhang pur	Shatavari	Root	Constipation in babies	100.0			Grounded with water and juice extracted	Used as gripe water	Bhat et al., 2023; Iangrai et al., 2023
16	*Aloe barbadensis* Mill.	Aloe vera	Aloe vera	Leaves	Pimples	33.3	50.0	58.3	The gel from leaves is taken	Topical	Panmei et al., 2019; Bhat et al., 2023
					Skin infection						
					Burns	33.4	35.0	41.7	Ground into paste		
					Wound	33.3	15.0		The gel from leaves is taken		
17	*Aristaloe aristata* Haw.	Aloe vera rit	Lace aloe	Leaves	Burns	28.7			Gel from the plant is extracted	Topical	Bdoor, 2017
					Face pack	28.5	100.0	75.0			
					Wound	42.8		25.0			
18	*Ageratum conyzoides* L.		*Billygoat weed*	Leaves	Wound	100.0			Grounded into paste	Topical	Kayang et al., 2005; Panmei et al., 2019
19	*Biden pilosa* L.	Batsoh byrthit	Beggar's tick	Leaves	Boils	100.0			Grounded into paste	Topical	Tyngsong and Tiwari, 2010
20	*Crassocephalum crepidioides* (Benth) S.Moore	Bat Aeroplane	Thickhead weed	Leaves	Dysentery	50.0			Eaten raw or made into juice	Oral	Iangrai et al., 2023
					High blood pressure	50.0			Eaten raw		
21	*Eupatorium adenophorum* Spreng	Bat iong	Crofton weed	Leaves	Wound	71.4	50.0		Smashed into paste	Topical	Kayang et al., 2005
					Dysentery	5.5			Grounded to extract the juice and then mixed with water	Oral	
					Stomach problem	15.5	22.7		Eaten raw	Oral	
					Cancer	8.6	27.3				
22	*Galinsoga parviflora* Cav		Gallant soldier	Leaves	Fungal infection	5.5			Crushed and applied	Topical	Bdoor, 2017
					Boils	94.5					
23	*Helianthus*	Sunflo	Sunflow	Seeds	Heart diseases		68.1	33.3	The roasted seeds are dehusked and	Oral	Iangrai et al.,

	annuus L	wer	er		Low blood pressure	66.7	13.7	33.3	eaten raw		2023
					Cancer	33.3	18.2	33.3			
24	*Lactuca saligna* L.	Jalyngshir	Willowleaf lettuce	Leaves	High blood pressure	40.0	100.0		Consumed either raw or made into juice	Oral	Iangrai et al., 2023
					Dynsentry	60.0			Consumed raw	Oral	
25	*Lactuca sativa* L	Salad	Lettuce	Leaves	Stomach disorder			100.0	Consumed raw as salad	Oral	
26	*Tagetes patula* L.	Tiewmongor	Marigold	Leaves	Ear infection	100.0			Grounded and the juice is squeezed out	Used as ear drops	Panmei et al., 2019
27	*Taraxacum officinale* L.	Jakhain	Common dandelion	Leaves	High blood pressure	33.3			Directly consumed	Oral	Bhat et al., 2023
				Roots	Fever	33.3			Grounded into paste	Topical	
				Leaves	Wound	33.3			Grounded into paste	Topical	
28	*Eruca sativa* Mill.	Salad pharen g	Arugula salad	Leaves	Blood deficiency			40.0	Eaten raw as salad	Oral	Iangrai et al., 2023
					Low blood pressure			20.0			
					Cancer			40.0	Eaten raw		
29	*Raphanus sativus* L.	Muli	Radish	Leaves	Blood deficiency		60.0		Consumed raw or boiled in water	Oral	Bdoor, 2017
					Low blood pressure		40.0				
30	*Selenicereus undatus (*Haw.)D.R. Hunt	Dragon fruit	Dragon fruit	Fruit	Diabetes		50.0		Eaten raw	Oral	Iangrai et al., 2023
					Heart diseases		50.0				
31	*Carica papaya* L.	Sohkynphoreitblang	Papaya	Fruit	Stomach problems	100.0	100.0	100.0	Eaten raw	Oral	Panmei et al., 2019
32	*Drymaria cordata* (L.)Willd. ex Schult	Batnongrim	Tropical chickweed	Whole plant	Wound	100.0			Made into paste and used	Topical	Panmei et al., 2019; Iangrai et al., 2023
33	*Ipomea batata* Lam	Phankaro	Sweet potato	Leaves	Blood deficiency		50.0		consumed raw or boiled in water	Oral	Panmei et al., 2019
					Low blood pressure	100.0	50.0				
34	*Cucurbita ficifolia* Bouchĕ	Pathawthohrew		Leaves	Fever	100.0			Placed on the patient's head for a few minutes to induce sweating; replaced with fresh leaves	Topical	Kichu et al., 2015
35	*Cucumis sativus* L.	Sohkhia	Cucumber	Fruit	Wound	40.0			Ground into a paste	Topical	Panmei et al., 2019
					Eye pain	40.0			Cut into slices	Placed on the eyes	

					Face pack	20.0			Ground to prepare a face pack	Topical	
36	*Momordica charantia* L.	Kerala	Bitter gourd	Fruit	High blood pressure	100.0			Eaten raw or cooked as a vegetable	Oral	Panmei et al., 2019
37	*Sechium edule* (Jacq) Sw	Biskot	Chayote squash	Shoots	Kidney stone	100.0	100.0		Boiled in water for some time, and the juice extracted	Oral	Iangrai et al., 2023
38	*Dioscorea bulbifera* L.	Phankyrsiew	Air potato	Fruit; Shoot	Boils	50.0			Both the fruit and the shoot are grounded	Topical	Bhat et al., 2021
				Roots	Piles	50.0			Boiled in water for some time, and the juice extracted	Topical	
39	*Elaeagnus commutata* Bernh. ex Rydb	Sohshang	Silver berry	Fruit	Stomach problem	100.0			Boiled in water, and the juice extracted	Oral	Jaiswal, 2010
40	*Elaeocarpus floribundus* Blume.	Sohkhyllam	Indian olive	Fruit	Diarrhea	100.0			Boiled in water, and the juice extracted	Oral	Das and Das, 2005
41	*Ricinus communis* L.	Slaryndi	Castor oil plant	Leaves	Fever		100.0		Placed on the patient's head for a few minutes to induce sweating and replaced with fresh leaves	Topical	Panmei et al., 2019
42	*Trifolium repens* L.	White clove	White clove	Leaves	Wound	100.0			Grounded as paste	Topical	Bhat et al., 2021
43	*Bauhinia variegata* L.	Diengtharlong	White Bauhinia	Flowers	Piles	100.0			Boiled in water and eaten	Oral	Kayang et al., 2005
44	*Castanea sativa* Mill.	Sohot	Chestnut	Fruit	Stomach problem		100.0		The raw fruits are consumed	Oral	Jaiswal, 2010
45	*Mentha spicata* L.	Pudina	Mint	Leaves	Dysentery	44.4			The leaves are eaten raw	Oral	Bdoor, 2017; Panmei et al., 2019
					Gastric		62.5	66.7			
					Cough	55.6	37.5	33.3			
46	*Litsea cubeba* Lour	Diengsohsying	May chang	Leaves	Stomach problem	60.0			Consumed raw or ground into a paste and mixed with water to prepare juice	Oral	Jaiswal, 2010
				Dry bark	Body pain	40.0			Powdered and mixed with oil	Topical	
47	*Persea americana* Mill.	Avocado	Avocado	Fruit	Heart diseases			100.0	Eaten raw	Oral	Laloo et al., 2006
48	*Artocarpus heterophyllus* Lam	Sohphan	Jackfruit	Leaves	Wound	57.2			Ground into a paste	Topical	Panmei et al., 2019
					Stomach problem	42.8					
49	*Morus alba* L.	Sohlyn	Mulberr	Fruits	Diabetes	33.3			The raw fruits are consumed	Oral	Iangrai et al.,

