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ORIGINAL PAPER

# Diversity of plant species in arecanut agroforests of south Meghalaya, north-east India

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**Abstract**: In south Meghalaya, farmers maintain a variety of economically important plant species in arecanut agroforestry systems. We investigated plant species composition of arecanut agroforests of south Meghalaya and encountered 160 plants, which included 83 tree species, 22 shrub species, 41 herb species and 14 climber species. The study reveals that arecanut agroforests provide cash income, medicine, timber, fuelwood and edibles for household consumption as well as for sale. We conclude that these agroforestry systems serve as home for many economically important plant species, harbour rich biodiversity and mimic the natural forests both in structural composition as well as ecological and economic functions.

**Keywords**: agroforests; arecanut; diversity; South Meghalaya; *War Khasi*

## Introduction

Effects of human activities on species diversity have attracted the attention of ecologists both from theoretical and practical points of view. The ecosystems with high species diversity are more stable and resilient to human disturbances than those having low species diversity. Ehrlich and Wilson (1991) argued that diverse systems are likely to contain some species that can thrive during perturbation and therefore, may compensate for those members of the community that are reduced or eliminated by the disturbance. Contrary to this view, Connell (1978), drawing analogy between coral reefs and tropical forests, proposed that species diversity in rain forest would be greatest where disturbances are moderate in intensity and frequency. Collins et al. (1995) argued that richness should be highest at intermediate frequencies of disturbances when the condition favours competitive species and those that tolerate disturbance. Thus, the intensity and frequency of disturbance are important determinants of plant diversity in a community.

The northeast region of India is considered as one of the richest biodiversity centres of the Indian continent. According to Takhtajan (1988), it is the centre of origin of angiosperms. Meghalaya, a constituent of Indo-Burma biodiversity hot spot, harbours 3 128 species of angiosperms which include 1 237 endemic species and 53 threatened plant species (Khan et al. 1997). The biodiversity of primary forests of Meghalaya has been studied by workers like Upadhaya (2002), Jamir and Pandey (2003) and Tripathi et al. (2006). However, there is a glaring gap in our understanding of the biodiversity of arecanut agroforests created and maintained by the local communities on sustainable use basis; unlike in other part of India viz., South Andaman where the biodiversity of arecanut agroforests have been investigated to a fair degree (Pandey et al. 2006). The objective of this study was to inventorise the plant diversity of arecanut agroforests and to examine the interrelations of biodiversity conservation with usage pattern of the forest products by the people living in south Meghalaya.

## Materials and methods

### Study area

The survey was conducted in tropical evergreen region in the two arecanut agroforests of south Meghalaya namely Mawriang village and Sohlong village, an area very close with the international boundary of Bangladesh (Fig. 1). The study area is located between latitude 25º6'25"–25º18'29" N and longitude 91º57'38"–92º1'26" E. Cherrapunjee-Mawsynram Plateau, one of the wettest places in the world is located in this region. The altitude varies from 10 m (Shella) to 1 200 m (Pynursla) a.s.l. The mean annual maximum and minimum temperatures are around 23ºC and 13ºC, respectively. The mean annual rainfall is 11 565 mm. The slope of the area is predominantly towards the south and the angle of the slope varies between 10º and 40º. The area has a large numbers of rivers and rivulets, which drain into the plains

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of Bangladesh. At times, narrow and deep river valleys separate one hill range from the other. The population density is sparse. Horticulture, forestry and fisheries are the principal occupation of the people. Agriculture is limited to some small valleys where mainly tuber crops are grown. Arecanut, orange, areca leaf, jack fruit, bay leaf, honey and broom grass are the important produce of the region. The area is inhabited by *War Khasi* people, a tribal community having long tradition of forest conservation. People gather a variety of edibles from forests and water bodies including fish, frog, crustaceans, mollusks, bushmeats, tubers and wild vegetables. The staple diet of the local inhabitants is rice, fish and meat. People collect process and market a large variety of non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs) such as *Cinnamomum tamala*, *Piper peepuloides*, *Phrynium capitatum*, bamboo, honey, mushrooms, nuts, tubers, edible worms, insects and leafy vegetables from the forests. About 30 000 farmers are currently cultivating arecanut in south Meghalaya on approximately 70 000 ha of land. The total area under the arecanut agroforest in the two studied villages is approximately 400 ha. Farmers of south Meghalaya have developed a system in which arecanut groves are deliberately and intimately grown while maintaining most biodiversity elements of the natural forests (Tiwari 2005).

