



RESEARCH ARTICLE

DISTRIBUTION AND DIVERSITY OF *GARCINIA* L. IN UPPER BRAHMAPUTRA VALLEY, ASSAM

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ABSTRACT

The genus *Garcinia* (family Clusiaceae) with its 400 species is reported to distribute in tropical parts of the world. The genus has 36 species in India mostly in forest as well as in non-forest areas of North-East, Western Ghats, and Andaman and Nicobar Islands. Of which, 16 species are endemic in India. *Garcinia* in Assam is locally known as *Thekara* and use for timber, food and medicinal values. However, the genus found to be disappearing from natural habitat in Assam. This study was conducted to survey in different forests, patch vegetations and homesteads on distribution, diversity and status of *Garcinia* species in Upper Brahmaputra Valley of Assam. The study recorded 10 species of *Garcinia* i.e. *Garcinia pedunculata* Roxb., *G. paniculata* Roxb, *G. cowa* Roxb. *G. morella* Desr *G. kydia* Roxb., *G. xanthochymus* Hook., *G. dulcis* (Roxb) Kurz., *G. spicata* (Wight & Arn) Hookf., *G. lanceifolia* Roxb. and *G. sopsopia* (Buch.-Ham.) Mabb. The study also revealed that except *G. lanceifolia* all these species were available in different evergreen and semi-evergreen forests with specific plant communities like *Holong-Morsal-Nahor*, *Holong-Mekai-Nahor* association. Moreover, *G. pedunculata*, *G. xanthochymus*, *G. cowa* and *G. kydia* were recorded from the patch vegetations around the villages. *Garcinia lanceifolia*, which is a small tree of the genus, was found only in the homesteads. Out of 12 reserve forests (RF) of Upper Brahmaputra valley, distribution of *G. kydia* Roxb was recorded in 9 RFs and *G. xanthochymus* Hook.f. ex. T. Anderson was recorded from 8 RFs. IVI of these species in the forest is very less in number in comparison to the other plants and its abundance is mainly restricted to core forest areas where anthropogenic disturbance is very less. Associated plant species of *Garcinia* in Kukuramara RF was highest with 33 plant species and lowest in Tengani RF with 10 plant species.

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INTRODUCTION

The genus *Garcinia* (family-Clusiaceae) with about 250 species is distributed mainly in humid tropical climate of the world. *Garcinia* is reported to be native to South Asia from Southern part of the Thailand and Malaysia to Indonesia also has their distribution in South East Asia (Mabberley, 2005; Rogers & Sweeney, 2007; Nimanthika & Kaththriachchi 2010). The number of species reported from Malaysia is 49 (Whitemore, 1973). In Madagascar and Comoros 32 species were reported where all species are endemic except one (Sweeney and Rogers, 2008). Li *et al.*, (2008) described 20 species of *Garcinia* in Flora of China. In India, *Garcinia* is represented by 35 species distributed in Konkon region of Maharashtra, Goa, coastal areas in Karnataka and Kerala and evergreen and semi evergreen forests of North Eastern States,

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West Bengal, Andaman and Nicobar Islands (Maheswari, 1964, Singh, 1993; Parthasarathy *et al.*, 2013). The species *G. cowa* is native to North East India and distributed in Assam, Mizoram, Arunachal Pradesh, West Bengal and Orissa (Malik *et al.*, 2010). Kanjilal & Das (1934) reported 9 species of *Garcinia* distributed throughout the then undivided Assam. Choudhury *et al.*, 2005 in his study on the status of vascular plants reported 15 species of *Garcinia* from Assam. The same study also highlighted that that among the species of *Garcinia* in Assam *G. acuminata*, *G. anomala* and *G. keenania* are critically endangered. Krishnamoorthy *et al.* (2007) reported that among the different species of *Garcinia* available in India *G. atroviridis*, *G. cowa*, *G. lanceifolia*, *G. morella*, *G. sopsopia*, *G. pedunculata* and *G. xanthochymus* were available from Assam and different parts of North East India. Kar *et al.* (2008) reported 8 species of *Garcinia* from Sonitpur district, Assam. Begam *et al.*, 2013 report the occurrence of *Garcinia dulcis*, a species earlier described from Peninsular Malaysia, Southern Thailand, Java, Borneo and Philippines were from Jokai reserve forest in Dibrugarh district of Upper Assam for the first time.

