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Tree Species Diversity and Its Population and Regeneration Status in Homegardens of Upper Assam, Northeast India

P. Saikia[1,*] and M. L. Khan[2]
[1]*Centre for Environmental Sciences, Central University of Jharkhand, Brambe - 835205, Ranchi, Jharkhand, India*
[2]*Department of Botany, Dr. Hari Singh Gour Central University, Sagar - 470003, Madhya Pradesh, India*

Abstract

Study was conducted to investigate tree diversity and its population and regeneration status in homegardens of upper Assam, Northeast India through field study by quadrat method. A total of 154 tree species have been recorded from 135 studied homegardens under 109 genera 53 families. Most of these species (79%) are indigenous to our country, while the rest (21%) arealiens (naturalized and cultivated exotics) by origin. Tree species richness per homegarden varies greatly in different homegardens and is ranged from 5 to 52 tree species with a mean of 22 (SE±0.58). *A. malaccensis* is the most dominant tree species in the studied homegardens contributed 34% of the total tree density of the documented trees. The tree density is much higher with 4,259 individuals ha^{-1} but, basal area (36.32 m^2 ha^{-1}) is very less. Based on the number of individuals present, very rare species is accounted for 10%, rare species 39%, common species 19%, dominants 14% and predominant species 18% in the present study. The population density of 154 tree species is 4,259 (individuals ha^{-1}) for adults (>3.18 cm DBH), 5,902 (individuals ha^{-1}) for saplings and 38,164 (individuals ha^{-1}) for seedlings. The density of seedlings>saplings>adults represents good regeneration status of tree species in studied homegardens. The population structure study showed that about 8% tree species have good regeneration status, 9% have fair regeneration status, 48% have poor regeneration status and 34% tree species have no regeneration. Study suggests that research and development action is needed to stimulate regeneration of those tree species which having high importance value indices but showing poor or no regeneration. Based on present observation, it can be conclude that homegarden can emerge as an effective means for both economic well-being and biodiversity conservation in upper Assam, Northeast India.

Key Words: tree species diversity, dominance, homegarden, Northeast India

Introduction

Homegarden is a mixture of deliberately planted vegetation, usually with a complex structure and designed to produce natural products for household consumption or for the market (Vogl and Vogl-Lukasser 2003). It is seldom host for more than a few hundred plants even of the most important crops (Hodgkin 2001) and the population size are highly variable depending on the species. In terms of composition, high species diversity with an immediate use in thehomestead is the most prominent feature of homegardens (Hoogerbrugge and Fresco1993). Customs, traditions and aesthetic preferences are instrumental in determining the overall aspect of homegarden (Smith et al.

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Corresponding author: P. Saikia
Centre for Environmental Sciences, Central University of Jharkhand, Brambe - 835205, Ranchi, Jharkhand, India
Tel: 91-9546757398, Fax: 91-6531294182, E-mail: purabi.saikia83@gmail.com

2006). Besides, a wide variety of factors may be associated with homegarden diversity and structure, including biophysical features such as biogeography, proximity to forest and elevation (Kumar et al. 1994; Trinh et al. 2003; Ali 2005); economic requirements (Trinh et al. 2003; Ali 2005; Abdoellah et al. 2006); and social responses that includes tradition, culture, ethnicity, previous experience and education (Mustafa et al. 2000; Trinh et al. 2003). The study of homegardens as distinct ecological and cultural entities was initiated in the tropics of South East Asia (Soemarwoto et al. 1975; Stoler 1975; Sommers 1978). Homegarden around the world often exhibit remarkable variation in floral composition and structure depending on the physiographic and climatic conditions of the area and a wide variety of household characteristics (Muhammed et al. 2011). Information on tropical tree species is needed because of its potential usefulness in understanding the relative extent of plant diversity across the tropics and its implication for conservation and management.

Homegardens are well established and vitally important traditional land use systems throughout Northeast India. Despite their importance, homegardens in Northeast India have not been thoroughly studied. Only, a few quantitative plant diversity inventories are available from Assam, Meghalaya, Mizoram and Arunachal Pradesh (Borthakur et al. 1998; Das and Das 2005; Sahoo 2009; Tangjang and Arunachalam 2009; Devi and Das 2010; Sahoo et al. 2010; Tynsong and Tiwari 2010; Saikia et al. 2012; Zimik et al. 2012; Hazarika et al. 2014; Saikia and Khan 2014). Hence, this investigation was undertaken to determine the extent of tree species richness, diversity, their population density, regeneration status and dispersion patterns in homegardens of upper Assam, Northeast India. It is hoped that these data will be useful in conservation and management planning of tree species available in homegardens of upper Assam, Northeast India.

