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Probable Agricultural Biodiversity Heritage Sites in India: V. The Garo, Khasi, and Jaintia Hills Region

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Abstract

The Garo, Khasi, and Jaintia Hills region, with its unique landscape, climatic phenomenon of heavy cloud cover and torrential rainfall, and agricultural richness involving the majority of the population, has been proposed as another National Agricultural Biodiversity Heritage Site based on six indices. The region is very rich in floristic and agricultural biodiversity, because being part of one of the biodiversity hotspots, the Indo-Burma Region, supporting cultivation of a large number of domesticated species using appropriate practices, innovated indigenously, facilitating harmonious interaction with the landscape. It can be credited with development of the shifting cultivation system, which has been the next step in the evolution of agriculture, from 'domiculture', using the concept of "farming the forests". Further, it has to its credit the development of the practice of the "sacred grove", which essentially is the management of the forest with sustainable conservation of biodiversity, and can be considered as the mother of all the approaches proposed on "nature reserves" (in-situ conservation). Culturally, the region is inhabited by the two dominant local tribes, Khasi and Jaintia, who are predominantly Christians, but with the strong influence of Aryan culture and Hindu religion, the basis of several practices and the composite culture that is followed. For example, the unique system of matrilineal inheritance possibly evolved for better and prolonged care of parents by the youngest daughter of the family. The present article discusses these and several other aspects of the region in detail, justifying the proposition of the Heritage Site.

The three hilly regions – Garo Hills, Khasi Hills, and Jaintia Hills – representing the Western, Central, and Eastern parts of the state of Meghalaya, are agriculturally unique. The name *Meghalaya* literally means the 'Abode of the clouds', describing the unique climatic phenomenon that brings torrents of rain to this region. Agriculture in this region is the main occupation, with 83% of the total population being dependent on it for their livelihood. The region can be credited with the development of the shifting system of cultivation, which in the evolution of agriculture, is a transition from the initial

'domiculture'. Under this system, economically selected plant species and crop cultivars are being grown in concentration in agricultural plots, made out of cleared forest, as a part of multi-species complex agroecosystem, and overall landscape organization (Ramakrishnan, 1992). The shifting agriculture is essentially "farming the forests" and is the next important step in the socio-ecological evolution of agriculture from 'domiculture' (Singh and Varaprasad, 2008). Further, the ecological diversity of the region has permitted cultivation of a large number of field and more so horticulture crops. This has led to the evolution of a wide spectrum of genetic variability in these crops for various traits. The crop diversity has also been enriched with the introduction, acceptance, and adoption of new crops from outside, such as the potato, which is playing a major role in the economy of the region. Many more crops are being adopted in recent times. In potato, the local farmers have also developed several in-situ and ex-situ methods for storage to facilitate year-round market supply as per the demand and avoid losses in storage (Sah and Kumar, 2008). Similarly, to capture water in the difficult undulating hilly terrain and to facilitate its efficient use, the local people have developed ingenious bamboo drip irrigation technology, which might have been the source of thought in the development of the present-day drip irrigation system practiced globally.

Culturally, the region has been influenced by races of Indo-Mongolic and Austric origin and by Hindu and lately Christian religions. They have made great impact both on social and agricultural practices. The occurrence of a number of sacred groves, untouched by humans is entirely due to the tireless efforts of the communities of the region who can be credited with the development of this unique concept of forest management. The sacred groves have been able to preserve the biological diversity of the region – which otherwise might have vanished from the surrounding areas – contributing significantly to the in-situ conservation of economically important plant biodiversity (Roy and Tomar, 2000) of the region. This happened under the influence of Hindu culture, which preaches respect for forests under the belief that our culture was born and nourished by the forest, and that human survival is dependent on the continued existence of forests. In the Vedic era, men were taught to revere *Vanaspati*, the Lord of the Forest, celebrated in many hymns. Therefore, it is quite logical to conclude that the way these protected forests were created, managed, and developed, probably led to the development of the modern scientific concept of nature reserves, protected areas, parks, wild life sanctuaries, etc. (Singh, 2002). Another unique cultural feature of the region is the development of social customs, of the matriarchal law of inheritance, by which custody to property and succession of family position passes from the mother to the youngest daughter

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(instead of passing to the son, as is the more common practice worldwide), to secure better and prolonged care of the parents in old age. These unique features, qualify the region to be proposed as another Agricultural Biodiversity Heritage Site as per the indices suggested by Singh and Varaprasad (2008). Nevertheless, identification of actual epicenter/site(s) of these unique features/systems needs to be explored.

Location and extent

The Khasi, Jaintia, and Garo Hills are geographically located in the area that lies 26°0' to 26°10' N and 89°45' to 92°45' E. These hills have significant variation in altitude. Basically, the Meghalaya plateau is a table land with the altitude varying from 610 m to 1,950 m, with its Shillong Peak at 1,950 m above mean sea level. The hill ranges are undulating in nature with an east-west orientation, with the Surma ravines and small rivulets separating them. The three hilly regions – Garo, Khasi, and Jaintia Hills – constitute the state of Meghalaya, representing Western Meghalaya, Central Meghalaya, and Eastern Meghalaya, respectively. However, the state comprises seven districts: East Garo Hills, West Garo Hills, South Garo Hills, East Khasi Hills, West Khasi Hills, Jaintia Hills, and Ri-Bhoi. The influence of this agricultural biodiversity heritage site extends to most districts covering all hills of Meghalaya. The Meghalaya state is bounded by Assam in the north and the east, and the plains of Bangladesh in the south and the west (Fig. 1).

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Landscape

The landscape of the region is mostly rolling plateau with extremely steep south-facing slopes. With the hills rising to 1,950 m, the region remains cool despite its proximity to the tropics. The region reveals a wonderful fairyland of great scenic beauty, a panorama of lush, undulating hills, fertile valleys, meandering rivers, waterfalls, sparkling mountain streams, lakes, etc., beautifully ornamented with the natural occurrence of 250 species of orchids. The Khasi and Jaintia Hills form the central and eastern part of Meghalaya, an imposing plateau with rolling grassland, hills, and river valleys. The southern face of the plateau is marked by deep gorges and abrupt slopes, at the foot of which a narrow strip of plain land runs along the international border with Bangladesh. The Garo Hills have many caves and lakes. There are no navigable rivers in the region, though small boats can ply in a few streams on the lower slopes. All the principle rivers in the State run either in a northerly or in a southerly direction and join the Brahmaputra or its tributaries. Around 30% of the total land in Meghalaya is under forest cover. One of the unique features of the landscape is the occurrence of numerous sacred groves found all over

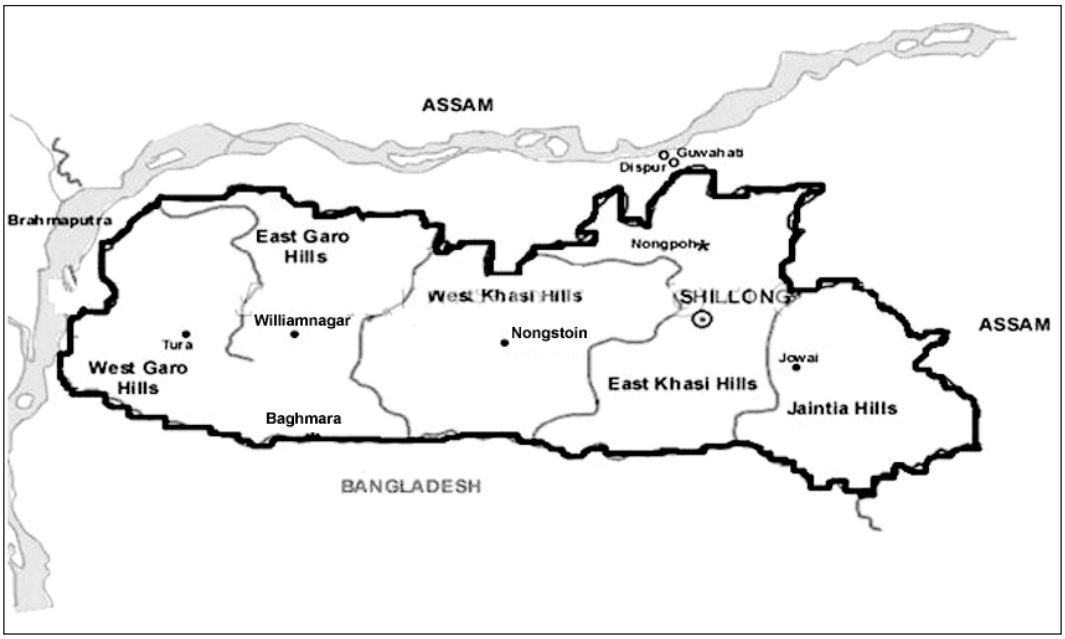

Figure 1. Location and extent of the Garo, Khasi, and Jaintia Hills.