The occurrence of the species *G. nervosa* was reported from Barak valley, Assam (Dutta et al., 2014). Begam et al., (2014) reported two new varieties of *G. morella* from Tinsukia district, Assam. Approximately 30 species of *Garcinia* are cultivated and produce edible fruits throughout the world. The species cultivated commercially in some parts of India are *G. cambogia*, *G. indica*, and *G. mangostana* (Hooker, 1874, Gamble, 1967, Roberts, 1984). Ethno-botanical studies on the use of different species revealed that *Garcinia* sp. have been used by different communities throughout the world including India (Dike et al. 2012; Rai and Lalramnghinglova, 2010; Das and Teron, 2014). Medicinal uses of different species of *Garcinia* are reported from different parts of the country (Nambiar et al., 1986; Deodhar et al., 2012). The plants of *Garcinia* recently gained attention for the presence of a natural diet ingredient the di-hydroxy citric acid in the fruit rind and leaves (Rao et al., 1981, Parthasarthy et al., 2013). The different species of *Garcinia* are important sources of bioactive compounds (Chowdhry, 2014; Gogoi et al., 2012; Rithiwigrom et al., 2013). Antibacterial activity of extracts from various parts of different species of *Garcinia* are reported (Negi et al., 2008; Chowdhury and Handique, 2012; Bora et al. 2014). A study on the Thai medicinal plants on inflammation caused by *Propionibacterium acenes* proved that *G. mangostana* is highly effective in scavenging free radicals and suppressing the production of pro-inflammatory cytokinins (Chemnawang et al., 2007). The fruits of *G. pedunculata* are rich source of ascorbic acid, phenol and flavonoid compounds (Mudoi et al., 2012).

The genus *Garcinia* in Assam is known by the common vernacular name *thekara*. The different species of *Garcinia* in the state are known by different local names like *bor thekara*, *kow thekara*, *kuji thekara*, *mamoi thekara* and *rupahi thekara* by different communities and have been found in different localities in wild or domesticated conditions. The species of *Garcinia* are evergreen polygamous trees or shrubs occur mainly in forest as well homestead gardens. Though different species of *Garcinia* are important multipurpose trees to the different societies of North East India, its value is not still realized like other forest trees of the region.

Considering the medicinal importance of the fruits of *Garcinia*, there is need to make a study of the status of availability of the species in different forest, patch vegetation and homestead areas of the state. Future cultivation of the important species of *Garcinia* in home gardens and community lands has great potentiality in upliftment of economy of the rural people. The species of *Garcinia* may also be ideal plants for different afforestation programmes of the State Forest Departments or other agencies under Joint Forest Management (JFM) or other agro-forestry programme. The research work was undertaken to study the distribution, diversity and associated plant species with different species of *Garcinia* in Upper Brahmaputra valley along with their uses by the people. The study included the chemical analysis of edible parts of *Garcinia* species and also tried to develop *ex situ* conservation measures of important species.

MATERIALS AND METHODS

Study area

The Upper Brahmaputra valley zone is lying between 24° 44' N to 27° 45' N latitude and 89° 41' E to 96° 02' E longitude comprising Jorhat, Sivasagar, Golaghat, Dibrugarh and Tinsukia district of Assam (Fig-1).

Among the six agro-climatic zones of Assam the valley is a rich area of biodiversity adjoining Arunachal Pradesh in the eastern and Nagaland towards the southern side. The river Brahmaputra demarcates the area from the northern part of the state covering the Sonitpur, Lakhimpur and Dhemaji district. The vegetation of valley is tropical wet evergreen, evergreen to secondary semi-evergreen types towards the western part covering Sivasagar, Jorhat and Golaghat district. The valley also covers a part of Kaziranga National Park of Golaghat district and the Dibru-Saikhowa National Park and Biosphere Reserve located of Tinsukia and Dibrugarh districts. The valley also includes some wildlife sanctuaries namely The Gibbon wildlife sanctuary in Jorhat district, Nambar Doigrong Tengani wildlife sanctuary of Golaghat district, Pani Dehing Birds wildlife sanctuary of Sivasagar district, Bherjan Borjan wildlife sanctuary of Tinsukia district. The Jeypore Reserve Forest, under the Dibrugarh Forest Division is considered as the lowland rain forest area of northeastern region of India with rich mega biodiversity.

Vegetation Survey

A total of twelve (12) reserve forests (RF) i.e. Gibbon Wildlife Sanctuary, Nambar R.F., Doiang-tengani R.F., Sola R.F., Abhoipur R.F., Jeypore R.F., Jokai R.F., Tinkupani R.F., Tipong R.F., Namdang R.F., Kukuramora R.F. and Hologaoon R. F. were selected as study sites as per availability of *Garcinia* species. Extensive survey was carried out in different reserve forests (R.F.) as well as the patch vegetations in rural areas of the valley following quadrat method (Misra, R. 1968). The reserve forest surveyed on the Southern bank of the river Brahmaputra were Gibbon Wildlife (WL) sanctuary, Disoi valley reserve forest, Jorhat district; Nambar, Doiang and Tengani reserve forest in Golaghat district; Sola, Abhoipur, Delhighat in Sibsagar district; Jokai, Jeypore, Medella and Namdan reserve forest in Dibrugarh district; Tinkupani, Tipong, Hologaoon, Kukuramora, Dolong, Balijan, Nahorbari, Ghoramara reserve forest in Tinsukia district. In Northern bank of Brahmaputra Kakoi and Dolong RF were surveyed. Availability and distribution of *Garcinia* was studied through field visits to different representative areas of each of the site during 2012-2014. It was found that the distribution of *Garcinia* was not uniform throughout all the forest area but localized in certain pockets. Therefore, ecological studies were carried out on the specific areas where species of *Garcinia* were found available in the forests. Ecological association of *Garcinia* with other species in the forest and regeneration pattern of each of species was done through standard quadrat methods (Misra, 1968; Muller-Dombois and Ellenberg, 1974). The records of tree species along with their basal area in 10 X 10 m² quadrates were made. The relative density, relative dominance and relative frequency were determined (Ambasht, 1990). The Importance Value Index (IVI) of *Garcinia* with respect to other species in different study sites were determined by summing up the relative density, relative dominance and relative frequency. Records of different anthropogenic disturbances to the forest were also made during the study. The different species of *Garcinia* found during the survey were collected and prepared herbarium specimens for record and deposited in the herbarium of RFRI. The collected samples were identified with the help of relevant literature (Kanjilal et al 1934; Hooker, 1874). Apart from this, the information on the traditional uses of different species of *Garcinia* was collected with different medicine men, elder persons as well as the housewives of the nearby villages of the study sites.