Materials and Methods

Study sites

Study was conducted in 135 selected homegardens of Golaghat and Jorhat districts of Upper Assam, northeast India (25° 48' to 27° 10' N and 93° 17' to 94° 36' E) covering ca. 6,400 square kilometer area (Fig. 1). The area is surrounded by Sibsagar and Dibrugarh districts in the east, Karbi Anglong and Nagaon districts to the west, Lakhimpur and Sonitpur districts in the north and the bordering state of Nagaland in the south. The climate is tropical having hot and humid summers (39°C during June-July) and cool winters (9°C during December-January). Annual average rainfall of Golaghat and Jorhat districts is 1,300 and 2,244 mm, respectively and experiences maximum precipitation during June and July. The population density of Golaghat and Jorhat districts are 302 and 383 people per square kilometer (Census of India 2011).

Economy of the study site is mainly agro-based comprising rice, tea and sugarcane as major economic crops. Agarwood (*Aquilaria malaccensis*) also contributes sig-

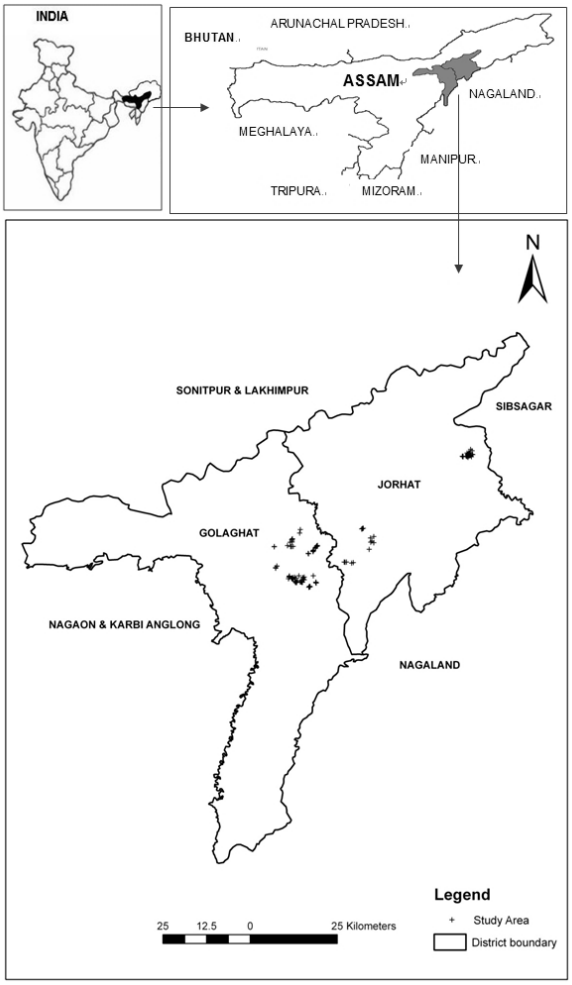

Fig. 1. Map of the study site (Golaghat and Jorhat districts of upper Assam) showing the location of studied homegardens.

nificantly to the economy of the region where it is cultivated. Other commonly cultivated household needs are vegetables, fruit plants, ornamental plants, timber yielding plants, spices and condiments, oil yielding plants, beverage yielding plants, construction materials and plants of religious and sacred value. Most common homegarden plants of upper Assam are agarwood (*A. malaccensis*), areca nut (*Areca catechu*), mango (*Mangifera indica*), tea (*Camelia sinensis*), jackfruit (*Artocarpus heterophyllus*), coconut (*Cocos nucifera*) banana (*Musa* spp.) and bamboo (*Bambusa* spp.).

