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Diversity and utilization of tree species in Meitei homegardens of Barak Valley, Assam

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Abstract

An inventory of tree diversity in traditional homegardens of Meitei community was conducted in a Bontarapur village in Cachar district of Barak Valley, Assam. Meitei homegarden locally called *Ingkhol* exhibits a wide diversity in size, shape, location and composition. Seventy one tree species were enumerated from 50 homegardens belonging to 60 genus and 35 families. Among the families encountered, Rutaceae was the dominant family (4 genus and 7 species) followed by Meliaceae (5 genus and 5 species), Arecaceae (4 genus and 4 species) and Moraceae (3 genus and 5 species). Total 7946 tree individuals were recorded, with the density of 831 No ha^{-1} of and total basal area of 9.54 m^2 ha^{-1}. *Areca catechu* was the dominant species with the maximum number of individuals. Other dominant trees include *Mangifera indica, Artocarpus heterophyllus, Citrus grandis, Parkia timoriana, Syzygium cumini* and *Psidium guajava*. Being a cash crop, the intensification of betel nut has been preferred in many homegardens. Homegardens form an important component of land use of Meitei community which fulfills the socio-cultural and economic needs of the family and helps in conserving plant diversity through utilization.

Key words

Meitei, Homegarden, *Ingkhol*, *Parkia timoriana*, *In-situ* conservation

Introduction

India has a long historical tradition of growing trees on farms and around homes. Farmers maintained or preferred trees as part of their agricultural landscapes where homegardens formed an important component. Trees provide shade, shelter, energy, food, fodder and many other goods and services that enable the farmstead to prosper (McNeely and Schroth, 2006; Huai and Hamilton, 2009). A homegarden refers to the traditional land use system around a homestead where several species of plants are grown and maintained by the household members and their products are primarily intended for the family consumption. The importance of homegardens as a site for biodiversity conservation in agricultural landscape was emphasized by several workers (Ramakrishnan *et al*., 1996; Martin *et al.,* 2001; Depommier, 2003; NBPGR, 2007; Schroth and Harvey, 2007). Homegardens are important *in situ* conservation sites and in accordance with the Convention on Biological Diversity articles 7, 8 and 10(c) (Heywood and Watson, 1995), inventorisation of such areas can help in the identification and conservation of biodiversity (Das and Das, 2005).

Different cultures and customs have different names for this homestead production system, for example, *Ghar Bagaincha* in Nepal (Shrestha *et al.,* 2002), *Kandy* in Sri Lanka (Perera and Rajapakse, 1991) and *Bari* in Bangladesh (Millat-e-Mustafa *et al*., 1996). The home garden, literally known in Meitei as *Ingkhol* refers to the traditional land use system around a homestead where several species of plants are grown and maintained by household members and their products are primarily intended for the family consumption. In fact it is an ecological system involving interactions between human being, plants and animals.

Considering the importance of homegardens in terms biodiversity management and conservation through

utilization, attempts have been made to scientifically document the conservational value and traditional knowledge associated with the management of this important rural landscape unit in North East India (Das and Das, 2005; Srivastava and Heinen, 2005; Devi and Das, 2010; Tynsong and Tiwari, 2011; Sahoo, 2009; Deb *et al*., 2009; Godbole, 1998). Homegardens form an important component of land use of Meitei community which fulfills the sociocultural and economic need of the family and thus helps in conserving plant diversity through utilization.

The present study attempts to investigate the patterns of diversity, composition and utilization of tree species in the homegardens of Meitei community in village Bontarapur of Cachar district, Assam in northeast India.

Materials and Methods

The study was conducted in a village Bantarapur (24º382 35"N, 92º542 65"E) in Palonghat Block of Cachar district, southern Assam and situated about 40 km from Assam University Campus. The village Bantarapur is inhabited by the Meitei community in the bank of Sonai River and encompasses an area of 93.2 ha with about 300 households. The chief occupation of the people of this village is farming.

Fifty homegardens were selected randomly in the study site. Complete inventories were carried out to document tree diversity and elder members of the household were interviewed about the uses of each species. Local name of all the species were recorded. Plants species in the homegardens were identified by consulting different floras (Kanjilal *et al*., 1934-40; Chowdhury, 2005) and herbarium of the Botanical Survey of India, Eastern Circle, Shillong.