		gdkhur	y		Low blood pressure	33.3					2023
					Blood purification	33.3		100.0			
50	*Musa spp.*	Kait	Banana	Stems	High blood pressure	53.3			Boiled in water and the extract is consumed	Oral	Panmei et al., 2019
					Diabetes	46.7	100.0		Cut into small pieces, boiled in water for a few minutes, and the juice extracted	Oral	
51	*Myrica esculenta* Buch-Ham.	Sohphie	Bayberry	Bark	Dysentery	54.5			Boil in water for one hour	Oral	Panmei et al., 2019; Iangrai et al., 2023
				Ripe fruits	Gastric	45.5			Made into juice and stored for two months and then consumed regularly	Oral	
52	*Psidium guajava* L.	Diengsohpriam	Guava	Young shoots	Dysentery	41.7	58.3	77.8	Eaten raw or crushed into a paste with water	Oral	Panmei et al., 2019
					Diarrhoea	58.3	41.7	22.2			
53	*Nephrolepis cordifolia* L.	Tyrkhang	Boston fern	Roots	Constipation in babies	100.0			Ground with water and the juice extracted	Orally used as gripe water for infants	Kichu et al., 2015
54	*Jasminum officinale* L.	Jasmine	Jasmine	Roots	Wound			100.0	Ground as paste	Topical	Das and Das, 2005
55	*Oxalis corniculata* L.	Kaitdkhiew	Creeping woodsorrel	Whole plant	Ear infection	33.3	100.0		Grounded and juice squeezed	Applied as ear drops	Kayang et al., 2005; Bdoor, 2017
					Wound	66.7					
56	*Passiflora edulis* Sims.	Sohbrab	Passion fruit	Leaves	Diabetes	100.0			Fifteen to twenty leaves are boiled in 1 litre of water for 10 minutes to obtain an extract	Oral	Kichu et al., 2015; Panmei et al., 2019
57	*Pinus kesiya* Royle ex Gordon	Diengksehkhasi	Khasi pine	Young female cone	Cough	58.8	100.0		Crushed and taken orally	Oral	Bhat et al., 2023
					Gastric	29.4			Crushed and taken orally	Oral	
					Stomach problem	11.8					
58	*Piper betle* L.	Tympew	Betel Vine	Leaves	Wound	100.0			Crushed and placed on the wound	Topical	Iangrai et al., 2023
59	*Piper nigrum* L.	Sohmarit	Black pepper	Dried berries	Cough	100.0			Powdered and mixed with warm water	Oral	Iangrai et al., 2023
60	*Plantago asiatica* L.	Shkorblang	Obako	Leaves	Wound		25.0		Grounded into paste	Topical	Iangrai et al., 2023
					Diarrhea		25.0		Consumed raw	Oral	Bdoor, 2017; Panmei et al., 2019
					Dysentery		25.0				
				Whole plant	Cancer		25.0		Consumed raw	Oral	

61	*Fagopyrum esculentum* Moench	Jarain	Common buckwheat	Leaves; Stem	Stomach problem	33.3			Consume raw as salad	Oral	Jaiswal, 2010
					Wound	33.3	40.0		Grounded into paste	Topical	
					Blood deficiency	33.3	60.0		The leaves are eaten raw	Oral	
62	*Rumex x acutus* L.	Jabar	Docks Weed	Leaves	Wound	100.0			Grounded into paste	Topical	Bdoor, 2017
63	*Punica granatum* L.	Sohksiar	Pomegranate	Fruit	Stomach problem			50.0	Eaten raw	Oral	Das and Das, 2005
					Cancer	100.0	100.00	50.0	Grounded and juice extracted	Oral	
64	*Anemone rivularis* Buch-Ham. ex DC.	Sohpliah	Riverside windflower	Leaves	Fungal infection	40.0			Scrubbed on the ringworm-infected area	Topical	Tyngsong and Tiwari, 2010
					Sinus	40.0			Wrapped in cloth and crushed; alternatively placed in boiling water to produce steam	Steam inhalation	
					Nose	20.0					
65	*Fragaria x ananassa (*Weston) Duchesne ex Rozier	Strawberry	Strawberry	Fruit	Heart diseases	100.0			Eaten raw or juice extracted	Oral	Bhat et al., 2021
66	*Zanthoxylum armatum* DC	Jaiur	Prickly ash	Dried berries	Cough	100.0	44.4		Eraw or ground and mixed with warm water	Oral	Panmei et al., 2019
				Fresh berries	Tooth ache		33.3		Ground into a paste	Topical	
				Leaves; Berries	Gastric		22.3		Mixed with warm water	Oral	Bhat et al., 2023
67	*Citrus limon* L.	Sohjew dkhar	Assam lemon	Leaves	Fever				Boiled in water	Bathing of newborn babies	Kayang et al., 2005
					Gastric		14.3	100.0			
				Fruit	Indigestion		75.4		Juice extracted	Oral	
68	*Murraya koenigii* (L.) Spreng.	Curry patta	Curry patta	Leaves	Gastric / indigestion	66.6		100.0	Boiled in water to obtain the juice	Oral	Bhat et al., 2023
				Leaves	Constipation	33.3			Added to food and consumed	Oral	
69	*Houttuynia cordata* Thunb.	Jamyrdoh	Fishwort	Leaves and roots	Low blood pressure			50.0	Eaten raw	Oral	Panmei et al., 2019
				Leaves	Blood purification	33.3		50.0	Eaten raw	Oral	
				Whole plant	Cancer	66.6			Crushed and consumed	Oral	
70	*Bergenia ciliata* (Haw.) Sternb.	Tiew dohma	Winter begonia	Leaves	Fever			100.0	Placed on the patient's head; sweat produced is wiped off every 5	Topical	Bhat et al., 2021