Methodology

An extensive field survey was undertaken in randomly selected 135 homegardensfrom 27 villages of Jorhat and Golaghat districts of Upper Assam, northeast India during 2007-2010. Adult trees were sampled using 10x10 m quadrats covering at least 30% area in each homegarden (Table 1). Within each randomly laid quadrat for adults, one 5x5 m quadrat for saplings and two 1x1 m quadrats for seedlings were studied. Diameter at breast height (1.37 m above ground) and height of all the individual trees were recorded in each quadrat. Individuals were grouped into seedlings ($\leq$20 cm height), saplings ($\leq$3.18 cm DBH and $>$20 cm height) and adults ($>$3.18 cm DBH) for analysis of population structure. The data were used to compute density (individuals ha^{-1}) of seedlings, saplings and adults and basal area ($cm^2 ha^{-1}$) of adults in each homegarden.

Regeneration was considered as (i) good, if seedlings $>$ saplings $>$ adult (ii) fair, if seedling $>$ sapling $\leq$ adult (iii) poor, if species survived in only sapling stage or sapling population was less than that of adult, and (iv) no regeneration, if only adult individuals were present in the population (Uma Shankar 2001).

Data analysis

Quantitative analysis of vegetation was done following Misra (1968). Importance Value Index (IVI) was computed by summing up relative density, relative frequency and relative dominance. The species richness was calculated by using the method 'Margalef's index of richness' (Dmg) (Magurran 1988).

$$Dmg=(S-1)/\ln N$$

Table 1. Homegarden size, quadrat studied, percentage of area covered and tree diversity of studied homegardens of upper Assam, northeast India

Homegarden No.	Homegarden size (m^2)	Quadrat studied	Total Area studied	Percentage of total area covered (%)	Tree diversity
1	1,338	5	500	37	12
2	1,070	4	400	37	15
3	1,070	4	400	37	26
4	2,007	6	600	30	18
5	2,007	6	600	30	17
6	2,007	6	600	30	16
7	3,345	10	1,000	30	18
8	3,345	10	1,000	30	24
9	1,338	4	400	30	17
10	2,007	6	600	30	18
11	3,345	10	1,000	30	18
12	1,338	4	400	30	18
13	1,338	7	700	52	20
14	1,070	4	400	37	5
15	2,007	10	1,000	50	25
16	2,676	8	800	30	24
17	2,676	8	800	30	14
18	2,676	8	800	30	15
19	2,007	6	600	30	17
20	1,338	5	500	37	23
21	1,338	5	500	37	21
22	803	4	400	50	18
23	2,007	8	800	40	29
24	1,070	5	500	47	22
25	2,676	8	800	30	21
26	1,070	5	500	47	21
27	575	4	400	70	15
28	1,338	8	800	60	29
29	2,007	6	600	30	18
30	2,007	6	600	30	25
31	2,007	6	600	30	18
32	535	5	500	93	33
33	2,676	8	800	30	24
34	535	5	500	93	28
35	1,338	6	600	45	26
36	1,338	7	700	52	19
37	803	3	300	37	23
38	2,007	6	600	30	29
39	1,338	4	400	30	22
40	803	4	400	50	17
41	1,338	4	400	30	20
42	2,007	6	600	30	18
43	1,632	5	500	31	24
44	1,338	4	400	30	11

Table 1. Continued

Home-garden No.	Home-garden size (m^2)	Quadrat studied	Total Area studied	Percentage of total area covered (%)	Tree diversity
45	1,070	4	400	37	27
46	1,338	4	400	30	17
47	803	3	300	37	21
48	1,338	4	400	30	29
49	1,338	4	400	30	23
50	535	2	200	37	15
51	535	3	300	56	18
52	1,605	5	500	31	14
53	2,007	6	600	30	21
54	1,070	4	400	37	26
55	1,338	4	400	30	13
56	2,676	8	800	30	18
57	1,338	5	500	37	19
58	2,140	7	700	33	23
59	2,676	9	900	34	32
60	1,070	4	400	37	15
61	2,007	6	600	30	27
62	2,007	6	600	30	25
63	2,676	8	800	30	23
64	669	3	300	45	21
65	1,605	6	600	37	24
66	1,338	4	400	30	25
67	1,605	5	500	31	25
68	1,605	5	500	31	21
69	1,605	5	500	31	42
70	2,676	8	800	30	23
71	682	3	300	44	34
72	1,338	4	400	30	21
73	1,605	5	500	31	21
74	1,338	4	400	30	27
75	669	2	200	30	14
76	803	3	300	37	21
77	2,676	9	900	34	27
78	1,338	4	400	30	21
79	2,007	6	600	30	40
80	535	3	300	56	15
81	2,676	8	800	30	25
82	2,007	6	600	30	21
83	3,345	10	1,000	30	27
84	535	2	200	37	12
85	1,070	4	400	37	19
86	669	2	200	30	17
87	1,338	4	400	30	26
88	1,338	5	500	37	40
89	1,338	4	400	30	20
90	2,676	8	800	30	20