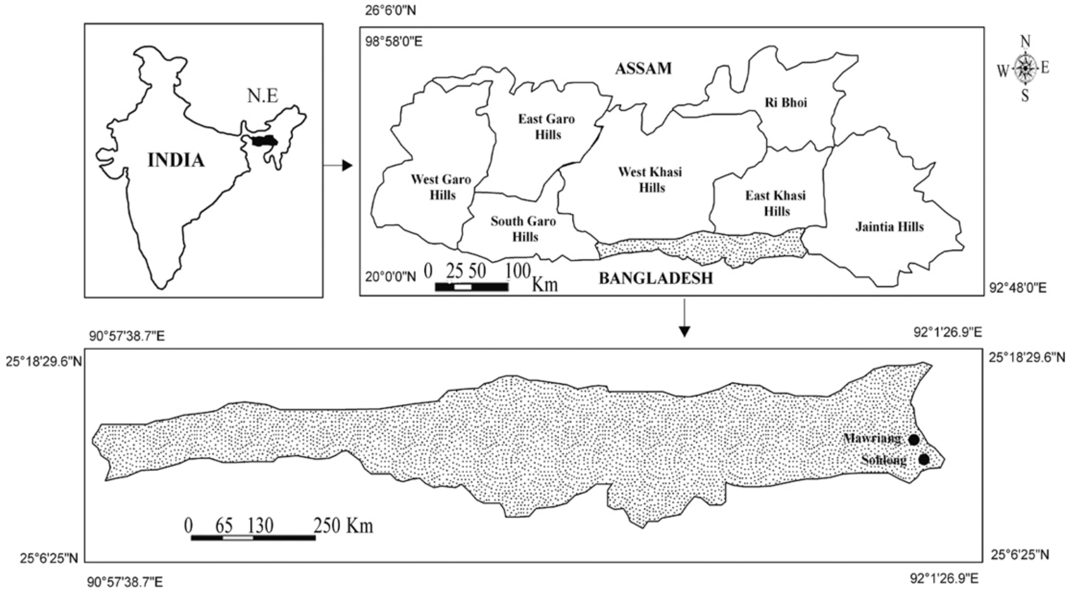


**Fig. 1 Location of the study area**

Arecanut agroforests are a poly-culture type of agroforest where arecanut (*Areca catechu* L.) is grown along with many native wild plants. In this type of agroforestry system, in the first year most of the trees are felled down creating a gap of approximately 5 m × 5 m for arecanut cultivation. From the second year onward people start enriching the gaps with economically important plant species along with arecanut the principal cash crop. The retention of forest trees and the introduction of native and exotic plants determine the composition and structure of the arecanut agroforests. The result is generally a multi-strata and multi-species agroforest whose species composition reflects the needs of the local people.

The natural vegetation of *War* area ranges from tropical evergreen to sub-tropical evergreen forests (Balakrishnan 1983). The plant species in the forests are distributed in distinct vegetation layers. The important evergreen trees found in the south Meghalaya include: *Cinnamomum tamala*, *Daphniphyllum himalayanse, Myrica esculenta, Sarcosperma griffithi,* and *Syzygium tetragonum*. The deciduous elements include: *Betula alnoides*, *Cedrela toona, Engelhartia spicata* and *Ficus roxburghii*. The shrub layer is thick and is predominantly composed of *Ardisia griffithii, Boehmeria malabarica, Goniothalamus sesquipidalis, Mahonia pycnophylla* and *Wallichia densiflora*. The ground vegetation (herb) is dominated by *Borreria pilosa, Commelina benghalensis, Impatiens* spp., *Ophiorrhiza hispida*, *Sonerila khasiana* and a large number of ferns. There are a good number of lianas and other climbers seen twining on the trees. The tree trunk and branches are covered with large number of mosses, epiphytic ferns and different variety of orchids. The invasive weedy species like *Artemisia* spp., *Eupatorium* spp. and *Mikania micrantha* are also present in good number.