		w							minutes and the process is repeated every 8–10 minutes		
71	*Solanum khasianum* C.B.Clarke	Sohpdok	Dutch eggplant	Dried fruit	Tooth ache	100.0			Burned to produce smoke	Fumigation for toothache	Bhat et al., 2021
72	*Solanum muricatum* W.T. Aiton	Sohshini	Pepino	Fruit	Cancer	100.0			Consumed raw or as juice	Oral	
73	*Solanum nigrum* L.	Sohngan rit	Makoi	Fruit	High blood pressure		100.0	100.0	Eaten raw	Oral	Bhat et al., 2023; Iangrai et al., 2023
74	*Solanum tuberosum* L.	Phan	Potato	Tuber	Burns	100.0	100.0		Ground into a paste	Topical	Bdoor, 2017
75	*Camellia sinensis* (L.) Kunteze	Sla-Scha	Cha-patti	Leaves	Fever	100.0			Boiled with ginger to prepare an decoction	Oral	Bhat et al., 2023
76	*Pouzolzia hirta* (Blume) Hassk	Jamynsleh	Oyik	Leaves	Wound	33.3			Crushed	Topical	Panmei et al., 2019
				Roots	Boils	33.3			Ground into a paste	Topical	Iangrai et al., 2023
					Hair growth	33.3					
77	*Urtica spp.*	Saintap	Common nettle	Roots	Allergies			100.0	Boiled for several hours to prepare an extract	Oral	Bhat et al., 2021
78	*Lantana camara* L.	Sohpongkhlieh	Lantana	Leaves	Fever	100.0			Placed in boiling water to produce steam	Steam inhalation	Iangrai et al., 2023
79	*Curcuma caesia* Roxb.	Shynrai iong	Black tumeric	Rhizome	Body pain	100.0			Ground with a small amount of water to form a paste	Topical	Panmei et al., 2019; Bhat et al., 2023
80	*Curcuma longa* L.	Shynrai	Turmeric	Rhizome	Gastric	37.5			Mixed with ash in warm water	Oral	Kayang et al., 2005; Iangrai et al., 2023
					Face pack	57.5	100.0		Mixed with honey to prepare a face pack	Topical	
					Ortho	5.0					
81	*Zingiber officinale* Rosc.	Sying	Ginger	Rhizome	Cough	47.6			Boiled with tea to prepare a decoction	Oral	Bhat et al., 2023
					Allergy	19.1					
					Indigestion	21.4			Boiled with water to prepare a decoction	Oral	
					Fracture	11.9			Ground and mixed with oil	Topical	

82	*Curcuma spp.*	Shynrai lakhadong	Lakhadong	Rhizome	Allergy	40.0			Ground into a paste	Topical	Panmei et al., 2019; Iangrai et al., 2023
					Gastric	40.0			Mixed with warm water	Oral	
					Face pack	20.0			Mixed with aloe vera gel to prepare a face pack	Topical	
83	*Zingiber rubens* var. rubrum	Sying makhir	Bengal Ginger	Rhizome	Allergy	35.7			The rhizome is scrubbed immediately	Topical	Iangrai et al., 2023
					Cough	42.9			Eaten raw or boiled in water	Oral	
					Fracture	21.4			Ground into a paste and applied as a plaster	Topical	

3.7. Local Perceptions towards Homegarden

The attitude of the respondents towards the home garden were reported (Figure 8-12).

3.7.1. Perception on Depletion and Conservation of Ethnobotanical Knowledge

Results showed that most respondents from the three different home gardens strongly agreed with that knowledge among the Khasi tribe is depleting. Results further showed that around 3.33 to 6.67 % of respondents from rural and semi-urban HGs were disagreed and undecided (Figure 8.a). For conserving the knowledge of ethnobotanical plants, urban with 73% respondents who were strongly agreed, 23.33 agreed, and 3.67 undecided, followed by Semi-urban 70% strongly agreed, 30 agreed, and Rural 66.67% strongly and 33.33% (Figure 8.b).

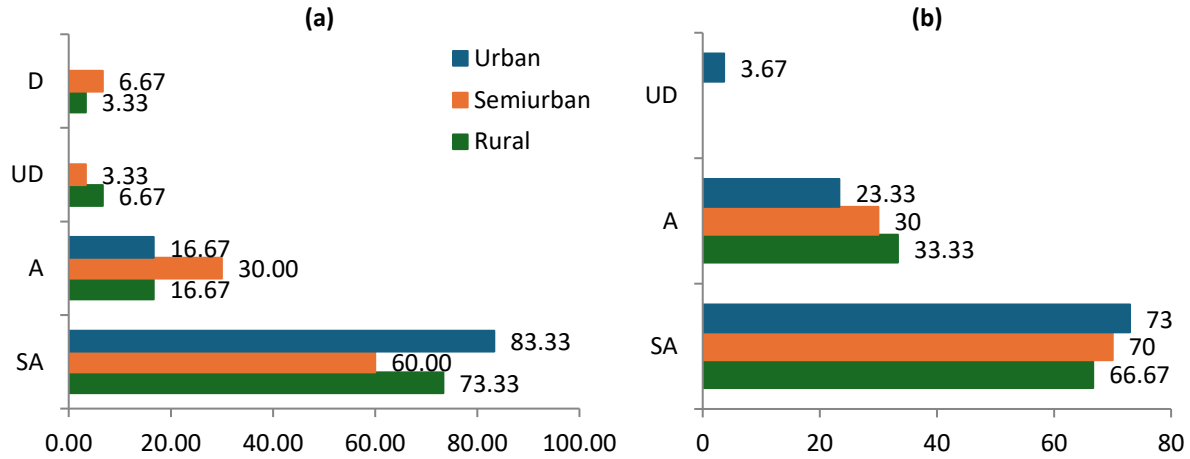


Fig. 8. Respondents' perception regarding (a) depletion of ethnobotanical knowledge and (b) importance of conservation of ethnobotanical plants across rural, semi-urban, and urban home gardens; SA= Strongly Agree, A= Agree, UD= Undecided, D= Disagree

3.7.2. Growing Plants and Gender-wise Knowledge Distribution

The majority of the respondents strongly agreed and agreed with the growing of the ethnomedicinal plant in all the three different types of home gardens, whereas in rural and semi-urban home gardens 10 % and 6.67 % of respondents were undecided, respectively (Figure 9.a). In the rural home garden results showed that females (60 %) knew better than the male (33.33%). Also, in Semi-urban the result showed females (53.33%) knew better than male (43.33%) but in contrast, male (56.67%) knew better than females (36.67%) in urban home gardens (Figure 9.b).