Table 1. Continued

Home-garden No.	Home-garden size (m^2)	Quadrat studied	Total Area studied	Percentage of total area covered (%)	Tree diversity
91	4,013	12	1,200	30	52
92	4,013	12	1,200	30	29
93	2,007	6	600	30	20
94	2,007	6	600	30	23
95	2,007	6	600	30	30
96	2,007	6	600	30	30
97	2,007	6	600	30	17
98	803	3	300	37	21
99	2,007	6	600	30	33
100	2,007	6	600	30	13
101	2,676	8	800	30	34
102	1,873	6	600	32	20
103	3,345	10	1,000	30	30
104	2,007	6	600	30	17
105	2,007	6	600	30	17
106	1,338	4	400	30	15
107	1,605	5	500	31	19
108	3,345	10	1,000	30	27
109	2,274	7	700	31	16
110	1,605	5	500	31	13
111	1,605	5	500	31	17
112	1,605	5	500	31	21
113	1,338	4	400	30	19
114	2,676	8	800	30	30
115	2,676	8	800	30	22
116	1,338	4	400	30	20
117	2,676	8	800	30	12
118	2,007	6	600	30	25
119	1,338	4	400	30	32
120	1,204	4	400	33	14
121	936	3	300	32	25
122	1,338	4	400	30	20
123	1,204	4	400	33	24
124	1,338	4	400	30	18
125	2,007	6	600	30	25
126	1,338	4	400	30	19
127	2,274	7	700	31	27
128	2,007	6	600	30	27
129	2,676	8	800	30	24
130	1,873	6	600	32	15
131	936	3	300	32	13
132	1,338	4	400	30	20
133	2,007	6	600	30	18
134	2,007	6	600	30	18
135	936	3	300	32	14

where, S=Total number of species

N=Total number of individuals

The Shannon-Wiener Diversity Index (Shannon and Wiener 1963) was calculated from the IVI values using the formula given by Magurran (1988).

$$H = \sum_{i=1}^{s} pi \ln pi$$

where, pi is the proportion of the IVI of ith species and the IVI of all the species (ni/N).

Concentration of Dominance was assessed by Simpson's Index (Simpson 1949).

$$CD = \sum_{i=1}^{s} (pi)^2$$

where, pi is the same as for the Shannon–Wiener information function.

Evenness index was calculated from Shannon-Wiener Diversity Index using the formula

$$E = H'/H'max$$

where, H' is Shannon-Wiener Diversity Index and H'max=lnS (where, S=total number of species)

E is constrained between 0 and 1. The less variation in communities between the species, the higher is the diversity. The higher value in E represents a higher diversity.

Based on the number of individuals, species were grouped into very rare (those represented by a single individual), rare (2 to 10), common (11 to 25), dominant (26 to 50) and predominant (>50) (Kadavul and Parthasarathy 1999). All the tree species were grouped into one of five frequency classes (FC): 1-20% (FCI), 21-40% (FC2), 41-60% (FC3), 61-80% (FC4) and 81-100% (FC5), according to Raunkier's law of frequency. The ratio of abundance to frequency was used to interpret the distribution pattern of the species (Whitford 1949). The ratio of abundance to frequency indicates regular distribution if below 0.025, random distribution between 0.025 and 0.05 and contagious if >0.05 (Curtis and Cottam 1956).