the region, which are untouched and protected by the local communities. These groves of plantations are considered sacred by the Khasis. The sacred groves commonly comprise mixed evergreen forest with oak, rhododendrons, species of *Schima* (an attractive genus of evergreen trees), and cinnamon (small evergreen tree). These groves contain a number of orchids and epiphytes, which, sometimes form a rich outgrowth of bushes and cover the trees. At a distance, rings of indigenous pines are found surrounding the groves, like protective hedges.

Agroclimate

The Khasi, Jaintia, and Garo Hills constitute a warm perhumid ecoregion with red and lateritic soil, as in other northeastern hills. The climate is characterized by warm summers and cold winters, and is greatly influenced by the region's topography. The sudden rise of hills in the south across the region is responsible for heavy rainfall. The annual rainfall varies from 1,600 to 2,600 mm, with potential evapotranspiration (PET) between 1,400 and 1,600 mm, leading to (moist-perhumid) moisture regimes throughout the year (Sehgal *et al.*, 1992). The region is directly influenced by the southwestern monsoon that originates in the Bay of Bengal. The monsoon begins in May and continues until October, bringing torrential rains. The rainfall pattern varies from place to place, and from altitude to altitude. There is a perceptible variation in rainfall within the region from south to north. Two villages in the southern part of this region have vied with each other for the world's highest rainfall record: Cherrapunjee (now known as Sohra) and Mawsynram. During the last two decades, rainfall at

Cherrapunjee ranged from 11,995 to 14,189 mm, and at Mawsynram, from 10,689 to 13,802 mm. The mean temperature ranges from 16 to 24°C. The summer lasts about 5 months, from May to September. Therefore, the growing period extends up to 270 days. The region may experience dry spells only in the post-monsoon period from November to April. Winter begins in December and lasts until February. The higher ranges of Khasi and Jaintia Hills enjoy a more salubrious Mediterranean type of climate.

The soils are reddish and lateritic in origin, and vary from shallow to very deep sandy loam, red and yellow loam to clayey loam soils. The major soils in the area include shallow to very deep loamy red and yellow soils. They are acidic and are low in phosphorus (Sehgal *et al.*, 1992). The variation in agroclimate has contributed to the evolution of significant genetic diversity in crops and other economically important plant species, along with diverse agricultural practices to overcome various constraints.

Floristic diversity

This region is a part of the Indo-Burma Biodiversity Hotspot, which has a wide variety of ecosystems, flora, and fauna and is very rich in floristic diversity with an estimated 7,000 native plant species. Of these, 3,331 floral species have been recorded from Meghalaya, of which 1,236 (37.11%) are endemic (Khan *et al.*, 1997). Nature has bestowed Meghalaya with unique vegetation, ranging from tropical and subtropical, to temperate or near temperate types. In general, the region is richly endowed with natural vegetation, which mostly comprises wet evergreen and tropical moist deciduous forests. The vegetation comprises floristic elements of Indo-Burma, Eastern Himalaya, and Peninsular India. The natural vegetation is classified into the following forest types: (1) ***Tropical evergreen and semi-evergreen forest***, with the dominant species *Castanopsis indica* (Roxb.) A.DC., *Bischofia javanica* Blume, *Tetrameles nudiflora* R.Br., *Elaeocarpus floribundus* Blume, *Firmiana colorata* (Roxb.) R.Br.; (2) ***Tropical moist and dry deciduous forest***, with dominant species such as *Albizia lebbeck* (L.) Benth., *Shorea robusta* A.DC., *Toona ciliata* M.Roem.; (3) ***Subtropical pine forest***, with *Pinus kesiya* Royle ex Gordon, *Schima wallichii* Choisy, *Lyonia ovalifolia* Hort.; (4) ***Temperate forest***, with *Lithocarpus fenestratus* Rehder, *Quercus griffithii*

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One of the unique features of the landscape is the occurrence of numerous sacred groves found all over the region, which are untouched and protected by the local communities.

Hook.f. & Thomson ex Miq., *Schima khasiana* Dyer, *Betula alnoides* Buch.-Ham., *Pinus kesiya* Royle ex Gordon; and (5) ***Bamboo forest***, with *Bambusa tulda* Benth., *Bambusa pallida* Munro, *Melocanna baccifera* Skeels, *Dendrocalamus hamiltonii* Nees & Arn. ex Munro.

Most of the hills are covered with mixed evergreen sal forest, bamboo jungle and canes in some parts of the area. The northern hills facing the Brahmaputra valley have tropical vegetation. The important trees are *sam* (*Artocarpus chaplasha* Roxb.), sal (*Shorea robusta*), *gomari* (*Gmelina arborea* Roxb.), siris (*Albizia* Durazz spp.), and teak (*Tectona grandis* L.f.). The floristic diversity has further been enriched and beautified by orchid species diversity. Of the total orchids found in the world, about 1,250 exist in India; about 700 species of these are distributed in the northeastern states, of which about 300 are found in Meghalaya.

The Khasi-Jaintia Hills function as a corridor of the southeast Asian floristic elements into the Indian subcontinent through the Arakan arc. The altitudinal variation and rainfall patterns of the southwest and northeast monsoons play a significant role in the development of diverse ecological niches in this region. The Khasi Hills region encompasses more than 2,000 flowering plants in a radius of 15 km from Cherrapunjee. Of these, around 150 are ferns with a profusion of mosses, fungi, and lichens, more than 250 species of orchids, 25 species of balsams, 20 species of palms, and 150 species of grasses. Wild species of apples and rhododendrons are found in the higher parts of the central plateau. In the upper hills from 1,500 m and above, in the central plateau of the Khasi Hills, coniferous vegetation, such as pines, oaks, and ferns are found. This makes it a distinct and interesting natural vegetation belt, the like of which cannot be found anywhere in the country in a single region. This ecological variation has produced a significant amount of natural genetic diversity in most economically important plant species. Efforts have been made to conserve this useful variability in-situ with the establishment of sanctuaries in the Tura range of the Garo Hills for the conservation of rich native diversity of wild *Citrus* L. and *Musa* L. species.

The variation in agroclimate has contributed to the evolution of significant genetic diversity in crops.

Agriculture and agrobiodiversity

The hilly landscape of the region, which is characterized by elevated ranges, foothills, and valleys, has less than 10% of the geographical area under cultivation, although agriculture is the main occupation, with 83% of the total population dependent on agriculture for their livelihood. Slopes are broadly used for horticulture. Due to its peculiar topography and richness in horticulture biodiversity, the people of the region depend more on such sectors as

forestry, horticulture, and animal husbandry than on traditional agriculture. For this reason, the indigenous farming systems of the region have a traditional base of forestry, and the local tribes have developed farming systems in which trees and crops are grown together to meet the household needs on a sustainable basis. Therefore, most of the traditional farming practices, besides agroforestry, revolve around silviculture, the science and art of cultivating forest crops, based on the knowledge of the life history and general characteristics of forest trees and horticulture, resulting in the development of systems, such as agri-silviculture, agri-horticulture, silvi-horticulture, pastoral-silviculture, and pastoral-horticulture. It includes mixed farming, which sometimes may include even medicinal plants along with crop or tree species.