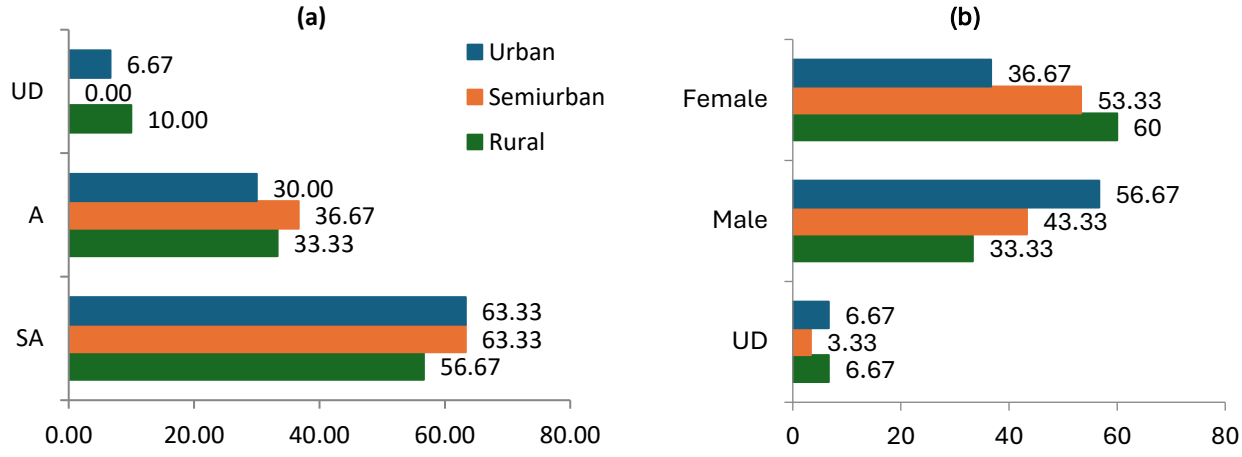


Fig. 9. Respondents' perception regarding (a) importance of growing ethnobotanical plants in home gardens and (b) gender-wise knowledge distribution in rural, semi-urban, and urban home gardens; SA= Strongly Agree, A= Agree, UD= Undecided, D= Disagree

3.7.3. Perception on Research and Economic Value

The majority of the respondents strongly agreed and agreed with more research to be done for identifying promising ethnobotanical plants use (Figure 10.a). Whereas 6.67 % of respondents were undecided both in rural and urban HGs (Figure 10.a). Around 56 to 70 % of the respondents in three different home gardens strongly agreed on the need for a higher price for ethnobotanical plants associated with indigenous practices, 20 to 43 % are agreed, while around 3 % were undecided, and 6.67% of the respondents disagreed in the urban HG (Figure 10.b).

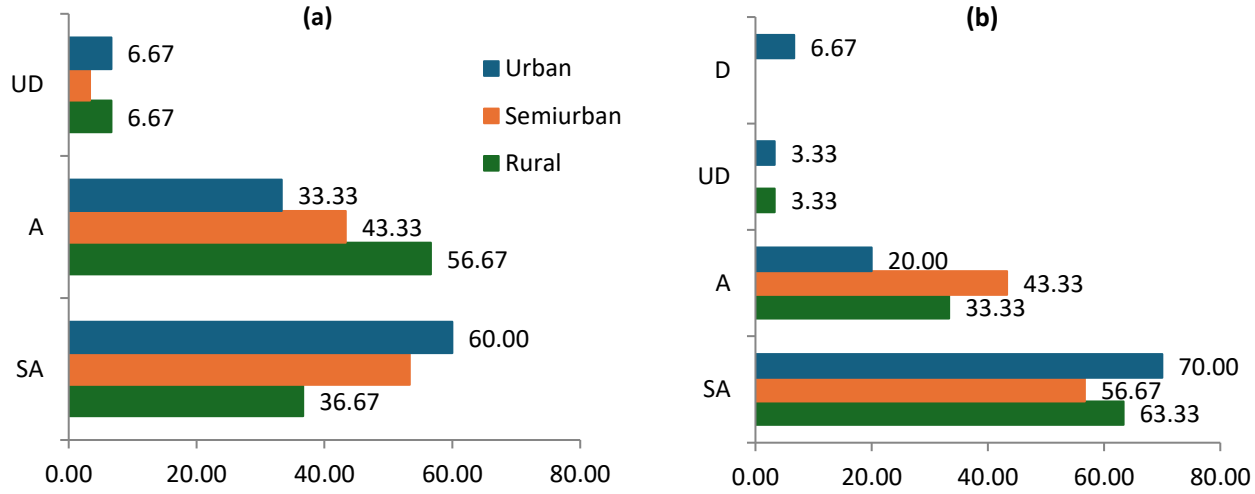


Fig. 10. Respondents' perception regarding (a) need for further research on ethnobotanical plants and (b) need for higher price for ethnobotanical plants associated with indigenous ethnobotanical practices; SA= Strongly Agree, A= Agree, UD= Undecided, D= Disagree

3.7.4. Cultural Beliefs and Medicinal Importance

In urban HGs, 66.67% of respondents strongly agreed, and 23.33 % agreed that they still believe in plant-related folklore, while 6.67% were undecided and 3.33% disagreed. Whereas in the semi-urban HGs, 63.33% strongly agreed, 33.33% agreed, and only 3.33% undecided. In rural HGs, 56.67% strongly agreed and 36.67 agreed, while 3.33% were undecided and 3.33% are disagreed (Figure 11.a).

Regarding the effectiveness of ethnomedicinal plants in curing diseases (Figure 11.b), around 60–66.67% of respondents across all HGs strongly agreed with their curative potential. A smaller proportion (33–36%) agreed, while only 3.33–6.67% remained undecided, indicating a generally high-level of confidence in ethnomedicinal practices (Figure 11.b).