Results

Tree species diversity

A total of 154 tree species have been recorded from 135 studied homegardens under 109 genera 53 families. Most of these species (79%) are indigenous to our country, while the rest (21%) arealiens (naturalized and cultivated exotics) by origin (Table 2). Some important indigenous tree species of cultivated origin are *Artocarpus heterophyllus* Lam., *Aquilaria malaccensis* Lam., *Bombax ceiba* L., *Cinnamomum tamala* (Buch.-Ham.) Nees & Eberm. and *Mangifera indica* L. on the other hand, *Areca catechu* L., *Anthocephalus chinensis* (Lam.) Rich. ex Walp., *Azadirachta indica* Juss., *Cocos nucifera* L. and *Eucalyptus citriodora* Hook. are some important exotic tree species commonly cultivated in the homegardens of upper Assam. Highest species are recorded from the family Moraceae (13 spp.) followed by Rutaceae (11 spp.) and Lauraceae (9 spp.). 27 families are represented by only single species (Fig. 2).Out of the total 53 families, 52 families are angiosperm of which 49 families are dicot (92%), and 3 families are monocot (6%) and only one family (2%) is gymnosperm. The only gymnosperm family, Araucariaceae is represented by Christmas tree *Araucaria heterophylla* (Salisb.) Franco., has four individuals in all the 135 studied homegardens. Arecaceae, Musaceae and Poaceae are the monocot families represented by 6, 5 and 4 tree species respectively. Tree species richness per homegarden varies greatly in different homegardens and it is ranged from 5 to 52 tree species with a mean of 22 (SE±0.58). *A. malaccensisis* the most dominant tree species in the studied homegardens of upper Assam as it has the highest frequency (98%), density (1,443 individuals ha^{-1}) and has contributed 34% of the total tree density of the documented tree species. The tree density in homegardens of upper Assam is much higher with 4,259 individuals ha^{-1} but, the basal area of tree species (36.32 m^2 ha^{-1}) is very less. The Shannon-Wiener diversity indices, species richness index, concentration of dominance, evenness index and all other community parameters of trees in homegardens of upper Assam are shown in Table 3.

Based on the number of individuals present, very rare species is accounted for 10%, rare species 39%, common species 19%, dominants 14% and predominant species 18% in the present study (Fig. 3). *A. malaccensis*, *A. catechu*, *A.*

Table 2. List of the families along with number of tree species along with its origin in homegardens of upper Assam, northeast India

Family	Exotic	Native	Total	Family	Exotic	Native	Total
Anacardiaceae	1	2	3	Magnoliaceae	-	5	5
Annonaceae	2	-	2	Meliaceae	3	4	7
Apocynaceae	1	1	2	Mimosaceae	2	4	6
Aquifoliaceae	-	1	1	Moraceae	-	13	13
Araliaceae	-	1	1	Moringaceae	-	1	1
Araucariaceae	1	-	1	Musaceae	-	5	5
Arecaceae	3	3	6	Myricaceae	-	1	1
Asteraceae	-	1	1	Myrtaceae	3	4	7
Averrhoaceae	1	-	1	Papilionaceae	1	3	4
Bignoniaceae	-	1	1	Phyllanthaceae	-	2	2
Bixaceae	1	-	1	Poaceae	-	4	4
Bombacaceae	-	1	1	Proteaceae	1	-	1
Boraginaceae	-	2	2	Rhamnaceae	1	-	1
Burseraceae	-	1	1	Rhizophoraceae	-	1	1
Caesalpinaceae	2	3	5	Rosaceae	2	2	4
Capparidaceae	-	1	1	Rubiaceae	1	1	2
Caricaceae	1	-	1	Rutaceae	1	10	11
Clusiaceae	-	6	6	Salicaceae	-	1	1
Combretaceae	1	4	5	Sapindaceae	2	-	2
Dilleniaceae	-	1	1	Sapotaceae	-	2	2
Dipterocarpaceae	-	1	1	Simaroubaceae	-	1	1
Ebenaceae	-	1	1	Sterculiaceae	-	1	1
Elaeocarpaceae	-	2	2	Symplocaceae	-	1	1
Euphorbiaceae	1	6	7	Theaceae	1	-	1
Fagaceae		1	1	Thymelaeaceae		1	1
Lauraceae		9	9	Verbenaceae		4	4
Lythraceae		1	1	Total	33	121	154