Shifting cultivation, involving slashing and burning of sites followed by cultivation of a number of diverse species to meet diverse needs (Fig. 2) and terrace (*bun*) agriculture are the two major farming systems prevalent

Figure 2. Burning of slashed site for *jhum* cultivation.

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in the region. Cultivation of economically important species in the indigenous shifting system called *jhum* has been the traditional way of farming, which is now being replaced with scientific methods, bringing lands under permanent cultivation. However, the Jaintias of the North Cachar Hills district still depend on traditional *jhum* or slash-and-burn cultivation. *Jhum* is a major component of the larger agroecosystem. It comprises agriculture, forestry, hunting, and fishing, and is a land-use system based on a traditional, year-round, community-wide, self-contained, and ritually sanctioned way of life. The Garos have more efficient slash-and-burn agriculture and animal husbandry systems compared with the others, who have more dependence upon the forest for food. Additionally, the local people make sustainable use of other available natural resources that include bamboo, cane, pine, and trees, such as *Artocarpus heterophyllus* Lam. (jackfruit), *A. chama* Buch.-Ham. (syn. *A. chaplasha* Roxb.; wild jackfruit), *A. lakoocha* Roxb. (monkey jack), *Garcinia* spp., *Licuala peltata* Roxb. ex Buch.-Ham. (palm), *Caryota urens* L. (toddy palm), *Mangifera indica* L. (mango), *Sapindus mukorossi* Gaertn. (soap nut), *Tectona grandis* L.f. (common teak),

The Khasi Hills region encompasses more than 2,000 flowering plants in a radius of 15 km from Cherrapunjee.

Toona ciliata M.Roem. (red cedar), *Cassia siamea* Lam. (senna – medicinal), etc., for different purposes.

Jhum has progressed to tree-based organized farming systems prevalent in the region. The crops are grown in association with such tree species as alder (*Aquilaria* Lam.), areca-nut, coconut, bamboo, Khasi pine, etc. Due to the undulating topography and hilly terrain, to support these cultivations, the farmers predominantly use indigenously developed bamboo drip irrigation technology (Fig. 3). Bamboo species such as *Phyllostachys bambusoides* Siebold & Zucc. and *Dendrocalamus hamiltonii* Nees & Arn. ex Munro are cultivated for the construction of houses and other domestic uses.

Figure 3. Ingenious bamboo drip irrigation, trapping and carrying water to the field.

Rice and maize are the major food crops, and are commonly cultivated in the valleys and in terraces on the hills. Other crops grown are pea, nigerseed, and rapeseed/mustard. The common crop rotations are rice–mustard, rice–pea, rice–vegetable, rice–cotton, rice–food crop, maize–mustard, and nigerseed–mustard. The harvesting of crops adds a new dimension towards improvement of soil fertility. In addition, commercial crops such as jute, mesta (*Hibiscus* spp.), short-staple cotton, ginger, and turmeric are also grown in diverse combinations and systems. Adding new dimension to crop harvest, the farmers harvest only the earheads and leave other plant parts on the cultivated land to decompose/recycle and contribute to the sustenance of soil fertility. The farmers store grains in structures made of soil and plant materials. The seed storage structures are traditional and insect-proof.

The important fruit crops are oranges (Khasi mandarins), pineapple, lemon, guava, litchi, jackfruit, while banana, *tezpatta* (bay-leaf), areca-nut, betel leaf, and black pepper are the chief plantation crops grown under diverse systems. Displaying acceptance to new crops and technology from other regions/parts of the world, the region, in the recent past has successfully adopted the cultivation of non-traditional crops such as tea and cashewnut in plantation; wheat and oilseeds, such as groundnut, soybean, and sunflower in field crops; tomato in vegetables; and mushroom in household/home gardens. Mixed farming/cropping is also practiced involving a number of species, facilitating management of tree species and providing food and raw material to meet other needs (Fig. 4).

Figure 4. Multiple mixed farming and intercropping facilitating tree management.

Potato (*Solanum tuberosum* L.), an introduced crop, is one of the most important crops grown in the hilly regions of Meghalaya. An indigenous and traditional method of land preparation – locally called *Nur Bun* – for potato cultivation is practiced. "*Nur*" is the agricultural land unit in the local Khasi language, and refers to one raised bed, which is usually 1–1.25 m wide and 2–7 m long (Shantanu Kumar Dubey and Sah, 2009).

The Pnar tribe of the Jaintia Hills district, whose main occupation is agriculture, even today uses plant species – such as *Butea buteiformis* (Voigt) Grier. & Long, *Castanopsis indica* A.DC., *Castanopsis tribuloides* (Sm.) DC., *Phoenix humilis* Royle ex Becc. & Hook.f., *Pinus kesiya* Royle ex Gordon, *Quercus serrata* Thunb., and *Schima wallichii* Choisy – as indicators for systematizing the steps they follow season-wise for achieving the best productivity of rice and other agricultural crops. Each plant indicator is provided with a vernacular name, the relevant plant parts indicative of the agricultural seasons and their significant role in agricultural productivity.

The Garos have more efficient slash-and-burn agriculture and animal husbandry systems compared with the others ...

Representative plant species in various crop groups

Cereals and pseudocereals. *Coix lacryma-jobi* L. var. *ma-yuen* (Romaner) Stapf ex Hook.f. (soft-shelled forms), finger millet (*Eleusine coracana* Gaertn.), foxtail millet [*Setaria italica* (L.) P.Beauv.], grain amaranth (*Amaranthus hypocondriacus* L.), maize (*Zea mays* L.), rice (*Oryza sativa* L.), and wheat (*Triticum aestivum* L.).

Legumes and oilseeds. Black gram [V*igna mungo* (L.) Hepper], castor (*Ricinus communis* L.), groundnut (*Arachis hypogaea* L.), nigerseed [*Guizotia abyssinica* (L.f.) Cass.], pea (*Pisum sativum* L.), pigeonpea [C*ajanus cajan* (L.) Millsp.], rapeseed/mustard (*Brassica* L. spp.), ricebean [*Vigna umbellata* (Thunb.) Ohwi & H.Ohashi], sesame (*Sesamum indicum* L.), soybean (*Glycine max*), and sunflower (*Helianthus annuus* L.).

Fiber and forages. *Boehmeria macrophylla* Siebold & Zucc. (fiber), jute (*Corchorus capsularis* L.), tossa jute (*Corchorus olitorius* L.), mesta (*Hibiscus cannabinus* L., *H. sabdariffa* L.), short-

staple cotton (*Gossypium hirsutum* L.), and *Trema orientalis* (L.) Blume (strings are made from the bark).

Vegetables and tuber crops. Aroid (*Alocasia acuminata* Schott), bitter gourd (*Momordica charantia* L.), brinjal (*Solanum melongena* L.), cabbage (*Brassica oleracea* L. var. *capitata* L.), cauliflower (*B. oleracea* L. var. *botrytis* L.), *kakrol* [*Momordica cochinchinensis* (Lour.) Spreng.] and *kartoli* (*M. dioica* Roxb. ex Willd.) in the Garo Hills (Ram *et al.*, 2002), *meetha karela* (*Cyclanthera pedata* Schrad.), *Flemingia vestita* Benth. ex Baker – a root crop of the Khasi Hills, pointed gourd (*Trichosanthes dioica* Roxb.), potato (*Solanum tuberosum* L.), radish (*Raphanus sativus* L.), *soh-phlanh* (*Pueraria tuberosa* DC.) – tubers are edible, sponge gourd (*Luffa cylindrica* M.Roem., *L. graveolens* Roxb.), *sural* [*Pueraria montana* (Lour.) Merr. var. *chinensis* (Ohwi) Maesen & Almeida ex Sanjappa & Pradeep] – roots are edible, taro [*Colocasia affinis* Schott, *C. fallax* Schott, *C. esculenta* (L.) Schott], tomato (*Lycopersicon esculentum* L.), white yam (*Dioscorea alata* L.), and yam (*Dioscorea pentaphylla* L. var. *hortorum*, *D. prazeri* Prain & Burkill, *D. trinervia* Roxb. ex Prain & Burkill). Additionally, edible bamboos are cultivated, such as *bans kaban* (*Dendrocalamus hamiltonii* Nees & Arn. ex Munro; giant bamboo) – young shoots are edible, *Melocanna baccifera* Skeels, and *Bambusa balcooa* Roxb. – cooked as vegetable.