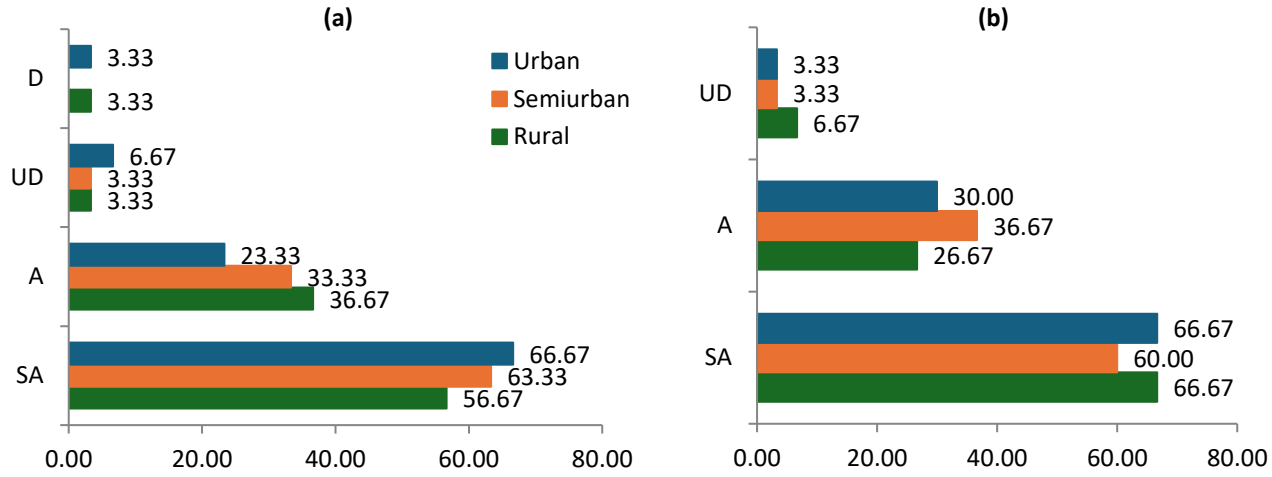


Fig. 11. Cultural perceptions associated with ethnobotanical plants showing (a) belief in plant folklore and (b) perceived role of ethnomedicinal plants in curing diseases; SA= Strongly Agree, A= Agree, UD= Undecided, D= Disagree

3.7.5. Knowledge Dynamics and Transmission

The results indicate that the majority of the respondents across all three HGs strongly agreed and agreed that the knowledge and practices on medicinal plants changes with time and places, while 3.33% undecided and 3.33% disagree (Figure 12.a). Only a small proportion of respondents were undecided and disagreed.

Moreover, the respondents from all three HGs expressed their willingness to pass their knowledge of home garden/medicinal plants to the next generation. In urban HGs, 73.33% of the respondents strongly agreed, 20% agreed, and 6.67% undecided. In semi-urban HGs, 80% of the respondents were strongly agreed and 20% were agreed. In rural HGs, 60% of the respondents were strongly agreed, 36.67% were agreed, and 3.33% were undecided (Figure 12.b).

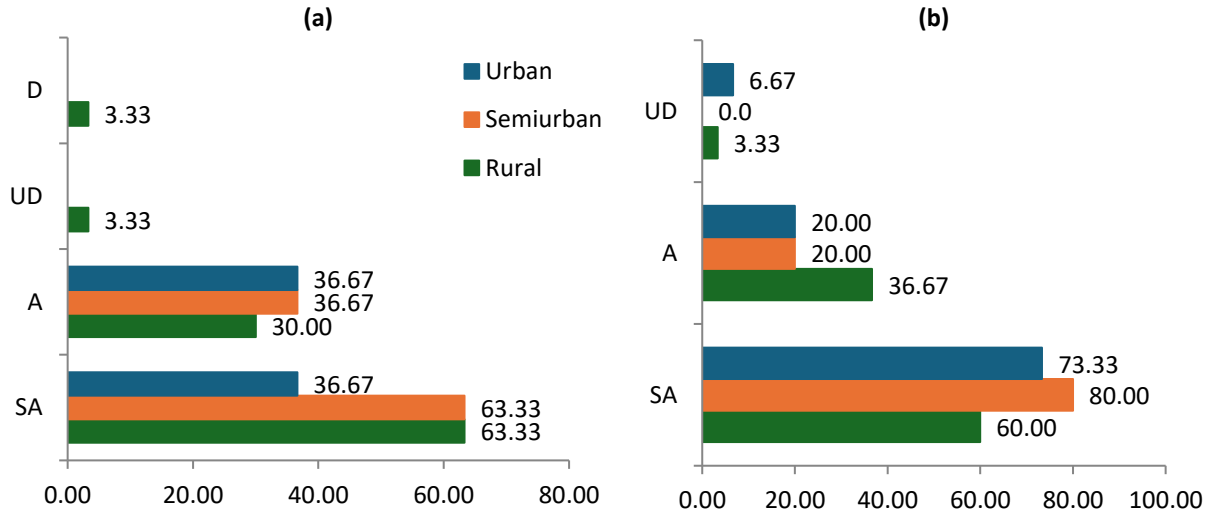


Fig. 12. Knowledge dynamics in ethnobotanical practices showing (a) perceived changes in traditional knowledge and (b) willingness to transmit knowledge to future generations; SA= Strongly Agree, A= Agree, UD= Undecided, D= Disagree

4. Discussion

4.1. Socio-Economic and Homegarden Characteristics

4.1.1. Socio-Economic Characteristics

The predominance of female respondents across all HG types reflects the matrilineal system of the Khasi tribe, where surname, property ownership and inheritance are traditionally passed through women. As primary custodians of land and household resources, women serve a central role in the management and maintenance of HGs, which explains their higher representation in the study. The strong involvement of women observed in the present study is consistent with findings from Indonesia, Sri Lanka, India, Egypt, and Bangladesh, where they serve a key role in home gardening and support household food systems and livelihoods (Akhter et al. 2010; Khan et al. 2021; El Khateeb et al. 2023). However, in contrast-to studies from the Pachmarhi Biosphere Reserve by Kala (2010), where male respondents were more prominent, the present study reveals a clear dominance of female participation, reflecting the influence of the Khasi matrilineal system.