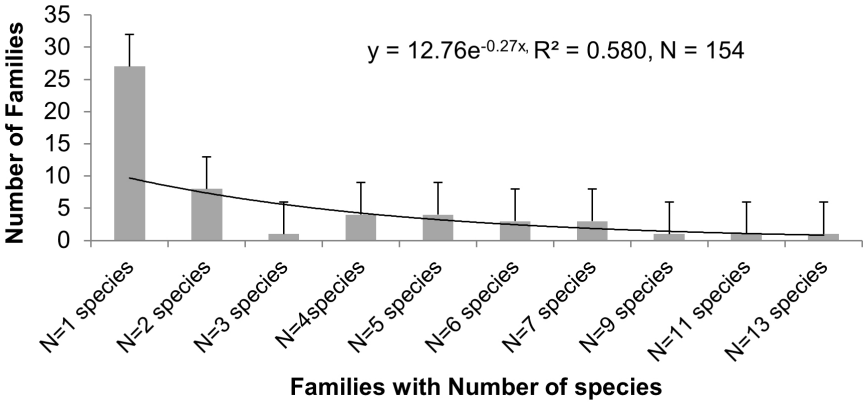

Fig. 2. Distribution of families according to species number in homegardens of upper Assam, Northeast India.

heterophyllus, *Alstonia scholaris* (L.) R.Br., *Cassia fistula* L. and *M. indica* are some example of predominant species. Analysis of Raunkier's frequency classes revealed that mostof the tree species have low frequency (Fig. 4) as would be expected in typical species-abundance distributions in tropical homegardens. All the tree species except *M. indicaare* distributed contagiously (high abundance and low frequency) in all the studied homegardens. *M. indica* showed

Table 3. Community characteristics of the studied homegardens of upper Assam, northeast India

Parameters	Tree
Number of families	53
Number of genera	109
Species richness	154
Species richness Index	18.31
Density (ha^{-1})	4259
Basal area (m^2 ha^{-1})	36.32
Diversity (Shannon's H')	3.99
Concentration of dominance	0.05
Evenness Index	0.79

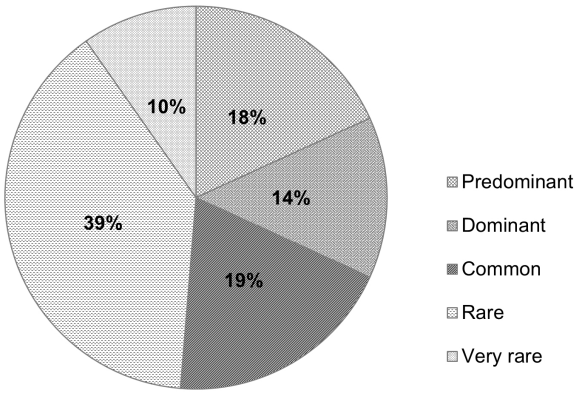

Fig. 3. Percentage of tree species in different rarity classes in homegardens of upper Assam, Northeast India.

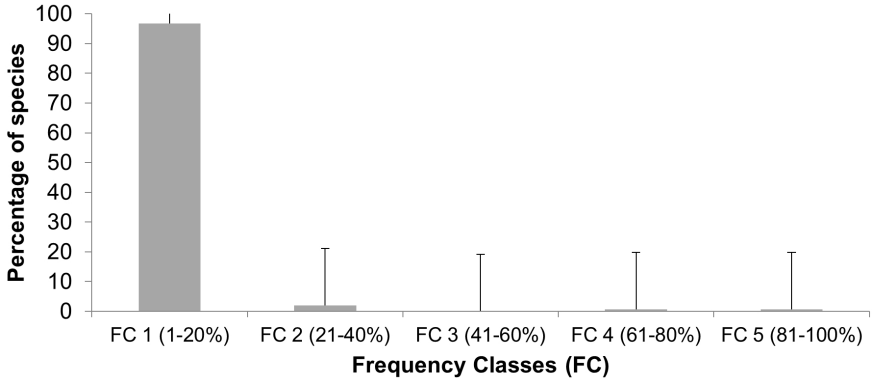

Fig. 4. Percentage of species in different frequency classes (FC) in homegardens of upper Assam, Northeast India.

random distribution with abundance to frequency ratio of 0.049 (low abundance and high frequency).