The important fruit crops are oranges (Khasi mandarins), pineapple, lemon, guava, litchi, jackfruit, while banana,* tezpatta *(bay-leaf), areca-nut, betel leaf, and black pepper are the chief plantation crops grown under diverse systems.

Spices. *Ajwain* (*Trachyspermum khasianum* H.Wolff), *ladja goah* (*Alpinia malaccensis* Roscoe) – yields oil, bay-leaf/ *tezpatta* (*Cinnamomum tamala* T.Nees & Eberm., *Cinnamomum pedunculatum* J.Presl var. *angustifolium*, *C. pauciflorum* Nees), Bengal cardamom (*Amomum aromaticum* Roxb.), black pepper (*Piper nigrum* Beyr. ex Kunth, *P. khasianum* C.DC.), ginger (*Zingiber officinale* Rosc., *Z. capitatum* Roxb.), *tirphal* or *chirphal* (*Zanthoxylum rhetsa* – also medicinal), and turmeric (*Curcuma domestica* Val.).

Fruits. *Clausena excavata* Burm.f., *Docynia indica* Decne., *Docynia hookeriana* Decne. – the fruits are edible fresh and in pickles, as well as in jelly preparations, *Eriobotrya angustissima* Hook.f., ginger citrus (*Citrus assamensis* S.Dutta & S.C.Bhattacharya), guava (*Psidium guajava* L.), jackfruit (*Artocarpus heterophyllus* Lam.), *khachur* (*Cornus macrophylla* Wall.), Khasi *papeda* (*Citrus latipes* Tanaka), Khasi black currant (*Antidesma khasianum* Hook.f.), lemon [*Citrus lemon* (L.) Burm.f.], litchi (*Litchi chinensis* Sonn.), mandarin (*Citrus reticulata* Blanco), mango (*Mangifera indica* L.), mangosteen (*Garcinia xanthochymus* Hook.f., *G. atroviridis* Griff. ex T.Anderson, *G. pedunculata* Roxb. ex Buch.-Ham.) – large

fruits used in curries, and as substitute for lemon, *G. sopsopia* (Buch.-Ham.) Mabb. – stem used as a rootstock for mangosteen, *G. stipulata* T.Anderson, Melanesian *papeda* [*Citrus macroptera* Montrouz. (syn. *C. papuana* F.M. Bailey), *C. aurantium* L. subsp. *saponacea* Saff.], monkey jack (*Artocarpus lakoocha* Roxb.), orange [*Citrus sinensis* (L.) Osbeck], passion fruit (*Passiflora edulis* Sims.), peach [*Prunus persica* (L.) Batsch], pear (*Pyrus communis* Durieu), persimmon [*Diospyros lancifolia* Roxb., *D. nigrescens* (Dalzell) C.J.Saldanha], pineapple [*Ananas comosus* (L.) Merr.], plum (*Prunus domestica* L.), pumello [*Citrus maxima* (Burm.) Merr.], red bayberry (*Myrica rubra* A.Chev.), *soh-khlur* (*Elaeagnus pyriformis* Hook.f.), sour orange (*Citrus aurantium* Linn.), *taranj* (*Citrus medica* L.), and evergreen dogwood [*Benthamidia capitata* (Wall.) Hara, syn. *Cornus capitata* Wall.].

Beverages and other plantation crops. Areca-nut (*Areca catechu* L.), betel-vine (*Piper betle* L.), cashewnut (*Anacardium occidentale* L.), coffee (*Coffea khasiana* Hook.f.), plantain (*Musa acuminata* Colla), sugarcane (*Saccharum officinarum* L., *Saccharum* L. spp.), and tea (*Camellia sinensis* Kuntze var. *assamica*).

Timber. Hollock (*Terminalia myriocarpa* van Heurck & Muell.-Arg.), hollong (*Dipterocarpus macrocarpus* Vesque), *Mesua ferrea* L., *Artocarpus chaplasha* Roxb., Khasi pine (*Pinus kesiya* Royle ex Gordon), chir pine (*Pinus roxburghii* Sarg.), red cedar (*Toona ciliata*), *Schima indica*, *Castanopsis indica* A.DC., teak (*Tectona grandis*), and sal (*Shorea assamica* Dyer).

Bamboos and canes. Biswas (1988) has reported 36 species of bamboo belonging to 14 genera from Meghalaya. The important clump-forming species include *Dendrocalamus strictus* (Roxb.) Nees (syn. *Bambusa stricta* Roxb.), *D. hamiltonii* Nees & Arn. ex Munro, *Bambusa arundinacea* (Retz.) Willd., *B. pallida* Munro, *B. tulda* Roxb., whereas *Melocanna bambusoides* Trin. is the important non-clump forming species. Other important species are *Arundinaria clarkei* Gamble ex Brandis, *A. falcata* Nees, *A. gracilis* (Hort. ex Riv.) Blan., *A. griffithiana* Munro, *A. hirsuta* Munro, *A. khasiana* Munro, *A. mannii* Gamble, *A. polystachya* Kurz ex Gamble, *A. prainii* Gamble, *Bambusa jaintiana* R.B.Majumdar, *B. khasiana* Munro, *B. pseudopallida* Majumdar, *Chimonobambusa callosa* Nakai, *Decalepis hamiltonii* Wight & Arn., *Dendrocalamus calostachys* (Kurz) Kurz, *D. sikkimensis* Gamble ex Oliv., *Drepanostachyum khasianum* (Munro) R.B.Majumdar, *D. polystachyum* (Kurz ex Gamble) Ohrnb., *Melocalamus gracilis* W.T.Lin, *M. indicus* R.B.Majumdar, *Neomicrocalamus clarkei* (Gamble ex Brandis) R.B.Majumdar, *N. mannii* (Gamble) Majumdar, *N. prainii* (Gamble) Keng f., *Phyllostachys assamica* Gamble ex Brandis, *P. bambusoides* Siebold & Zucc., *P. mannii* Gamble., *P. nigra* (Lodd. ex Lindl.) Munro, *Pseudotenanthera albociliata* (Munro) R.B.Majumdar, *Racemobambos prainii* (Gamble) Keng

f. & T.H.Wen, *Schizostachyum dullooa* (Gamble) R.B.Majumdar, *S. helferi* (Munro) Majumdar, *S. polymorphum* (Munro) R.B.Majumdar, *Sinarundinaria falcata* (Nees) Chao & Renvoize, *S. griffithiana* (Munro) Chao & Renvoize, *S. hirsuta* (Munro) Chao & Renvoize, *S. polystachya* (Kurz ex Gamble) Chao & Renvoize, and *Teinostachyum helferi* (Munro) Gamble.