Plant survey

For plant diversity studies, extensive survey was carried out in the two arecanut agroforests of south Meghalaya during the months of January, 2004 to October, 2006. The data were collected once in every season of the year for a period of two years. Vegetation characteristics were determined within 100 $m^2$ plots (10 m × 10 m) for trees; 25 $m^2$ plots (5 m × 5 m) for shrubs and climbers and 1 $m^2$ plots (1 m × 1 m) for herbs. The total sample area for each study site was 0.4 ha for tree, 0.05 ha for shrub and climber and 0.01 ha for herbs. Arecanut and non-arecanut trees with diameter at breast height (dbh) ≥5 cm were individually, counted, measured and numbered, and their density, frequency per plot was estimated. The information on the uses and importance of plant species were collected by using questionnaires, focused group discussion, key informant interview, and Participatory Rural Appraisal (PRA) methods as described by Mukherjee (1993).

Data analysis

Plant specimens collected from the two arecanut agroforests were identified with the help of Flora of Assam (Kanjilal et al. 1934–1940) and Flora of Jowai (Balakhrishnan 1981–1983). The identifications were confirmed by consulting the herbaria at Botanical Survey of India, North-Eastern Circle, Shillong. The nomenclatures of the species are as per the regional flora.

Diversity was calculated using the Shannon and Wiener index of diversity ($H^-$) (Shannon and Wiener 1963), Simpson index of dominance (D) (Simpson 1949) and Pielou's evenness index (E) (Pielou 1975). The Shannon index tends to be slanted slightly towards less abundant or rare species, while the Simpson index favours the more abundant or dominant species. The two indices together give a good description of the alpha diversity (within site) of the agroforest. The Pielou evenness index provides information on the distribution of individuals among the species; it is high if all species are about similarly abundant and low if some species dominate in number.

The frequency, density and abundance of the species were determined following the methods of Misra (1968) and Muller-Dombois and Ellengberg (1974). The basal cover ($m^2 \cdot ha^{-1}$) was calculated by using the formula: basal cover (BC) = plant density × average tree basal area (Khan et al. 1997). The importance value index was calculated by using the formula for tree: Importance Value Index (IVI) = relative frequency + relative density + relative basal area, and for shrub and herb: IVI = relative frequency + relative density (Upadhaya 2002). Floristic similarity between the stands was studied by computing Sorensen's index of Similarity (Sorensen 1948) to determine similarities in species composition between the two agroforests. The data on uses of each plant species present in the agroforests are based on the local use.

## Results

In the two agroforests, a total of 160 plant species were recorded out of which 83 were trees, 22 shrubs, 41 herbs and 14 climbers. The approximate age of tree species and arecanut was 15–70 and 12–65 years, respectively. These plant species belonged to 45 families. Euphorbiaceae (11), Moraceae (11) and Arecaceae (8) and Lauraceae (8) were the dominant tree families. The plant species richness, Shannon-Wiener index, Pielou's eveness index and the Simpson index of dominance for the arecanut agroforests are presented in Table 1.

**Table 1. Diversity and community characteristics of plant species of arecanut agroforests of south Meghalaya (values are mean of the two agroforests located in Mawriang and Sohlong villages)**

| Plant species | Sampling size (ha) | Family | Genera | Species richness | Density ($ha^{-1}$) | Basal cover ($m^2 \cdot ha^{-1}$) | Pielou's evenness index | Shannon-Wiener diversity index | Simpson index of dominance |
|---|---|---|---|---|---|---|---|---|---|
| Tree | 0.4 (±0.00) | 36.0 (±2.89) | 65.7 (±6.33) | 83.0 (±5.57) | 1807.33 (±80.83) | 53.95 (±3.02) | 0.7 (±0.11) | 3.5 (±0.30) | 0.1 (±0.03) |
| Shrub | 0.4 (±0.00) | 13.7 (±0.33) | 18.3 (±1.45) | 18.3 (±0.88) | 6527 (±589) | - | 0.8 (±0.17) | 2.8 (±0.05) | 0.1 (±0.01) |
| Herb | 0.02 (±0.00) | 27.0 (±2.31) | 38.0 (±2.31) | 41.3 (±3.53) | 622542 (±114875) | - | 0.9 ( ±0.01) | 3.5 (±0.11) | 0.0 1 (±0.01) |
| Climber | 0.1 (±0.00) | 11.0 (±0.58) | 12.0 (±1.53) | 13.0 (±1.53) | 800.0 (±85.25) | - | 0.8 (±0.01) | 2.1 (±0.07) | 0.1 (±0.02) |