The higher average age of respondents in rural areas compared to semi-urban and urban settings can be attributed to rural–urban migration, where younger working-age populations move to cities for better opportunities, leaving older individuals to manage rural households and agricultural activities (Cao et al. 2019). The dominance of Christianity among respondents, particularly in urban areas, indicates a gradual cultural shift, although indigenous beliefs still persist in rural communities. Such transitions have been reported to influence traditional knowledge systems and resource management practices associated with home gardens and other land uses (Namsa et al. 2011).

The income gradient with higher earnings in urban areas reflects differences in livelihood opportunities. Rural households relay more on farming and home gardens for subsistence, while semi-urban and urban areas shift toward non-farming and diversified livelihoods (Purushotham and Steinhübel 2024). Educational patterns reveal that most respondents from rural home gardens possess basic levels of education, yet they maintain rich traditional knowledge, particularly evident in home garden systems (El Khateeb et al. 2023).

4.1.2. Homegarden Characteristics

The predominance of small-sized (0–0.20 ha) HGs across all three systems, particularly in urban (100%) and semi-urban (93.33%) areas, reflects increasing land fragmentation and space constraints associated with urbanization. The findings are consistent with earlier studies, such as those conducted in the Barak Valley of Assam by Das and Das (2005), where HG sizes ranged from 0.02 to 1.20 ha with an average of 0.30 ha, and indicated similar structural characteristics. The dynamic nature of HG size, particularly at the urban fringe, supports observations that these areas experience gradual transformations due to socio-economic and environmental changes (Egodawatta and Warnasooriya 2014).

The variation in age structure suggests that the rural HGs include a relatively higher proportion of older systems (75 to 100 years), indicating long-standing traditional practices compared to urban HGs. Semi-urban HGs show an intermediate pattern, with a higher proportion in the 26–50 years category. Furthermore, the variation in age distribution aligns with previous studies from Mizoram, where HG ages ranged from 5 to 47 years, highlighting the dynamic and evolving nature of these systems and suggesting transitional phases between rural traditions and urban influences (Jeeceelee and Sahoo 2015).

The observed reduction in home garden size, particularly in semi-urban and urban areas, indicates ongoing land-use changes and increasing pressure on available space. Labour shortage emerged as a key factor influencing size reduction in semi-urban and urban HGs, possibly due to occupational shifts away from

agriculture (Msengana et al. 2025). In contrast, rural areas showed a relatively balanced trend, with some gardens expanding, suggesting comparatively lower land pressure and continued reliance on HGs. Urbanization has a significant role in shaping these patterns, as it influences people's lifestyles, resource use, and management practices, ultimately affecting the structure and sustainability of home gardens (Arjona-García et al. 2021; Marak et al. 2023).

4.2. Identification of Plants and Stratification of Homegarden Structure

4.2.1. Plant species diversity

The present study indicates a relatively high-level of species richness (162 species across 92 families) in three different types of HGs, highlighting their role as key reservoirs of plant biodiversity. However, species richness was higher (106 species) in rural homegardens as compared to semi-urban and urban homegardens, suggesting increasing urbanization with a decline in plant diversity may be due to space limits, lifestyle changes, and other factors (Marak et al. 2023; Msengana et al. 2025). The Asteraceae and Solanaceae families were dominant across all HGs highlights their wider ecological adaptability, cultivation, and uses. Similar trends have been reported for Asteraceae and Fabaceae in other regions, representing their widespread importance in ethnobotanical systems (Kidane et al. 2018).

The abundance of herbs across all three HGs suggests a higher preference for short-duration and easily manageable species that fulfill daily household needs such as vegetables, spices, and medicinal plants. Similar patterns were also observed from other studies (Seta et al. 2013; Kidane et al. 2018), where herbs constituted the highest proportion, followed by shrubs and trees (Arjona-García et al. 2021).

Similarly, Tyngsong and Tiwari (2010) reported higher species richness from the Khasi Hills (197 species) and Saikia et al. (2012) from Upper Assam (294 species). This trend indicates that ecological, cultural, and socio-economic factors have a strong influence on homegarden biodiversity. Similarly, studies from Ethiopia and Bangladesh also reported the dominance of herbs, reinforcing the global pattern of herbaceous species prevalence in traditional home gardens (Seta et al. 2013; Faruque et al. 2018; Tefera et al. 2019).

4.2.2. Vegetation Stratification

The observed structural complexity of HGs, both horizontally and vertically, aligns with earlier findings (Kumar and Nair 2004; Saikia et al. 2012). The presence of multiple vegetation layers highlights their resemblance to natural forest ecosystems. Such a multistorey canopy structure enhances efficient utilization of light, space, and nutrients, thereby increasing biodiversity and productivity. Similar vertical layering patterns have been reported in the HGs of Khasi Hills of Meghalaya (Tyngsong and Tiwari 2010) and Upper Assam (Saikia et al. 2012), where comparable species composition and stratification were observed.

The variation in the number of species across strata among rural, semi-urban, and urban HGs suggests differences in management practices, space availability, and socio-economic factors (Msengana et al. 2025). Rural HGs exhibited greater species richness in lower strata, indicating higher dependence on herbaceous and food plants, whereas urban systems showed relatively fewer species in upper strata, likely due to space constraints (Faruque et al. 2018; Tefera et al. 2019).

The presence of one to five vertical strata in the present study further confirms that HGs are among the most complex and widespread agroforestry systems in tropical regions (Patel et al. 2022). This penta-layered vegetation structure, including climbers, herbs, shrubs, and trees, contributes to ecological stability and supports diverse functional roles within the system (Kumar and Nair 2004).

4.3. Quantitative Vegetation Analysis

The dominance of species such as *Centella asiatica*, *Mentha spicata*, and *Oxalis corniculata* across different HGs reflects their high utility and adaptability in the study area (Tyngsong and Tiwari 2010). *Centella asiatica* is widely used by local communities for treating dysentery, diarrhea, and other stomach-related ailments, which explains its high IVI in rural and semi-urban HGs (Konthoujam and Meitei 2025). Similarly, *Oxalis corniculata* is traditionally used for treating ear-related problems, while *Drymaria cordata* is used for its role in healing injuries, wounds, and tumors (Pradhan et al. 2025). The predominance of *Mentha spicata* across all three HGs indicates its importance as a medicinal plant, particularly for treating stomach disorders and cough.

Apart from medicinal uses, certain species also serve functional and cultural roles. For example, *Phyllostachys mannii* is commonly used for fencing in rural home gardens, while *Hibiscus rosa-sinensis* is widely planted across all HGs for both ornamental purposes and fencing (Tyngsong and Tiwari 2010). These findings are consistent with earlier studies (Tyngsong and Tiwari 2010; Bdoor 2017). For instance, a study conducted in Mawsmai (adjacent to the present study area) reported *Ligustrum confusum* as the most dominant species in terms of IVI, followed by *Wendlandia budleioides* (Bdoor 2017). This comparison suggests that species dominance in HGs may vary regionally, but is generally influenced by local needs, traditional knowledge, and functional uses of plant species (Konthoujam and Meitei 2025).