Medicinal plants. The report of the State Level Planning Committee, Meghalaya lists 850 species of medicinal plants, 377 of which are used by 70–80% of the State's population for primary health care (http://megforest.gov.in/activity_medic_plants.htm). Some representative species are *Achyranthes aspera* L., *Acorus calamus* L., *Aegle marmelos* (L.) Corrêa ex Roxb., *Arisaema jacquemontii* Blume, *Aristolochia tagala* Cham., *Asparagus racemosus* Willd., *Baliospermum micrathum* Muell., *Catharanthus roseus* (L.) G.Don, *Centella asiatica* (L.) Urban, *Cinnamomun bejolghota* (Buch.-Ham.) Sweet, *C. tamala*, *Clerodendrum serratum* (L.) Moon, *Costus speciosus* Sm., *Curcuma longa* L., *C. zeodoria* Rosc., *Cuscuta reflexa* Roxb., *Dioscorea alata* L., *Eryngium foetidum* Walter, *Fagopyrum dibotrys* (D.Don) Hara, *Gloriosa superba* L., *Gynocardia odorata* R.Br., *Houttuynia cordata* Thunb., *Hedychium spicatum* Sm., *kayaphal* (*Myrica esculenta* Buch.-Ham. ex D.Don), *Lycopodium clavatum* L., *Nepenthes khasiana* Hook.f., *Ocimum sanctum* L., *Oxalis corymbosa* L., *Panax pseudoginseng* Wall., *Piper longum* L., *P. nigrum* L., *Plantago ovata* Forsk, *Plumbago zeylanica* L., *Scroporia dulcis* L., *Solanum khasianum* C.B.Clarke, *Swertia charayita* (Roxb. ex Flem.) Karst., yew (*Taxus baccata* L.), *Terminalia chebula* Retz., *Viburnum foetidum* Wall., *Zanthoxylum armatum* Druce, etc.[1]

Ornamentals. About 300 ornamental species are found in the rich forestland, gardens and nurseries of Meghalaya. Amongst the State's rare species are the insect-eating pitcher plant and pygmy lily. The highest numbers of orchid species are located in Mawsmai and Mawmluh villages. En route to Cherrapunjee, the forest at Sohrarim is a botanist's paradise. Blessed with different climatic conditions, the region boasts a variety of plants, from the rhododendron forest (Shillong Peak) to the insectivorous pitcher plants found both in the Jaintia and the Garo Hills. Meghalaya is home to about 300 known orchid species of the 17,000 species of orchids found in the world (http://megtourism.gov.in/flora.html). Some representative ornamental species are *Corybas purpureus* Joseph & Yog., *Corylopsis himalayana* Griff. (flowers used as pot herb), *Cypripedium himalaicum* Rolfe, *Goodyera recurva* Lindl., butterfly lily (*Hedychium aurantiacum* Wall.), white ginger lily (*Hedychium coronarium* J.Koenig), *H. ellipticum* Sm., *H. elwesii* Baker, *H. hookeri* C.B.Clarke ex Baker, *H. radiatum* A.S.Rao & Hajra, *H. robustum* A.S.Rao & Hajra, *H. spicatum* Sm.), *Hypericum*

1. For recent information, see Base Line Information on Medicinal Plants Conservation and Sustainable Use (sponsored by UNDP/GEF, MoEF, Government of India and coordinated by Foundation for Revitalisation of Local Health Traditions (FRLHT), Bangalore).

hookerianum Wt. & Arn. var. *lobbii* (N.Robson) S.N. Biswas, *Impatiens depauperata* Hook.f., *I. formosa* Hook.f., *I. khasiana* Hook.f., *I. striloba* Hook.f., *Jejosephia pusilla* (Joseph & Deka) A.N. Rao & K.J. Mani, *Liparis assamica* King & Pantl., *Nepenthes khasiana* Hook.f., *Paphiopedilum hirsutissimum* Pfitzer, *P. insigne* Pfitzer, *P. venustum* Pfitzer, *Pennilabium proboscideum* A.S. Rao & Joseph, *Thrixspermum muscaeflorum* var. *muscaeflorum* A.S. Rao & Joseph, voodoo lily (*Amorphophallus bulbifer* Blume), etc.

Multipurpose species. *Alnus nepalensis* D.Don. (used in making boxes, in light construction, as firewood, for erosion control and nitrogen fixation), *rudraksha* tree (*Elaeocarpus floribundus* Blume – fruits edible and medicinal; *E. lancifolius* Roxb. – seeds used as beads in rural areas), *Chrysanthemum coronopifolium* Vill. (ornamental, insecticidal), *Solanum sisymbrifolium* Lam. (native of Africa, grown for vegetable and medicine). Many orchids have been used as medicinal agents by the tribals. For example, the juice from cut leaves of *Cymbidium giganteum* Sw. is used by the Khasis for clotting blood.

Wild relatives of crop plants. *Amomum aromaticum* Roxb., *Amorphophallus bulbifer* Blume, *Camellia caudata* Wall., *Citrus indica* Tanaka, *Citrus latipus* (Sw.) Tanaka (Khasi *papeda*), *Citrus macroptera* Montr. (Melanesian *papeda*), *Citrus medica* Linn. (*turanj*), *Coffea fragrans* Wall., *C. jenkinsii* Hook.f., *C. khasiana* Hook.f., *Corchorus capsularis* L. (wild forms), *Cucumis hystrix* Chak., *Curcuma amada* Roxb., *Digitaria cruciata* (Nees ex Steud.) A. Camus, *Dioscorea hispida* Dennst., *Fragaria nilgerrensis* Schlecht., *Luffa graveolens* Roxb., *Mangifera khasiana* Pierre, *M. sylvatica* Roxb., *Momordica macrophylla* Gage, *M. subangulata* Blume, *Mucuna bracteata* DC., *Musa flaviflora* Simmonds (syn. *M. thomsoni* King ex Cowan), *M. assamica* G.Mann. ex Baker, *M. sikkimensis* Kurz, *M. superba* Roxb. [syn. *Ensete superba* (Roxb.) Cheesman], *M. velutina* H.Wendl. & Drude, *Narenga fallax* (Palansa) Bor. (syn. *Saccharum longifolium* Munro ex Benth., *Phoenix dactylifera* L., *Piper attenuatum* Herb. ex Link, *P. cornilimbum* C.DC., *P. khasianum* C.DC., *P. oldhamii* C.DC., *Prunus arborea* (Blume) Kalkman, *P. cornuta* Wall., *P. nepalensis* K.Koch, *P. wallichii* Steud. (syn. *P. acuminata* Dietr non Michx), *Pyrus pashia* Ham. ex D.Don, *P. pyrifolia* Nakai, *Rosa gigantea* Collett ex Crép., *R. longicuspis* Bertol., *Rubus ellipticus* Smith, *R. moluccanus* Linn., *R. paniculatus* Smith, *R. rosaefolius* Smith, *Setaria pallide-fusca* (Schumach.) C.E.Hubb., *Solanum khasianum* C.B.Clarke, *S. kurzii* Brace ex Prain, *Trichosanthes himalensis* C.B.Clarke var. *himalensis*, *T. khasiana* Kundu, *T. wallichiana* Wight, *T. bracteata* Voigt, *Vigna clarkei* Prain, and *Zingiber capitatum* Roxb. (Arora and Nayar, 1984).

Amongst the State's rare species are the insect-eating pitcher plant and pygmy lily.