The species name, family, frequency, density and IVI of ten most frequent trees, shrubs, herbs and climbers encountered during the study period are given in Table 2. Both the agroforests have more or less the same type of species with Sorensen index 92% among trees, 89% among shrubs, 92% among herbs and 40% among climbers of the two sites. The one way analysis of variance (ANOVA) between the plant species of the two agroforests showed no significant variation with P-Values (0.994) for trees, (0.954) for shrubs, (0.852) for herbs and (0.938) for climbers. *Cinnamomum tamala, Artocarpus heterophyllus, Cedrela toona* and *Cryptocarya andersoni* were the dominant tree species. Both the arecanut agroforests have high heterogeneous distribution of trees.

Main uses of the plants

The plant species maintained in the agroforests were used for timber, fuelwood, food, medicine, spice, thatch grass, packing leaf and latex. Out of a total 160 species, 114 species were assigned one or the other use by the villagers. This shows that 71.25% of all plants found growing in the agroforests have one or the other uses for the people (Table 3). Naturally growing tree species were managed mainly for timber, fuelwood and edible purposes. In the arecanut agroforests of south Meghalaya, *Cinnamomum tamala, Phrynium capitatum* and *Piper peepuloides* species are high value cash crops. *Cinnamomum tamala* and *Piper peepuloides* were sold mainly outside the state, whereas *Phrynium capitatum* was sold within the state.

Cash income from arecanut

The mean density of arecanut plant in the two villages was found to be 1 565 (±20) stem/ha with an average production of fruits 3 kg/plant/year. The average gross production of fruits were 4 695 kg·ha$^{-1}$·a$^{-1}$ and the gross revenue from arecanut was Rs. 234 750 ha$^{-1}$·a$^{-1}$ (at the rate of Rs.50/kg arecanut, fruiting only once in a year). This amount was much higher than the gross production of other products collected from the agroforests of south Meghalaya, e.g the gross production of Wild Pepper (*Piper peepuloides*)– Rs.175 000·ha$^{-1}$·a$^{-1}$ and Bayleaf (*Cinnamomum tamala*) – Rs.22 500·ha$^{-1}$·a$^{-1}$ (Tynsong 2009).

**Table 2. The 10 most frequent tree, shrub, herb and climber species encountered in the two arecanut agroforests of south Meghalaya (values are mean of the two agroforests are located in Mawriang and Sohlong villages).**