The density and basal area of each tree species were determined according to Mueller-Dombois and Ellenberg (1974). The importance value index (IVI) was calculated by using the formula, IVI= Relative frequency + Relative density + Relative basal area (Misra, 1968).

Relative frequency is the number of occurrences of a tree species, as a percentage of the total occurrences of all tree species in all homegardens; relative density is the number of individuals of a species as a percentage of the total number of individuals of all species; and relative dominance is the total area occupied by one tree species as a percentage of the total area occupied by all the tree species in the sampled homegardens (Kumar *et al*., 1994; Mohan *et al*., 2007). The IVI based Shannon diversity index and Simpson's dominance index were calculated as per equation of Magurran (2004). Based on height, trees were categorized into five canopy and height classes (Das and Das, 2005): Emergent canopy (> 15 m), Dominant (10-15 m), Under-storey (5-10 m), shrub layer (1-5 m) and herb layer (<1m).

Results and Discussion

Among the 50 homegardens sampled, the size ranged between 0.13 to 0.28 ha with an average of 0.18 ha, which is within the range of the sizes of similar homegardens reported by global inventory of other tropical homegardens by Fernandes and Nair (1986). Perera and Rajapakse (1991) reported 0.05 to 2.50 ha as homegarden size in Kandyan, Sri Lanka, the size of Bangladesh homegardens ranged from 0.01-1.72 ha (Kabir and Webb, 2008). In Kerala, Kumar *et al*. (1994) reported size range of 0.4- 2 ha. All households in the study village posses a homegarden adjacent to the home and most of them are fenced with bamboo. Few homegardens are also demarcated by live fence of trees like *Areca catechu, Artocarpus heterophyllus* and *Mangifera indica* etc.

In the study village the homegarden trees were distributed in five distinct strata (Fig. 1). The layering of vegetation was not similar as not all the five layers were found in all the homegardens. Some of the species like *Areca catechu, Artocarpus heterophyllus* and *Mangifera indica* were found in more than one layer due to the difference in age groups which the homegarden owners are managing for sustainable production. In the present study, maximum number of species and individuals were present in the third and fourth layer. In the Kandyan homegardens of Sri Lanka, four layers were recorded (Perera and Rajapakse, 1991) whereas in the homegardens of Andaman and Nicobar five stories were reported by Pandey *et al.* (2006). In the homegardens of Kerala (Kumar *et al.,* 1994) maximum species were reported to be found in the ground layer.

Seventy one tree species (<15cm gbh) in 60 genera and 35 families were encountered in the study village (Table 1). Kumar *et al*. (1994) reported 127 tree species from the homegardens of Kerala while in the homegardens of Karnataka 68 tree species were recorded (Shastri *et al.,* 2002). Das and Das (2005) documented 87 tree species from the homegardens of tea garden communities in Dargakona village of Barak valley, Assam which was higher than the present study. Similarly, Tynsong and Tiwari (2010) reported a comparatively higher value of 187 species in homegardens of War Khasi community in Meghalaya.

The number of species per homegarden varies with the size of the homegarden - in the smaller homegarden lowest of nine species were recorded. In the larger homegarden, maximum of 28 species were recorded with more multipurpose trees, fruit yielding trees, and wild trees like *Dysoxylum binectariferum and Palaquium polyanthum*.Although domesticated for its timber value,