Endemic species

Baliospermum micrathum Muell., *Bambusa pseudopallida* R. Majumdar, *Bupleurum khasianum* (Cl.) P.K. Mukh., *Chrysanthemum coronopifolium* Vill., *Cinnamomum pedunculatum* Nees var. *angustifolium* Hemsl., *Coix lacryma-jobi* L. var. *ma-yuen*, *Corybas purpureus* Joseph & Yog., *Cotoneaster khasianus* Klotz, *Crotalaria noveoides* Griff., *Dalbergia debilis* Baker, *D. millettii* Benth. var. *oldamii* Toth., *D. rimosa* Roxb. var. *griffithii* Toth., *D. volubilis* Roxb. var. *assamica* Toth., *Daphne shillongii* Banerji, *Eriobotrya angustissima* Hook.f., *Euonymus lawsonii*, *Goodyera recurva* Lindl., *Hedychium ellipticum* Smith var. *asraoii* Srivastva & Jain, *Holboellia khasiana*, *Hypericum hookerianum* Wt. & Arn. var. *lobbii* (N.Robson) S.N. Biswas, *Ilex embelioides* Hook.f., *Impatiens depauperata* Hook.f., *I. formosa* Hook.f., *I. khasiana* Hook.f., *I. striloba* Hook.f., *Indigofera bracteata* Grah. ex Baker var. *khasiana* Sanj., *Jasminum andophyllum* Wall ex DC., *Jejosephia pusilla* (Joseph & Deka) A.S. Rao, *Liparis assamica* King & Pantl., *Mahonia simonsii* Takeda, *Micromeles meghalayensis* Panigrahi, *M. polycarpa* (Hook.f.) Panigrahi, *Nepenthes khasiana* Hook.f., *Pennilabium proboscideum* A.S. Rao & Joseph, *Peristrophe acuminata* (Wall.) Nees var. *khasiana*, *Piper cornilimbum* C.DC., *P. oldhamii* C.DC., *P. parvilimbus* C.DC., *Polyalthia meghalayensis* Prakash & Mehrotra, *Sterculia khasiana* Debbearm., *Thrixspermum muscaeflorum* A.S. Rao & Joseph var. *muscaeflorum*, *Trichosanthes himalensis* C.B.Clarke, *T. majuscula* (C.B.Clarke) Kundu, and *Viburnum simonsii* Hook.f. (Nayar, 1996). Table 1 lists representative endemic species of economically important plants.

Threatened economic species

Agapetes obovata (Wight) Hook.f., *Boesenbergia rubrolutea* Kuntze, *Citrus indica* and *C. macroptera* (Malik *et al.*, 2006), *Citrus latipes*, *Cypripedium himalaicum* Rolfe, *Hedychium auranticum*, *Ixonanthus khasiana*, *Jasminum adenophyllum* Wall., *Mangifera khasiana* Pierre, *Musa flaviflora*, *Nepenthes khasiana* Hook.f., *Piper peepuloides*, *Nostolachma jenkinsii* (Hook.f.) Deb & J.Lahiri, and *Sterculia khasiana* Debbearm. have been reported to be endangered. In addition, many more species, such as *Ilex khasiana* Purkayastha (tree) are being reported to be under threat, because of various developments, including intensification of agriculture and infrastructure development. *Rhododendron arboretum* ssp. *arboretum* is under threat due to overexploitation (Yunnam, 2008). In a recent study, higher land cover dynamics has been observed in the Garo Hills showing more alternations in the landscape during the study period (Roy and Joshi, 2002). For example, plant species such as *Cycas pectinata* Griff. and *Dipteris wallichi* (R.Br.) T.Moore have been lost in Meghalaya (Kataki, 1983). Also species, such as *Diospyros undulata* Hiern, *Nymphaea pygmaea* [Dryand.] and *Sageretia hamosa* Brongn. are considered extinct, and *Luvunga scandens* (Roxb.) Wight is thought to be locally extinct (Khan *et al.*, 1997; Roy and Tomar, 2000).

Table 1. Representative agriculturally important species endemic to the Khasi, Jaintia, and Garo Hills: Meghalaya.

Species	Family	Habit	Distribution	Remarks/Use
Bambusa pseudopallida	Bambusoideae	Tall shrub	Khasi-Jaintia Hills	Ornamental
Bupleurum khasianum	Apiaceae	Herb	Khasi-Jaintia Hills	Medicine
Chrysanthemum coronopifolium	Asteraceae	Herb	Khasi-Jaintia Hills	Ornamental, insecticidal
Cinnamomum pedunculatum var. *angustifolium*	Lauraceae	Tree	Khasi Hills	Spice
Coix lacryma-jobi var. *ma-yuen*	Poaceae	Herb	Garo-Khasi Hills	Forage
Corybas purpureus	Orchidaceae	Tiny herb	Khasi Hills	Pinkish white flowers
Dalbergia volubilis var. *assamica*	Fabaceae	Tree	Meghalaya	Wood
Eriobotrya angustissima	Rosaceae	Shrub	Khasi-Jaintia Hills	Fruit
Euonymus lawsonii	Celastraceae	Small tree	Garo-Khasi-Jaintia Hills	Medicinal, wood
Goodyera recurva	Orchidaceae	Epiphyte	Khasi Hills	Orchid
Hedychium ellipticum var. *asraoii*	Zingiberaceae	Herb	Khasi-Jaintia Hills	Medicinal and aromatic
Impatiens depauperata	Balsaminaceae	Herb	Khasi- Jaintia Hills	Ornamental
Impatiens khasiana	Balsaminaceae	Herb	Khasi-Jaintia Hills	Ornamental
Impatiens striolata	Balsaminaceae	Herb	Khasi-Jaintia Hills	Ornamental
Jejosephia pusilla	Orchidaceae	Herb	Khasi-Jaintia Hills	Ornamental
Liparis assamica	Orchidaceae	Herb	Khasi-Jaintia Hills	Ornamental
Mahonia simonsii	Berberidaceae	Shrub	Khasi Hills	Roots with alkaloid
Nepenthes khasiana	Nepenthaceae	Herb	Khasi Hills	Pitcher plant
Pennilabium proboscideum	Orchidaceae	Herb	Khasi-Jaintia Hills	Ornamental
Peristrophe acuminata var. *khasiana*	Acanthaceae	Herb	Khasi Hills	Medicinal
Polyalthia meghalayensis	Annonaceae	Shrub	Khasi Hills; 800–900 m	Wood, avenue tree, genetic resource
Selinum striatum	Apiaceae	Herb	Khasi Hills	Indicator species
Sterculia khasiana	Sterculiaceae	Shrub	Khasi-Jaintia Hills	Medicinal/ multipurpose
Thrixspermum muscaeflorum var. *muscaeflorum*	Orchidaceae	Epiphyte	Khasi-Jaintia Hills	Ornamental
Trichosanthes himalensis	Cucurbitaceae	Scandent herb	Khasi-Jaintia Hills	Vegetable, genetic resource
Trichosanthes majuscule	Cucurbitaceae	Scandent herb	Khasi-Jaintia Hills	Vegetable, genetic resource
Viburnum simonsii	Sambucaceae	Small tree	Khasi-Jaintia Hills	With red drupes

Representative economically important species under threat are listed in Table 2.

Associated cultures

The region is inhabited by Mongoloid and Austric races, with the influence of Aryan culture and Hindu religion and lately that of Christianity. Tribal people make up the majority of Meghalaya's population. It is predominantly inhabited by the Khasi, the Jaintia, and the Garo tribal communities. The Khasis and the Jaintias trace their lineage to the Mongolian race, while the Garos belong to the Tibeto-Burman race. Their cultural trails and ethnic origins remain distinctive, mainly due to their geographical isolation. However, Meghalaya is dominated by the Khasis and the Garos. The Khasis are the largest group (49%), followed by the Garos (34%). These were among those known to the British as "hill tribes". Other groups include the Koch, the Hajong,

Table 2. Representative agriculturally important species under threat in the Khasi, Jaintia, and Garo Hills: Meghalaya.

Species	Family	Habit	Threat level[1]	Remarks/Use
Agapetes obovata	Ericaceae	Shrub	I	Ripe fruits are edible
Citrus indica	Rutaceae	Small tree	I	Wild orange, genetic resource
C. macroptera	Rutaceae	Small tree	I	Wild orange, genetic resource
Cypripedium himalaicum	Orchidaceae	Herb	EN	Beautiful blossom
Ilex khasiana	Aquifoliaceae	Tree	EN	Ornamental, medicinal
Ixonanthus khasiana	Ixonanthaceae	Tree	VU	Wood for cabinet work
Jasminum adenophyllum	Oleaceae	Shrub	EN	Fragrant ornamental
Luvunga scandens	Rutaceae	Woody climber	Locally EX	Medicinal; antifungal; essential oil from fruit
Mangifera khasiana	Anacardiaceae	Tree	I	Wild relative of mango; fruit eaten by natives
Nepenthes khasiana	Nepenthaceae	Climbing shrub	CR	Used for urinary problems
Nymphaea pygmaea	Nymphaeaceae	Herb	EX	Miniature water lily, best grown in tub gardens
Rhododendron arboretum ssp. *arboretum*	Ericaceae	Shrub	EN	Ornamental
Sterculia khasiana	Sterculiaceae		EX; CR	Medicinal
Vanda coerulea	Orchidaceae	Herb	R	Ornamental of high value

1. CR = Critically endangered; EN = Endangered; EX = Possibly extinct from wild; I = Indeterminate; R = Rare; VU = Vulnerable.