| Tree | Local Name | Family | Use | Frequency | Density | Important Value Index |
|---|---|---|---|---|---|---|
| *Cinnamomum tamala* Fr. Nees. | Latyrpad | Lauraceae | SP | 82.5 (±7.5) | 82.5 (±7.5) | 157 (±45.25) |
| *Artocarpus heterophyllus* Ham. | Sohphan | Moraceae | HVT, E | 72.5 (±7.5) | 72.5 (±7.5) | 531 (±420) |
| *Caryota mitis* L. | Tlai | Arecaceae | LVT | 27.5 (±0.5) | 27.5 (±0.5) | 19 (±1) |
| *Cedrela toona* Roxb. | Bti | Meliaceae | HVT | 28 (±0) | 28 (±0) | 28 (±2) |
| *Cryptocarya andersoni* King. | Sohlyngskuin | Lauraceae | LVT | 20.5 (±2.5) | 20.5 (±2.5) | 12.5 (±1.5) |
| *Schima wallichii* Choisy. | Shyrngan | Theaceae | HVT | 19 (±1) | 19 (±1) | 6 (±0) |
| *Aporosa dioica (*Roxb.) Muell. Arg. | Diengphlang | Euphorbiaceae | HVT | 15.5 (±2.5) | 15.5 (±2.5) | 8.5 (±3.5) |
| *Ficus gibbosa* Blume. | Soh Lapong | Moraceae | HVFW | 16.5 (±1.5) | 16.5 (±1.5) | 27 (±6) |
| *Macaranga peltata* (Roxb.)Muell.Arg. | Kharrong | Euphorbiaceae | HVFW | 19 (±1) | 19 (±1) | 14 (±3) |
| *Toona ciliata* Roem. | Phaniaw | Ochnaceae | LVT | 17.5 (±2.5) | 17.5 (±2.5) | 18.82 (±1.48) |
| **Shrub** | **Local Name** | **Family** | **Use** | **Frequency** | **Density** | **Important Value Index** |
| *Ficus clavata* Wall. | Soh pyrnai | Moraceae | E | 42.5 (±2.5) | 42.5 (±2.5) | 270 (±110) |
| *Cassia floribunda* Clarke. | Not available | Verbenaceae | W | 35 (±0) | 35 (±0) | 140 (±120) |
| *Boehmeria* sp. | Thynrait | Urticaceae | M | 27.5 (±2.5) | 27.5 (±2.5) | 270 (±130) |
| *Flemingea macrophylla* (Willd.) Prain. | Not available | Fabaceae | W | 20 (±10) | 20 (±10) | 220 (±120) |
| *Clerodendron bracteatum* Walp. | Jarem sniang | Verbenaceae | M | 25 (±0) | 25 (±0) | 140 (±120) |
| *Dracaena fragrans* (L.) Ker-Gawl. | Not available | Agavaceae | OR | 30 (±5) | 30 (±5) | 450 (±230) |
| *Ficus hirta* Vahl. | Sohlapong saw | Moraceae | E | 25 (±0) | 25 (±0) | 100 (±60) |
| *Melastoma nepalensis* Lodd. | Soh | Melastromaceae | E | 25 (±0) | 25 (±0) | 700 (±140) |
| *Thysanolaena maxima* (Rozb.)O.Ktze. | Synsar | Poaceae | M | 25 (±0) | 25 (±0) | 490 (±330) |
| *Phrynium capitatum* Willd. | Sla met | Maranthaceae | PL | 62.5 (±2.5) | 62.5 (±2.5) | 1221.5 (±1.5) |
| **Herb** | **Local Name** | **Family** | **Use** | **Frequency** | **Density** | **Important Value Index** |
| *Borreria pilosa* K.Schum | Not available | Rubiaceae | W | 41.5 (±7.5) | 41.5 (±7.5) | 55156.5 (±5968.5) |
| *Crassocephalum crepioides (*Benth.)Moore. | Jalympu | Asteraceae | W | 25 (±6) | 25 (±6) | 14375 (±6625) |
| *Paspalum dilatatum* Pior. | Phlang | Poaceae | W | 27.5 (±1.5) | 27.5 (±1.5) | 28531.5 (±3593.5) |
| *Oplismenus compositus* P.Beauv. | Phlang | Paniceae | W | 29 (±6) | 29 (±6) | 139469 (±40844) |
| *Anthyrium drepanopterum* (Kuntze.)A.Brown. | Tyrkhang sad | Athyriaceae | W | 25.5 (±2.5) | 25.5 (±2.5) | 27188 (±33750) |
| *Cyperus compressus* L. | Phlang | Cyperaceae | W | 30.5 (±7.5) | 30.5 (±7.5) | 16281.5 (±2656.5) |
| *Commelina beghalensis* L. | Phlang | Commelinaceae | W | 20 (±1) | 20 (±1) | 19813 (±2625) |
| *Ageratum conzynoides* L. | Kynbat khla | Asteraceae | M | 23.5 (±5.5) | 23.5 (±5.5) | 80125.5 (±8312.5) |
| *Begonia picta* Sm. | Jajew | Begoniaceae | M, E | 19 (±1) | 19 (±1) | 31312.5 (±62.5) |
| *Drymaria cordata* (L.) Roem.&Schult. | Bat-nongrim | Caryophyllaceae | M | 23 (±5) | 23 (±5) | 29594 (±3406) |
| **Climber** | **Local Name** | **Family** | **Use** | **Frequency** | **Density** | **Important Value Index** |
| *Piper betle* L. | Lakor | Piperaceae | CP | 100 (±0) | 100 (±0) | 2490 (±2050) |
| *Piper peepuloides* Roxb. | Mrid khlaw | Piperaceae | M | 100 (±0) | 100 (±0) | 1150 (±1070) |
| *Merremia hedereaca* (Burm.f.) Hallier.f. | Kynbat kshang | Convolvulaceae | M | 55 (±0) | 55 (±0) | 980 (±0.00) |
| *Calamus gracilis* Roxb. | Ri phin | Arecaceae | C, E | 32.5 (±2.5) | 32.5 (±2.5) | 3300 (±840) |
| *Hemidesmus indicus* (L.) R.Br. | Kynbat kpoh | Asclepiadaceae | M | 32.5 (±7.5) | 32.5 (±7.5) | 550 (±450) |
| *Deoscorea hispida* Dennst. | Phan khlaw | Dioscoreaceae | E | 15 (±5) | 15 (±5) | 250 (±50) |
| *Gynostemma pedata* Blume. | Not available | Cucurbitaceae | W | 17.5 (±2.5) | 17.5 (±2.5) | 540 (±340) |
| *Mikania micrantha* Kunth. | Puji | Asteraceae | M | 22.5 (±7.5) | 22.5 (±7.5) | 2080 (±1200) |
| *Stephania gladulifera* Miers. | Soh lashang | Menispermaceae | M | 15 (±0) | 15 (±0) | 80 (±20) |
| *Calamus latifolius* Roxb. | Ri sniang | Arecaceae | C | 12.5 (±2.5) | 12.5 (±2.5) | 2300 (±2080) |