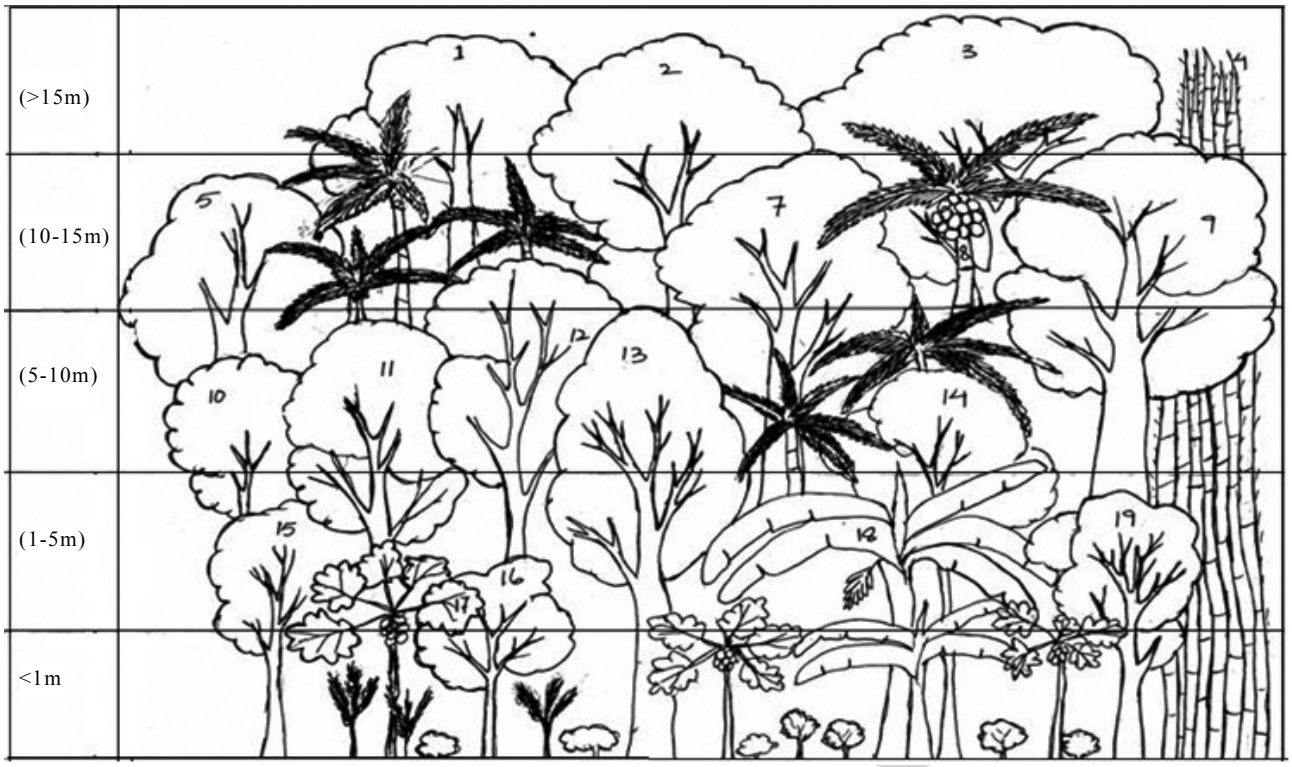

Fig. 1 : Vertical stratification of species in the homegardens of Bontarapur village, Assam (1) *Bombax ceiba* (2) *Albizia lebbeck* (3) *Artocarpus chama* (4) *Bambusa* spp. (5) *Mangifera indica* (6) *Areca catechu* (7) *Artocarpus heterophyllus* (8) *Cocos nucifera* (9) *Parkia timoriana* (10) *Citrus grandis* (11) *Gmelina arborea* (12) *Syzygium cumini* (13) *Toona ciliata* (14) *Premna bengalensis* (15) *Psidium guajava* (16) *Vatica lanceaefolia* (17) *Carica papaya* (18) *Musa* spp. (19) *Erythrina*

Table 1 : List of tree species with details on density, frequency and IVI of Meitei homegardens in Bantarapur village, Assam