Population structure and regeneration status of tree species

The population density of 154 tree species in 135 studied homegarden is 4,259 (individuals per hectare) for adults (> 3.18 cm DBH), 5,902 (individuals per hectare) for saplings and 38,164 (individuals per hectare) for seedlings (Fig. 5). The population densities in three different life forms (adults, saplings and seedlings) represent their possible future species composition. The density of seedlings > saplings > adults which represents good regeneration status of tree species in studied homegardens of upper Assam. The population structure study showed that about 8% tree species have good regeneration status, 9% have fair regeneration status, 48% have poor regeneration status and 34% tree species have no regeneration without any population of seedlings and saplings and represented by only adults (Fig. 6). Some tree species with good regeneration status are *A. malaccensis*, *A. catechu*, *Cordia grandis* Roxb., *Delonix regia* (Boj. ex Hook.) Raf., *Litsea monopetala* (Roxb.) Pers., *M. indica* and *Melia azedarach* L. On the other hand, *Anacardium occidentale* L., *Callistemon lanceolatus* D.C., *Cinnamomum glanduliferum* (Wall.) Meisn., *Diospyros embryopteris* Pers., *Eucalyptus citriodora* Hook. and *Grevillea robusta* Cunn. ex R.Br. are some tree species of cultivated origin with no regeneration status as these species are represented by only adult trees.

Discussion

From ecological and conservation point of view, assessment of biodiversity of any habitat or locality has been regarded as one of the vital issue for careful preservation, promotion and management of the variety of life-forms.

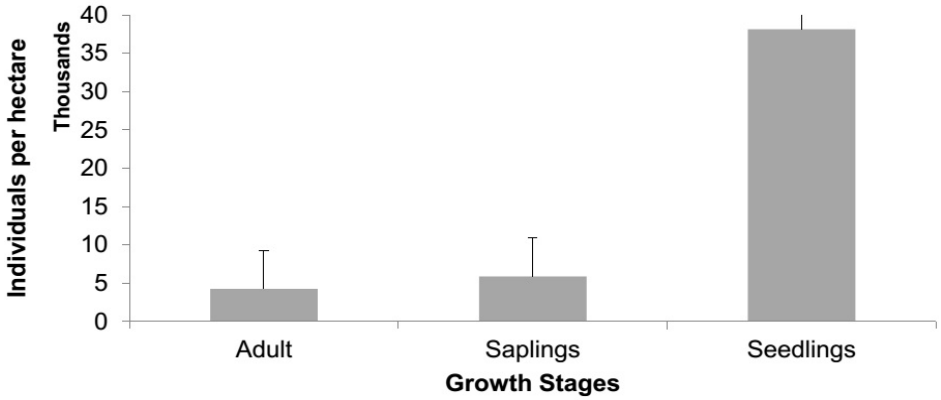

Fig. 5. Seedling, sapling and adult density (individuals ha^{-1}) of tree species in homegardens of upper Assam, Northeast India.

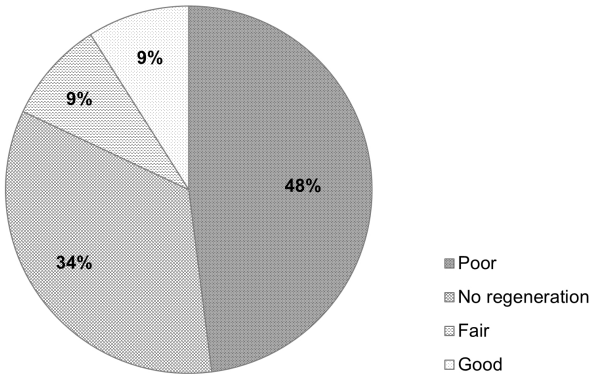

Fig. 6. Percentage of tree species showing different regeneration status in homegardens of upper Assam, Northeast India.

Understanding species diversity and distribution patterns is important to evaluate the complexity any ecosystems. Trees form the major structural and functional basis of tropical homegardens and can serve as robust indicators of changes. Trees are usually found in low numbers in homegardens, mostly because of their greater demand for space. In the present study, we are recording 154 different trees which is much greater than the previous report from Assam (87 trees) (Das and Das 2005) as well as India (68 trees) (Shastri et al. 2002) signifying homegardens of upper Assam as store house of tree species diversity. The tree diversity found in the homegardens probably reflected the specific needs (including food requirements and household dietary priorities and preferences), nutritional complementarities with major food sources, as opposed to economic, ecological and social factors (Kumar and Nair 2004). The management of exotics which represented 21% of all tree species reflected response of homegarden owners to market opportunities and availability of planting material. Also, several exotic fruit trees have been cultivated in Assam for a long time. For instance, the cultivation of *A. catechu* and *C. nucifera* and their uses in different rituals and customs are date back. The management of exotic species (21%) in Assamese homegarden is less compared to the homegardens of Brazil which represented by 40% exotics (Akinnifesi et al. 2010).