4.4. Floristic Diversity Analysis

The higher species richness observed in rural HGs indicates greater plant diversity, which may be attributed to larger landholdings (Park et al. 2019) and stronger dependence on traditional plant-based practices. In contrast, urban HGs, despite having lower species richness, exhibited higher Menhinick's index and species evenness, suggesting a more balanced distribution of species (Bernholt et al. 2009). The higher Shannon–Wiener index values across all HG types indicate considerable species diversity, with urban HGs showing slightly higher diversity due to even species distribution. The higher Simpson index in rural gardens reflects greater dominance of certain species compared to urban systems.

The 75% similarity among HG types suggests a significant level of overlap in species composition, possibly due to shared cultural practices and plant preferences (Tyngsong and Tiwari 2010). These findings are consistent with studies conducted in Wolayta, Southern Ethiopia (Seta et al. 2013), Upper Assam (Saikia et al. 2012), and Kerala, India (Mohan et al. 2007), which also reported high similarity across HGs. However, variations in species richness compared to studies from Northwestern Yunnan, China (Yang et al. 2014), highlight the influence of regional, cultural, and ecological factors on HG diversity.

4.5. Ethnobotanical Data Collection

4.5.1. Use Category

The observed differences in plant use categories (UCs) across rural, semi-urban, and urban HGs reflect varying livelihood priorities and socio-economic conditions. Rural HGs exhibited a strong emphasis on food and medicinal plants, indicating their crucial role in household subsistence and traditional healthcare practices (Park et al. 2019). Semi-urban HGs showed a more balanced distribution among use categories, suggesting a transition from subsistence-oriented to diversified plant use systems. In contrast, urban HGs were dominated by ornamental (aesthetic) plants, indicating a clear shift toward recreational and aesthetic values rather than utilitarian functions. This trend may be attributed to limited space availability, changing lifestyle preferences, and reduced dependence on home-grown resources in urban settings (Bernholt et al. 2009). These findings are

consistent with previous studies, such as those conducted in Southern Ethiopia, where multiple plant use categories, including food, income generation, construction, fuel, and medicinal purposes, were reported, emphasizing the multifunctional nature of home garden systems (Tefera et al. 2019).

4.5.2. Part used for Medicinal purposes

The predominance of leaves as the most utilized plant part in all HGs indicates their central role in traditional healthcare practices. This preference may be attributed to their easy availability, ease of collection, and the presence of bioactive compounds that are helpful in treating various ailments (Faruque et al. 2018). The findings are consistent with earlier ethnobotanical studies, which report that leaves, followed by roots, whole plants, stems, and other parts, are commonly used in ethnomedicine. Studies from different regions, including Uttarakhand (Shah et al. 2014), Bangladesh (Faruque et al. 2018), Pakistan (Bibi et al. 2014), and Ethiopia (Kidane et al. 2018), also indicate a similar dominance of leaves in medicinal applications, supporting the widespread reliance on leaf-based remedies in traditional healthcare systems (Idrisi et al. 2010).

The use of multiple plant parts, including fruits, roots, rhizomes, and bark, highlights the diversity of traditional knowledge systems and the multipurpose nature of medicinal plants (Shah et al. 2014). The practice of combining different plant species or using different parts of a single species to treat various ailments highlights the complexity and adaptability of indigenous healthcare systems. However, the lack of standardized dosages and reliance on factors such as age, physical condition, and severity of illness suggest that these practices are largely experience-based and vary among practitioners (Payyappallimana 2010).

4.6. Quantitative Ethnobotanical Indices

4.6.1. Frequency of citation, relative frequency of citation, and use value

The variation in FC, RFC, and UV across HGs reflects significant differences in dependence on plant resources and traditional knowledge. Higher values in rural HGs indicate strong reliance on ethnobotanical practices, with key species like *Zingiber officinale* and *Curcuma longa* highlighting their cultural and medicinal importance. Semi-urban HGs show moderate values, suggesting a transition where traditional knowledge persists alongside modernization, while urban HGs exhibit lower values due to reduced dependence on plant-based remedies and greater access to modern healthcare facilities (Jeeceelee and Sahoo 2015). Medicinal and food plants consistently recorded higher indices across all HGs, emphasizing their functional importance, whereas ornamental species showed limited use (Arjona-García et al. 2021). Similar patterns were reported from Bangladesh (Faruque et al. 2018) and Pakistan (Bibi et al. 2014).

4.6.2. Fidelity Level

The fidelity level (FL) results support the ethnobotanical indices, showing stronger and more consistent traditional knowledge in rural HGs. The higher number of species with 100% FL in rural HGs indicates greater agreement among informants, reflecting well-established and specific plant uses. Widely cited species such as *Allium cepa*, *Carica papaya, Mangifera indica*, and *Spinacia oleracea* demonstrate strong cultural acceptance across all HGs. Plants with high FL values indicate specific and reliable uses, while those with lower FL reflect multipurpose applications. The decline in 100% FL species from rural to urban HGs parallels the reduction in FC, RFC, and UV, suggesting erosion of precise ethnomedicinal knowledge with urbanization (Bibi et al. 2014; Kidane et al. 2018).

4.7. Local Perceptions towards Homegarden

4.7.1. Perception on Depletion and Conservation of Ethnobotanical Knowledge

The results clearly indicate a strong consensus among respondents across all HGs that ethnobotanical knowledge within the Khasi community is gradually declining. This may be attributed to modernization (Bibi et al. 2014), urbanization (Bdoor 2017), and reduced dependence on traditional plant-based healthcare practices (Jeeceelee and Sahoo 2015). The very low proportion of respondents who disagreed or remained undecided suggests that the awareness of this decline is widespread and not limited to a particular settlement type. Such trends have been widely reported in ethnobotanical studies (Arjona-García et al. 2021), where intergenerational knowledge transfer is weakening due to shifts toward formal education, market-based livelihoods, and higher dependence on allopathic medicine (Dinesha et al. 2024; Konthoujam and Meitei 2025).