Name of species	Family	Uses	Density (no. ha^{-1})	Dominance (m^2 ha^{-1})	Frequency (%)	IVI
Aegle marmelos (L.) Corr.	Rutaceae	Religious	0.21	0.01	1.9	0.21
Albizia lebbeck (L.) Benth.	Mimosaceae	Timber	0.84	0.17	7.7	0.96
Alstonia scholaris (L.) R.Br	Apocynaceae	Timber	0.42	0.18	3.8	0.58
Annona squamosa L.	Annonaceae	Fruit	0.52	0.03	5.8	0.60
Anthocephalus chinensis (Lamk) A. Rich.ex Walp.	Rubiaceae	Timber	0.21	0.07	1.9	0.27
Aphanomixis polystachya (Wall.) Parker	Meliaceae	Fruit	0.10	0.01	1.9	0.20
Areca catechu L.	Arecaceae	Masticator	307.32	30.43	100.0	79.11
Artocarpus chama Buch-Hum.	Moraceae	Timber	2.51	0.98	21.2	3.24
Artocarpus heterophyllus Lam.	Moraceae	Fruit	26.67	5.48	82.7	16.48
Artocarpus lacucha Buch-Hum.	Moraceae	Timber	0.21	0.09	1.9	0.30
Averrhoa carambola L.	Averrhoaceae	Fruit	0.31	0.07	3.8	0.45
Azadirachta indica A. Juss.	Meliaceae	Medicine	0.10	0.00	1.9	0.19
Baccaurea ramiflora Lour.	Euphorbiaceae	Fruit	0.10	0.01	1.9	0.19
Bambusa balcooa Roxb.	Poaceae	Fencing	30.65	1.34	17.3	6.67
Bambusa cacharensis R.Majumder	Poaceae	Fencing	185.56	13.22	40.4	40.37
Bambusa nutans Wall.ex Munro.	Poaceae	Fencing	28.56	1.10	13.5	5.82
Bambusa tulda Roxb.	Poaceae	Fencing	11.92	0.13	1.9	1.75
Bambusa vulgaris Schrad.ex Wendl.	Poaceae	Fencing	22.59	1.69	9.6	5.41
Bombax ceiba L.	Bombacaceae	Fiber	0.52	0.17	7.7	0.92
Borassus flabellifer L.	Arecaceae	Fan	0.10	0.04	1.9	0.22
Carica papaya L.	Caricaceae	Vegetable	1.46	0.09	11.5	1.28

Caryota urens L.	Arecaceae	Timber	0.10	0.02	1.9	0.20
Cinnamomum tamala Nees & Ebern	Lauraceae	Spice	0.10	0.00	1.9	0.19
Citrus aurantium L.	Rutaceae	Fruit	0.63	0.02	9.6	0.94
Citrus grandis (L.) Osbeek	Rutaceae	Fruit	7.22	0.88	51.9	6.40
Citrus medica L.	Rutaceae	Fruit	0.73	0.03	7.7	0.80
Citrus reticulata Blanco.	Rutaceae	Fruit	0.63	0.08	7.7	0.84
Cocos nucifera L.	Arecaceae	Fruit	2.72	2.02	28.8	5.08
Cordia grandis Roxb.	Ehretiaceae	Timber	0.94	0.15	9.6	1.12
Crataeva religiosa Buch.Ham.	Capparaceae	Religious	0.10	0.11	1.9	0.30
Delonix regia (Boj.)Raf.	Caesalpiniaceae	Ornamental	0.10	0.06	1.9	0.25
Dillenia indica L.	Dilleniaceae	Fruit	0.31	0.20	1.9	0.43
Duabanga grandiflora (Roxb.ex DC.)Walp.	Sonneratiaceae	Timber	0.10	0.01	1.9	0.19
Dysoxylum binectariferum Hk.f.	Meliaceae	Timber	1.05	0.23	11.5	1.39
Elaeocarpus floribundus Blume.	Elaeocarpaceae	Fruit	1.88	0.20	26.9	2.81
Emblica officinalis Gaertn.	Euphorbiaceae	Fruit	0.10	0.05	1.9	0.24
Erythrina stricta Roxb.	Fabaceae	Fuelwood	1.57	0.41	15.4	1.99
Ficus hispida L.	Moraceae	Fuelwood	0.94	0.11	15.4	1.59
Flacourtia jangomas (Lour.) Raeusch.	Flacourtiaceae	Fruit	0.31	0.02	5.8	0.57
Gmelina arborea Roxb.	Verbenaceae	Timber	4.50	1.30	34.6	5.01
Gossypium herbaceum L.	Malvaceae	Fiber	0.10	0.02	1.9	0.20
Hibiscus rosa sinensis L.	Malvaceae	Ornamental	0.10	0.06	1.9	0.25
Lagerstroemia reginae Roxb.	Lythraceae	Fuelwood	1.67	0.51	13.5	1.94
Ligustrum robustum (Roxb.)Bl.	Oleaceae	Fuelwood	0.10	0.01	1.9	0.19
Litchi chinensis (Gaertn) Sonn.	Sapindaceae	Fruit	1.05	0.16	13.5	1.49
Litsea monopetala (Roxb.) Pers.	Lauraceae	Timber	0.10	0.01	1.9	0.19
Mallotus philippinensis (Lam.) Muell.Arg.	Euphorbiaceae	Timber	0.21	0.01	3.8	0.37
Mangifera indica L.	Anacardiaceae	Fruit	93.51	15.74	98.1	37.12
Melia azedarach L.	Meliaceae	Medicine	0.10	0.02	1.9	0.20
Michelia champaca L.	Magnoliaceae	Timber	0.21	0.06	3.8	0.43
Moringa oleifera Lamk	Moringaceae	Vegetable	0.42	0.10	7.7	0.83
Murraya koenigii (L.) Spreng.	Rutaceae	Spice	0.10	0.00	1.9	0.18
Musa sps	Musaceae	Fruit	48.43	4.92	82.7	18.48
Nyctanthes arbor- tristis L.	Verbenaceae	Ornamental	0.10	0.01	1.9	0.19
Palaquium polyanthum Engl.	Sapotaceae	Timber	0.10	0.03	1.9	0.21
Parkia timoriana (A.DC.) Merr.	Fabaceae	Vegetable	5.02	1.50	42.3	5.97
Polyalthia longifolia (Sonner.) Thw.	Annonaceae	Ornamental	0.21	0.00	3.8	0.37
Premna bengalensis Clark.	Verbenaceae	Fuelwood	5.65	1.23	40.4	5.58
Psidium guajava L.	Myrtaceae	Fruit	5.86	0.35	50.0	5.48
Pterospermum acerifolium Willd.	Sterculiaceae	Fuelwood	0.52	0.06	7.7	0.81
Spondias dulcis L.	Anacardiaceae	Fruit	1.78	0.66	17.3	2.45
Spondias pinnata (L.f.) Kurz.	Anacardiaceae	Fruit	0.10	0.01	1.9	0.19
Streblus asper Lour.	Moraceae	Fuelwood	0.31	0.02	5.8	0.56
Syzygium cumini (L.) Skeels	Myrtaceae	Fruit	7.22	1.88	40.4	6.48
Syzygium jambos (L.) Alston	Myrtaceae	Fruit	0.52	0.02	9.6	0.93
Tabernaemontana divaricata (L.) R.Br.	Apocynaceae	Ornamental	0.42	0.03	3.8	0.43
Tamarindus indica L.	Fabaceae	Fruit	0.10	0.04	1.9	0.22
Tectona grandis L.	Verbenaceae	Timber	3.77	0.50	19.2	2.69
Toona ciliata M.Roem.	Meliaceae	Religious	6.80	1.24	57.7	7.24
Vatica lancaefolia (Roxb.) Bl.	Dipterocarpaceae	Resin	1.05	0.68	11.5	1.89
Ziziphus mauritiana Lam.	Rhamnaceae	Fruit	0.52	0.14	7.7	0.89
			831.17	9.54		300.00