In conformity with the present study Tynsong and Tiwari (2010) also reported family Moraceae as the most dominant plant species contributed the highest diversity in the studied homegarden. On the other hand, Solanaceae is the most dominant plant species in the homegardens of Mizoram (Sahoo et al. 2010) and Fabaceae in Barak Valley, Assam (Devi and Das 2010). The wide variation of species richness (5 to 52 tree species) per homegarden was found in the present study may be attributed to the levels of disturbance particularly selective felling of trees and ground clearance for maintaining the weedy growth. Variation in tree species richness as well as composition is largely due to variation in microclimatic conditions, biotic interference and edaphic factors. The estimated tree density is 4259 individuals ha^{-1} and basal cover is 36.32 m^2 ha^{-1}. The tree density in the present study is much higher than the values of 1,535 individuals ha^{-1} reported by Das and Das (2005) in Barak Valley, Assam homegardens and the basal area is nearer the recorded basal area of 33.86 m^2 ha^{-1}. Much lesser basal area of tree species may be due to the dominance of narrow range girth class species in homegardens of upper Assam. Differences in basal area may be attributed to altitudinal

variations, species composition, age structure and successional stage of the community (Swamy et al. 2000).

Shannon indices vary widely in tropical homegardens and are reported to range from 0.93 to 3.00 (Karyono 1990). Our analysis indicates that diversity index (Shannon's H') 3.99 suggesting that diversity of trees of these homegardens is relatively high compared to a value over 3.53 in Assamese homegarden (Saikia et al. 2012) and homegardens of Meghalaya (Tynsong and Tiwari 2010) and Mizoram (Sahoo et al. 2010). The evenness index (E=0.79) shows that most of the tree species are equally abundant and dominance of a certain set of species in the studied homegardens as in homegardens of Kerala (George et al. 1993) and Mizoram (Sahoo et al. 2010). All the tree species except *M. indica* were distributed contagiously in all the studied homegardens. A contagious or clumped distribution is an indication of clusteredness of species throughout the indigenous homegardens. Contagious distribution has been accepted as a characteristic pattern of plant occurrence in nature (Odum 1971). The predominance of clumped dispersion of trees obtained in the present study is consistent with the results of various tropical forests (Whitmore 1975; Hubbell 1979). Owners have understood this natural concept through time and therefore, adopted the strategies for introducing more and more tree species into their homegardens (Sahoo et al. 2010).

The success of regeneration can be predicted on the basis of current population structure, growth and fecundity (Guedje et al. 2003). Population structure and regeneration status of tree species in terms of proportions of seedlings, saplings and adults varied greatly. Species regeneration potential was represent to consider their population density in three different life phases. The overall expanding population structure (density of seedlings > saplings > adults) indicates that the studied homegardens are typical mature stands with good regeneration status. Good regeneration status (expanding population) of tree species indicates effectiveness of ecosystems and signifies the sustainability of the species for the future. Regeneration status of tree species of any ecosystem is quantified by recruitment potential of saplings and seedlings (Saikia and Khan 2013). Microclimate variability controls species composition, species recruitment and establishment in different ecosystems (Behera et al. 2012). Competition among species for space, light and water (Holl et al. 2000) and ground clearance for the maintenance of weeds may be the reason of no regeneration of 34% tree species in homegardens of upper Assam. The homegardens owners are constantly introducing new tree species into their homegardens as evidenced by the occurrence of plants of different stages, such as seedlings, saplings and adult trees (Akinnifesi et al. 2009).

Conclusions

Species richness is one measure of biodiversity and is very important for ecosystem functioning, stability and integrity. Apart from the ecological reasons, maintaining high floristic diversity in homegarden has economic, spiritual, ethical, scientific and educational importance. This study helps to complete the description of homegarden structure and diversity and may be used to interpret aspects of population dynamics. Further research is needed to provide directly relevant and applicable evidence for a better understanding of the homegarden, including the growth behaviour of the trees and the factors affecting it. Study suggests research and development action is needed to stimulate regeneration of those tree species which having high importance value indices but showing poor or no regeneration. Based on present observation, we can conclude that homegarden can emerge as an effective means for both economic well-being and conservation of plant diversity in upper Assam, Northeast India.

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