Dimasa, Hmar, Kuki, Lakhar, Mikir, Rabha, Nepali, etc. The stone monoliths that can be seen around the state were erected by the Khasis to commemorate tribal chieftains. The Khasi traditional female dress is rather elaborate with several pieces of cloth, giving the body a cylindrical shape. It consists of checked cotton cloth pinned on each shoulder (*jainsem*) and a shawl (*tapmoh*). Although they are Christian, it is not unusual for the Khasis to sacrifice chickens and goats at festivals to ensure the return of the sun, and chewing betel (the Khasis call it '*kwai*'), which is considered a semi-religious habit. Bullfights in many Khasi village fairs are common. However, in their version of bullfighting, called '*yaturmasi*', one bull is pitted against another.

The Khasi, Garo, Jaintia, and Hajong are the dominant tribes associated with agriculture. There are numerous myths and legends regarding the origin, transmitted orally, over the centuries from generation to generation, for want of any written script. Among the Khasis and the Jaintias, the story of the celestial origin of their *Hynniew Trep* ("Seven Families") tribe is narrated in the following words: in the good old days, there were sixteen families living in Heaven. They descended on earth whenever they liked by climbing down the Golden Stairs on the peak of *Sohpetbneng* (the navel of Heaven), a few kilometres away from the Umiam Lake on the way to Guwahati. It is said that seven families wished to live on earth. When God granted their wish, these seven families (known as *Ki Hynniew Ha Tbian*) came down to live in the hills. However, God snapped the Golden Stairs and the seven families were left permanently on earth. The Khasi-Pnars originated from these 'Seven Families', but even today they have not forgotten the other 'Nine Families' living in Heaven. Whenever the Khasis pray to God, they remember to make a request to these 'Nine Families' to forgive them for their omissions.

One of the unique features of the region is that the majority of the tribal populations follow a matrilineal system, where lineage and inheritance are traced through the women. Under the matriarchal law of inheritance, custody to property and succession of family position passes from the mother to the youngest/selected daughter, rather than from the father to the son, as is common worldwide. As per the tradition, among Khasis, a boy or girl born of a Khasi mother, belongs to the family of the mother. The property is inherited by the youngest daughter, probably to ensure prolonged care of parents in old age. The Khasi society is divided into clans or *Kurs*, which are actually outgrown families. As per the traditional matrilineal norm, the "*Ka Khadduh*" (the youngest daughter) inherits all the property and acts as the caretaker of her aged parents and any unmarried siblings. However, the sons, particularly the mother's brother, may indirectly control the ancestral property since he may be involved in important decisions relating to property including its sale and disposal.

In the case of Garo society, the parents have the option to select any one of their daughters as the heiress. The Garo society is divided into three major clans or *Katchis*. Each of

these *Katchis* is further subdivided into a number of lineages called *Machongs*, which form the basic unit in the Garo social structure, and are named after animals, rivers, caves, etc. The dominant *Machong* in a village selects its *Nok-ma* or the headman. *Nok* in Garo means house, while *ma* stands for mother. Though the headman is a male, they call him *Nok-ma*. This shows the importance the Garos attach to the woman.

Traditionally animist-Hindu, more than 80% of the Garo are now Christian. The Khasis now are also mostly Christians. However, witch doctors are still common and *Wangala* dances are held in order to insure a good harvest. Individuals take their clan titles from their mothers and the youngest daughter (*nakma*) inherits the property from her mother. The sons leave the parents' house at puberty, and are trained in the village bachelor dormitory (*nokpante*). After getting married, the man lives in his wife's house. The tribal people of Meghalaya are part of what may be the world's largest surviving matrilineal culture. It has implications, as according to India's National Family Health Survey, Meghalaya is the state where parents have shown the least interest in having a male child – 73% less than the national average.

The region also practices a unique land tenure and management system: for example, in the Garo Hills, the headman of a cluster of villages owns the land on behalf of his clans-men and allocates for cultivation as per the requirement and expected family input. In the Khasi and Jaintia Hills, private ownership of land also exists.

Technology and products

One of the major technologies contributed from the region is the evolution of the concept of sacred groves for forest management, facilitating the conservation and sustainable use of forest resources. The sacred groves were established by the local people to keep the vegetation unchanged, and were often integrated with the regeneration of forest and forest work-plans for commercial extraction of timber, firewood, and other forest produce organized by the local communities. This helped to avoid considerable devastation that could have been caused by overexploitation of forest resources. A recent study on the diversity of vascular plants in three sacred groves of the Jaintia Hills recorded about 395 species belonging to 250 genera, and 108 families, comprising pteridophytes, gymnosperms, and angiosperms. Orchidaceae, Rubiaceae, Asteraceae, and Lauraceae were dominant families and *Ficus* was the largest genus, with nine species. About 160 tree species were found distributed in canopy, sub-canopy, and under canopy strata (Jamir and Pandey, 2003). They had tropical and temperate elements of the neighboring Sino-Himalayan and Burma-Malayan regions with 54 endemic, 31 rare, and 38 primitive species, surviving in these groves due to favorable climatic conditions and prolonged protection,

The region is inhabited by Mongoloid and Austric races, with the influence of Aryan culture and Hindu religion and lately that of Christianity.

reflecting successful management and conservation of the rich species diversity along with forest wealth through this unique traditional approach (Khan *et al.*, 1997). In this manner, local communities have made a significant contribution towards the conservation of bio-resources (particularly plants) of the region.

The agroecological conditions of the region favor the cultivation of horticulture crops. To facilitate their cultivation, the locals have developed an ingenious system of tapping of stream and spring-water by using bamboo pipes to irrigate plantations (Fig. 3). About 18–20 L of water entering the bamboo pipe system per minute gets transported over several hundred meters and finally gets reduced to 20–80 drops per minute at the site of the plant. This 200-year-old system is used by the tribal farmers of Khasi and Jaintia Hills to drip-irrigate their black pepper cultivation. Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches by gravity. The channel sections, made of bamboo, divert and carry water to the plot site where it is distributed without leakage into branches, again made and laid out with different forms of bamboo pipes. Manipulating the intake pipe positions also controls the flow of water into the lateral pipes. Reduced channel sections and diversion units are used at the last stage of water application. The last channel section enables the water to be dropped near the roots of the plant. Bamboos of varying diameters are used for laying the channels. About a third of the outer casing in length and internodes of bamboo pieces have to be removed while fabricating the system. Later, the bamboo channel is smoothened by using a *dao*, a type of local axe, a round chisel fitted with a long handle. Other components of the system are small pipes and channels of varying sizes used for diversion and distribution of water from the main channel. About four to five stages of distribution are involved from the point of the water diversion to the point of application (http://www.rainwaterharvesting.org/Rural/nehr_tradi.htm). This unique ingenious bamboo drip irrigation system has helped in conserving forests and natural resources in addition to the efficient use of water for cultivation of horticulture plants.