SP-spice, HVT-high value timber, LVT-low value timber, HVFW-high value fuelwood, E-wild edible, W-no specific use, M-medicinal, OR-ornamental, T-Tool, CP-cash crop, W-no specific use, C-craft, PL-packing leaf

**Table 3. Number of plant species in arecanut agroforests in south Meghalaya according to their main uses**

| arecanut agroforests | The number of plant species | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Timber | Fuelwood | Edible | Medicinal | Tool making | Ornamental | Cash crop | Craft | Thatch leaf | Spice | Packing leaf | Latex producing plant | No specific use | Total |
| Mawriang | 22 | 33 | 19 | 17 | 3 | 3 | 2 | 3 | 1 | 1 | 2 | 1 | 40 | 147 |
| Sohlong | 22 | 31 | 22 | 19 | 3 | 3 | 2 | 5 | 1 | 1 | 2 | 1 | 46 | 157 |
| Both agroforests | 22 | 33 | 22 | 19 | 3 | 3 | 2 | 5 | 1 | 1 | 2 | 1 | 46 | 160 |

## Discussion

### Plant diversity of the arecanut agroforests

The arecanut agroforests harbour substantial plant diversity close to the primary forests of south Meghalaya. The Shannon's diversity index of arecanut agroforest was 3.3 for trees, 2.8 for shrubs, 3.4 for herbs and 2.01 for climbers, which is very similar to Shannon's diversity index of primary forests of south Meghalaya which was 3.9 for trees, 3.5 for shrubs, 3.0 for herbs and 2.2 for climbers (Tynsong 2009). Similarly, the average tree basal cover of arecanut agroforest (53.95±3.02) was also very high and only slightly less than the primary forests of south Meghalaya. For example, the subtropical forests of south Meghalaya had a basal cover of 57.82 $m^2 \cdot ha^{-1}$ (Tynsong 2009), and sub-tropical evergreen forests of Jaintia Hills, Meghalaya had a basal cover of 53.5 $m^2 \cdot ha^{-1}$ (Upadhaya 2002). It has been found that density of tree (1 807 $stem \cdot ha^{-1}$) and shrub (6 527 $stem \cdot ha^{-1}$) in arecanut agroforests was significantly lesser compared to average density of tree (2 005 $stem \cdot ha^{-1}$) and shrub (18 987 $stem \cdot ha^{-1}$) in natural forests of south Meghalaya (Tynsong 2009). Lower tree and shrub density in the arecanut agroforests may be due to the fact that a number of trees and shrubs were felled during the conversion of natural forests to agroforests. However, the density of herb (622 542 $stem \cdot ha^{-1}$) and climber (800 $stem \cdot ha^{-1}$) was much higher in the agroforests as compared to the natural forests (Tynsong 2009). The density of herb was higher in the arecanut agroforests mainly due to lower tree density which provides ample sunlight for light demanding herbaceous plants to grow. Species composition in both the forests is more or less similar.