Table 2 : Ecological characteristics of Meitei homegardens in Bantarapur village, Assam

Homegarden size ((ha) :	Range	0.13 to 0.28
	Average	0.18
Total homegarden area surveyed (ha)		9.56
No. of trees / homegarden :	Range	23-242
	Average	158.92
Tree density (no. ha^{-1})		831.17
Basal area (m^2 ha^{-1})		9.54
Species		71
Genus		60
Family		35
Shannon's diversity index		2.86
Simpson's dominance index		0.11

D.binectariferum has been recently found to be a rich source of 'Rohitukine' which has a potential use as an anti-cancer compound (Yang *et al*., 2004; Patel *et al*., 2010). It is relevant in this context to emphasize that potential use of homegarden plants need to be spread among the homegarden owners for their utilization and commercial value (Chandrashekara and Baiju, 2010; Eyzaguirre and Linares, 2004; Galluzzi *et al*., 2010). *Areca catechu* constituted the most dominant component of the Meitei homegardens in the study village regardless of the size of the homegarden and constituted 56.70% of the total number of trees (7946) in 50 homegardens. The tree is also a very important and inseparable item for Meitei traditional community functions. Other multipurpose trees were also encountered but fruit trees were dominant in the Meitei homegardens of Bontarapur village as also in homegardens of Kerala (Kumar *et al*., 1994; Chandrashekara, 2009). The homegarden owners prefer to grow more fruit trees for generating additional cash income. The average number of tree individuals per homegarden was 159.The estimated tree density was 831 no ha^{-1} and the basal cover was 9.54 m^2 ha^{-1} (Table 2).The density of trees in the present study was much higher than the values of 238-319 No ha^{-1} reported by Kumar *et al*. (1994) in Kerala homegardens but lower than the Dargakona village (1535 No ha^{-1}) of Barak valley, Assam (Das and Das, 2005). The correlation between homegarden size and number of individuals ($r = 0.32$, $p < 0.05$) was significant in spite of the low value of the resulting coefficient. The range of species with an average of 9.6 per homegarden recorded in the present study was lower than that of 20 from Dargakona village of Barak valley (Das and Das, 2005), 46 recorded in Kandyan homegardens (Perera and Rajpakse, 1991) in Sri Lanka. A number of factors such as socioeconomic status, market reach, size of homegarden etc., affect the diversity in homegardens (Santhakumar, 1996).