Results showed a respondent's strong willingness towards ethnobotanical knowledge and plant resource conservation despite recognizing their population decline. The higher (73%) percentage of strong agreement in urban HGs compared to semi-urban (70%) and rural (66.67%) areas may reflect a growing awareness among urban populations about the loss of traditional knowledge and biodiversity (Ulimboka et al. 2022). In contrast, rural respondents have slightly lower levels of strong agreement as rural communities continue to practice and retain a portion of traditional knowledge in their daily lives, leading to a relatively lower perception of conservation urgency (Galluzzi et al. 2010).

4.7.2. Growing Plants and Gender-wise Knowledge Distribution

Results indicate a strong positive perception toward the cultivation of ethnomedicinal plants across rural, semi-urban, and urban HGs, reflecting their continued relevance in local healthcare and livelihood systems (Arjona-García et al. 2021). Further, results suggest that traditional plant-based knowledge remains an integral component of household practices.

Females possess greater knowledge in rural (60%) and semi-urban (53.33%) HGs, which aligns with their traditional roles in healthcare, food preparation, and plant management within households (Kumar and Nair 2004). This observation is consistent with earlier studies highlighting women as key custodians of ethnomedicinal knowledge and biodiversity conservation (El Khateeb et al. 2023; Daudu et al. 2025). In contrast, the higher knowledge reported among males (56.67%) in urban HGs may reflect changing gender roles, increased access to formal education, or reduced involvement of women in traditional practices due to urban lifestyles (Cruz-Garcia and Price 2012; El Khateeb et al. 2023).

4.7.3. Perception on Research and Economic Value

Results indicate a strong consensus among respondents across three HG types regarding the need for further research to identify promising ethnobotanical plants. This trend reflects a growing awareness of the importance of documenting, validating, and utilizing traditional plant knowledge, which is increasingly threatened by socio-cultural changes and biodiversity loss (Martin 1995). The small proportion of undecided respondents (6.67%) in both rural and urban HGs may indicate limited awareness or uncertainty about the research process and its benefits, particularly among certain demographic groups.

Furthermore, the results emphasize a strong inclination among respondents (56–70%) toward the need for higher pricing of ethnobotanical plants associated with indigenous practices. The agreement levels (20–43%) further reinforce the perception that fair market pricing could serve as an incentive for conservation (Hamilton 2004) and sustainable use (Kala et al. 2006). However, a small proportion of respondents (~10%), particularly in urban HGs, may reflect concerns about commercialization, accessibility, or the erosion of traditional values due to overharvesting and over-commercialization, as highlighted by Shanley and Luz (2003). Therefore, it is

essential to ensure that such strategies are accompanied by sustainable harvesting practices and equitable benefit-sharing mechanisms.

4.7.4. Cultural Beliefs and Medicinal Importance

The strong belief in plant-related folklore across all HGs highlights the persistence of traditional knowledge systems despite increasing urbanization and modernization (Kala et al. 2006). Interestingly, it is not confined to rural settings but continues to be culturally embedded even in more urban environments. This may be attributed to the continued transmission of indigenous knowledge through family traditions and cultural practices (Konthoujam and Meitei 2025).

The widespread agreement on the effectiveness of ethnomedicinal plants in treating various diseases further underscores the trust communities place in long-standing traditional healthcare systems. A significant proportion of the global population depends on traditional medicine for primary healthcare, particularly in developing regions (WHO 2002). However, the presence of a small percentage of undecided and disagreeing respondents may indicate a gradual shift in perception, possibly influenced by increased access to modern healthcare (Kala et al. 2006).

4.7.5. Knowledge Dynamics and Transmission

The strong agreement that ethnomedicinal knowledge changes with time and place highlights the dynamic nature of traditional knowledge systems, evolves in response to environmental changes, socio-economic conditions, and cultural interactions. The high willingness among respondents of HGs to transmit knowledge to future generations is a positive indication for the conservation of ethnobotanical practices. The slightly higher proportion of strong agreement in semi-urban and urban HGs compared to rural HGs may reflect increased awareness about the potential loss of traditional knowledge due to modernization and urbanization (Arjona-Garcia et al. 2021). No respondents expressed disagreement in any of the HG types, reflecting a positive attitude toward knowledge continuity. The findings are consistent with earlier work by Marambe et al. (2018), who reported that farmers in Sri Lanka, Bangladesh, and India recognized the importance of HGs for livelihood security and climate change adaptation.

5. Conclusion

The present study revealed that homegardens are important agroforestry systems that contribute significantly to biodiversity conservation, livelihood support, and the preservation of traditional knowledge. A total of 162 plant species were documented across the study sites, with rural homegardens showing the highest species richness (106 species), followed by semi-urban (92 species) and urban homegardens (81 species). Rural and semi-urban homegardens were dominated by food and medicinal plants, whereas urban homegardens were dominated by ornamental species. Rural HGs exhibited the lowest income (₹11,300) with 73.33% farmers, while urban HGs had the highest income (₹58,067) and were entirely (100 %) non-farmers, with semi-urban HGs in between. Most HGs were small (0–0.20 ha), but size reduction was more common in urban (53.33%) and semi-urban (50%) HGs than in rural HGs (33.33%).

The study also highlights that women are key custodians of preserving traditional knowledge and are involved in the management of homegardens due to the matrilineal inheritance system of the Khasi community. Rural respondents exhibited greater knowledge of medicinal plants compared with those in semi-urban and urban areas, reflecting stronger dependence of rural communities on traditional plant-based healthcare systems. Overall, homegardens are a valuable micro-land use system capable of conserving plant genetic resources,

supporting local livelihoods and food security, and preserving ethnobotanical knowledge. Strengthening policy support, extension services, and community awareness programs will be essential to conserve these traditional agroforestry systems and ensure their sustainable management in the face of increasing urbanization and socio-economic changes.

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CRediT authorship contribution statement:

Dahunshisha Khongwar: data collection, data curation, formal analysis, and writing - original draft; Biplov Chandra Sarkar: conceptualization, methodology, and data curation; Ram Gopal: data curation, formal analysis, and visualization; Hanamaraddi Kencharaddi: data curation, validation, and writing - review & editing; Pynwanjingsukiaki Rymbai: formal analysis, writing - review & editing; Gopal Shukla: validation, and writing - review & editing; Dinesha S: supervision, methodology, investigation, data curation, formal analysis, validation, writing - original draft, and writing - review & editing. All authors approved the manuscript.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Ethics statement

Ethics approval was obtained from the Ethics Committee of the Department of Forestry, North-Eastern Hill University, Tura. In addition, all participants provided their informed consent for participating in this study.

Consent to participate

Not applicable

Consent to publish

Informed consent to publish was obtained from all participants whose identifiable images or personal data were included in the manuscript.

Declaration of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this study.

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