The diverse ecologies of the region have promoted evolution of rich genetic diversity both in field and horticulture crop species. In rice, it has resulted in variability that includes stem borer resistance, Tungro virus resistance, gall midge and drought tolerance, and waxy endosperm rice landraces (Siddiq *et al*., 2006). Similarly, among grain legumes and oilseeds, particularly, in the case of Indian mustard, the region is known for variability in number of seeds per pod. The region is also known for the occurrence of *Erianthus arundinaceus*, a genus related with *Saccharum*, the sugarcane, and is known for its thick stem, broad leaves with resistance to insect pests, high tillering, high yield, and low nutritional requirement (Sreenivasan and Amalraj, 2004).

This region, like other parts of the sub-Himalayan region, is very rich in genetic diversity of *Solanum melongena* for fruit and plant characteristics. *Solanum khasianum* reported from the region has been found to have resistance to stem and fruit borer (Kalloo, 1993). *Solanum kurzii*

Brace ex Prain used as vegetable and medicine is endemic to Garo Hills. In chili, a genotype with high pungency has been reported from the region (Kalloo *et al*., 2005). In cucurbits, genetic diversity has been collected in *Momordica charantia, Benincasa hispida* (Thunb.) Cogn., *Lagenaria siceraria* (Molina) Standl., *Sechium edule* (Jacq.) Sw., etc. (Sirohi *et al.,* 2005). The wild *Cucumis hardwickii* Royle, the likely progenitor of cultivated cucumber, found growing in natural habitats in the foothills of the Himalayas, also occurs in Meghalaya. In okra, it is one of the regions with possible variability for plant type and fruit type in local landraces with varying degree of tolerance to stresses.

The region is very rich in species diversity for tropical fruits, both of major and minor importance, and has contributed significantly towards the evolution and selection of useful genetic diversity. In case of mango, the Khasi Hills have an endemic species, *Mangifera khasiana*, which is not known in much detail, but is distinguished from *M. sylvatica,* in having smaller and narrower leaves, small flowers and inflorescence with fasciculate divergent branching, oval to lanceolate petals, and disc glandular or with distinct lobes (Mukherjee, 1985). In cultivated mango, the region is known for dwarf and poly-embryonic types. Similarly, the region displays significant species diversity in the case of *Citrus* species, in continuum of the Northeastern region as a whole, recording 8 of the 17 species reported from the region. Several *Citrus* species, such as *C. indica, C. macroptera, C. latipes*, etc., present rich genetic diversity resulting in the development of cultivars from native germplasm. Similarly, the Northeastern region is the main center of species and genetic diversity for *Musa* L. *Musa flaviflora* Simmonds is localized to Manipur and Meghalaya. Additionally, four more species have been reported from the region. Other fruits with significant variability are *Artocarpus heterophyllus, Litchi chinensis*, etc. The region also harbors genetic variability for several temperate fruit species, such as *Malus* spp., *Pyrus* spp., *Prunus* spp. (wild) and *Prunus persica*, *Rubus* spp., *Sorbus* spp., *Corylus* spp. and for *Castanea sativa* Mill., particularly in the Khasi Hills (Sharma *et al.,* 2005). The Shillong plateau of the Khasi Hills has *Prunus* species such as *P. nepalensis* K.Koch, *P. undulata* Buch.-*Ham.,* and *P. cerasoides* D.Don. The Asian pear tree *Pyrus pyrifolia* Nakai cv. Cubha makai is grown semi-commercially in Meghalaya, Manipur, and other places.

The Northeastern and Southwestern regions are recognized as two independent centers of diversity of spices in India. This region of the Northeast is one of the main areas of cultivation and diversity for spices, such as black pepper, ginger, and turmeric. In the case of pepper (*Piper nigrum*), it is second to the Malabar region in variability and also presents maximum variability for ginger. Significant levels of variability have also been recorded in turmeric (*Cucurma longa*). The

This 200-year-old system is used by the tribal farmers of Khasi and Jaintia Hills to drip-irrigate their black pepper cultivation.

cultivar Megha Turmeric 1 has been produced through selection from the local Lakadong type with high curcumin content and bold rhizome (Ravindran *et al.,* 2005). Also, the region is rich in diversity of aroids and minor tuber crops. These reports of useful genetic diversity reflect the significant contribution of the region towards conservation and sustainable use of genetic resources that have either contributed or have potential for contribution in genetic improvement of respective crop species.

The local tribes have developed valuable knowledge about the medicinal value of the plants growing in the region. For example, according to Sajem and Gosai (2006), the medicinal plant species used by Jaintias of the neighboring North Cachar Hills district of Assam are distributed across 27 families and 37 genera. Different parts of medicinal plant species are used for curing ailments. The use of aboveground plant parts was higher (76.59%) than the underground plant parts (23.41%). Of the aboveground plant parts, leaves were used in the majority of cases (23 species), followed by fruits (4). Different underground parts of the plant, such as root, tuber, rhizome, bulb, and pseudo-bulb have been found to be in use as a source for curing ailments. The whole plants of five species, *Centella asiatica* (L.) Urban, *Cuscuta reflexa* Roxb., *Oxalis corymbosa* L., and *Clerodendrum serratum* (L.) Moon, and *Scroporia dulcis* L., were used. In total, 39 medicinal plant species were used in curing about 30 types of ailments, of which the highest numbers of plant species (20 species) were used for the treatment of gastrointestinal disorders, such as indigestion and constipation. About eight medicinal plant species were used in curing cough and cold, and five for healing cuts and wounds. The root powder of *Asparagus racemosus* Willd., known as *Shatavari*, has been found to be effective in chronic peptic ulcer; the Jaintias use it for urinary disorders, as well as stomachache that could be due to high peptic juice secretion.

This region, like other parts of the sub-Himalayan region, is very rich in genetic diversity of* Solanum melongena *for fruit and plant characteristics.

Future perspective

The rich heritage of species and genetic diversity of the region is getting depleted because of several factors such as preparation of land in the hill slopes for shifting cultivation, cutting, overexploitation, and burning of valuable forest products, which is also causing serious damage to the ecology and natural environment. Indiscriminate destruction of forests that exposes vast tracts of hilly lands to erosion causes rapid depletion of the valuable fertile top soil and other nutrients, creating low-base-status soil. Further, inadequate knowledge about the value of diversity is also resulting in the destruction of vegetative cover and removal of valuable flora causing irreparable genetic erosion. Therefore, efforts are needed to develop awareness, remediation and initiation of appropriate policy initiatives to restrict these processes.

The region has a vast potential for developing horticulture due to its climatic variations, which offers much scope for cultivation of temperate, subtropical, and tropical fruits and vegetables. The region is very rich in horticultural crop species and considerable diversity exists among the regional horticultural crops, for plant type, morphological and physiological characteristics, reactions to diseases and pests, adaptability and distribution, offering vast opportunities for cultivation and commercial exploitation. This would help initiate income-generating and poverty-alleviation programs in the rural areas. It may include non-traditional crops such as cashewnut, strawberry, tea and coffee, mushroom, medicinal plants, orchids, and commercial flowers.

Different studies have shown that around two-thirds of medicinal plants of the total reported from all over the country are from the Northeastern region, including this region, where the medicinal plant species used by the Jaintias only, are widely distributed across a large number of families and genera. This situation offers great opportunity to the region for commercial exploitation of medicinal and aromatic plants reported from the region based on validation of reported facts and their improvization.

Animal husbandry is one of the principal components of agriculture, which requires the availability of quality feed and fodder in requisite quantities to ensure the productivity of livestock. Therefore, certain initiatives are to be taken to attain required quantities of cereals and oil meals for livestock and poultry sector. Non-conventional animal feed resources are to be exploited to obtain protein for livestock feeding. More seed production farms must be established to meet the requirement of fodder and fodder seed, by increasing area under fodder crops, agroforestry, etc., and utilizing uncultivated, barren, and fallow lands (grasses, pasture, etc.) on priority with appropriate resources and technologies.

The local tribes have developed valuable knowledge about the medicinal value of the plants growing in the region.

The region has a vast potential for developing horticulture due to its climatic variations, which offers much scope for cultivation of temperate, subtropical, and tropical fruits and vegetables.

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