Among the tree species, the IVI of *Areca catechu* was highest (79.11) followed by *Bambusa cacharensis* (40.37) and *Mangifera indica* (37.12). Analysis of IVI of a species is used to recognize the pattern of association of dominant species in a community (Parthasarathy, 2001). The tree species diversity (Shannon Weiner) and dominance respectively were 2.86 and 0.11 (Table 2). The density based Shannon Wiener diversity index in homegardens of Kerala ranged from 1.12 to 3.0 suggesting low to moderate levels of diversity. The present study indicates that the dominance index value of homegadens (0.11) was relatively low compared to the value (0.45-0.60) reported in Kerala homegardens (Kumar *et al.*, 1994).

Ten different use categories of tree species have been found in the study area. Among these categories, the

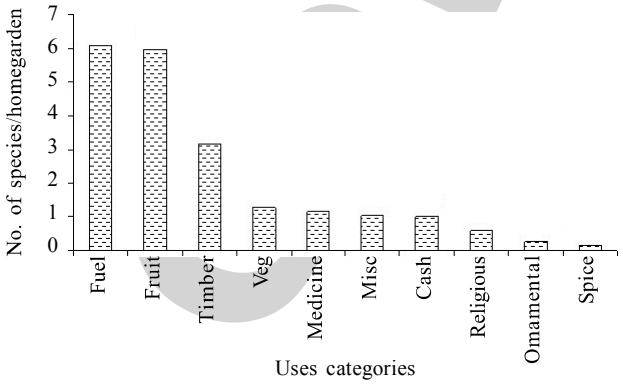

Fig. 2 : Distribution of tree species in different use categories in homegardens of village Bantarapur, Assam

maximum number of tree species per use category was found to be in the fruit. The Fig. 2 shows the number of tree species in each use category per homegarden in which fuelwood and fruit trees formed the dominant category followed by timber, medicinal etc. *Areca catechu* being a multipurpose plant, the nut is used as masticator, trunk as pole, leaves are used in fencing, broom making and as fuel. *Parkia timoriana* was one of the important trees for the Meiteis, and hence found in almost all homegardens for family consumption and the villagers conserved this tree species from generation to generation. A number of workers have reported the biochemical and nutritional importance of the plant including various medicinal values (Sharma *et al*., 1993; Mohan and Janardhan, 1993; Mao *et al.,* 2009).

Farmers choose specific zones based on practical considerations, plant requirements and soil conditions. For example, the fruit trees and ornamental trees were grown closer to the house for taking proper care and beautification of the house and in order to facilitate constant watering, weeding and to safeguard against theft. Banana was grown in periphery of the pond as it required more water and sunlight. It may be mentioned here that pond is an important component in many (34 %) homegardens and periphery of

the pond forms a site for domesticating selected tree species: *Areca catechu*, *Artocarpus heterophyllus*, *Mangifera indica*, *Musa* sp.etc. This indicates that the farmers were having good knowledge of ecological requirements of trees which they had accumulated over generations from their ancestors. Kala (2010) also emphasized the importance of traditional ecological knowledge of homegarden farmers in conserving many threatened wild species in homegardens in Pachmari Biosphere Reserve in India.

The present study showed that Meitei homegardens could be considered as potential units for conservation through utilization at a village landscape level. Further there is a need of awareness through knowledge dissemination regarding the potential values of trees domesticated in the homegardens.There is an urgent need to document and understand the dynamics of such traditional village ecosystem of socio-economic, ecological and cultural significance and this should form a component of the 'People's Biodiversity Register' (Gadgil, 2006) mentioned in the India's Biological Diversity Act, 2002 and Biodiversity Rules, 2004.

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