A comparison between the species richness of arecanut agroforest of south Meghalaya with that of cocoa agroforest in southern Cameroon reflects that the species richness of trees of arecanut agroforest of south Meghalaya was significantly higher (83 tree species) than that of cocoa agroforest in southern Cameroon (21 tree species); however, the species richness of herb was higher in the cocoa agroforest of south Cameroon (48 herb species) than the arecanut agroforest of south Meghalaya (41 herb species) (Sonwa et al. 2007). In arecanut agroforest of south Meghalaya, the plant genera were represented by multiple species contributing to high species richness and diversity of forests. High species richness shows that the traditional agroforestry systems are suitable land use for the edapho-climatic conditions prevailing in the area for conservation of biodiversity. It has been argued that productivity of the system and structural complexity or heterogeneity determines species richness in the community. Though it is difficult to explain the specific reasons of species richness of arecanut agroforests of south Meghalaya, it seemed that favorable climatic condition, unique topography and deliberate mangement of plant species over a long period of time have played a major role in making the community rich in diversity of plants. These arecanut agroforests mimic to some extent natural forests in structure and function (Saha and Azam 2004). Growing arecanut along with diversified native plant species contributes to biodiversity conservation within agricultural landscapes, complementing conservation in protected areas (Schroth et al. 2004). Arecanut agroforests can play a role in conservation strategies in fragmented landscapes by providing habitat and resources for plant and animal species and by maintaining connectivity between forest areas. Although not always recognized by agronomists (Saha and Azam 2004), native and exotic species promoted and maintained in arecanut agroforests have many more uses for local farmers than just providing a suitable microclimate for arecanut trees.

### Utility of plant species associated with arecanut

The high percentage of useful plant species in arecanut agroforests reflects the fact that farmers actively retain or introduce useful plant species into the arecanut agroforests. The preference for useful plant species is understandable in the context that rural people of Meghalaya depend on plant product for food, shelter, medicine and fuelwood (Tiwari et al. 2004). The presence of such trees in arecanut agroforests helps farmers achieve their basic needs for food, health, energy and housing. Motiur et al. (2006) also found that agroforests in Bangladesh supply important forest products like fruit, fuelwood, timber, and bamboo to meet household demands.

Tree species were managed mainly for timber, fuelwood and edible purposes. Tree species which are preferred by local people for timber include *Artocarpus heterophyllus, Cedrela toona, Cryptocarya andersoni, Schima wallichii* and *Aporosa dioica*; the most preferred fuelwood tree species include *Macaranga denticulata, Macaranga hypoleuca, Macaranga peltata, Quercus dealbata* and *Quercus lanceofolia* and important tree species which are managed for edible products include native species like *Aporosa aurea*, *Gynocardia odorata, Garcinia anomala, Garcinia spicata* and a few introduced species like *Litchi chinensis*, *Cocos nucifera* and *Mangifera indica.* The important Non-Timber Forest Product (NTFP) species managed in arecanut agroforests of south Meghalaya include *Cinnamomum tamala*, *Phrynium capitatum* and *Piper peepuloides*. The management of arecanut agroforests for cash crop as well as for other native and exotic plant species for various human needs is similar to cocoa agroforest of south Cameroon as well as agroforestry systems of

West and Central Africa (Sonwa et al. 2007). Here local traditional knowledge plays an important role. These NTFP species besides being source of cash income, also contribute to the structural diversification of the agroforests, which is important for creating habitat for local fauna (birds) and flora (vines, epiphytes) (Sonwa et al. 2007). Farmers continue to rely on medicine from their agroforests. A total of 19 plant species were managed in these agroforests for curing different ailments. Tradition of health care based on folk medicines is widespread and popular in Meghalaya. The tribal communities are very knowledgeable about the wild medicinal plants and depend on the herbal product for treatment of most of their common ailments and diseases (Tiwari et al. 2004).

## Conclusion

This study elucidates the multiple purposes served by arecanut agroforests of south Meghalaya. It also revealed that though arecanut was the principal crop; other plant species contribute to the livelihood of local people in many ways such as source of food, construction materials, medicines and cash income. We found that many potentially valuable NTFP and timber species from the local forest flora grow well in arecanut agroforests. We conclude that these agroforestry systems, though managed mainly for arecanut as cash crop, yet serve as home for many NTFPs and habitat for wild native plants.

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