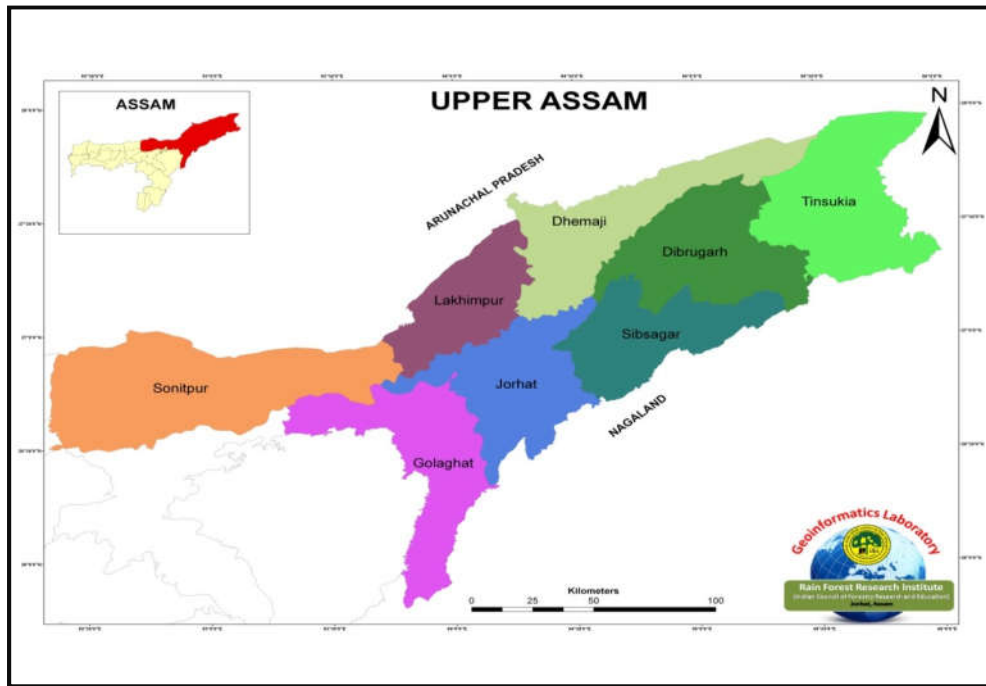


Fig 1. Map of Upper Brahmaputra valley



Fig 2 Different species of *Garcinia*: *Garcinia pedunculata*[A], *G. cowa* [B], *G. lanceifolia*[C] *G. morella* [D], *G. sopsopia* [E], *G. kydia* [F], *G. xanthochymus*[G] and *G. dulcis*

RESULTS AND DISCUSSION

A total of 10 species of *Garcinia* were recorded from different forest areas, patch vegetations in rural areas and homesteads of the valley (Fig-2). The evergreen and semi evergreen forests of upper Brahmaputra valley with humid ecological conditions were found as the ideal habitat for many species of *Garcinia*. Among the ten species recorded, *G. dulcis*, *G. morella*, *G. sopsopia*, *G. spicata* and *G. xanthochymus* were found in wild. Three species *G. pedunculata*, *G. cowa* and *G. kydia* are distributed in wild as well as under domesticated conditions. The distribution of these species has been found in the patches of rural areas. The species *G. xanthochymus* was found throughout the entire valley with its distribution in natural forest as well as patch vegetation. The species of *Garcinia* recorded in the study sites were medium size trees except *G. lanceifolia* which is a small tree only found in cultivated condition in the homestead gardens (Table 1).

It was observed that in natural forests, distribution of *Garcinia* was found to be localized in some specific pockets with its associated species rather than having uniform distribution. According to available research information among the Indian *Garcinia*, 14 species and 4 varieties are endemic (Sarma et al., 2016). They also reported a new species *Garcinia assamica* from the semi-evergreen forests adjacent to Manas National Park, Assam, India. Begum et al, 2014 reported similar observation while describing two new varieties of *G. Morella* from Tinsukia district, Assam. Therefore, in natural habitat, the association of *Garcinia* with other tree species was studied in the specified locations. It was found that in Gibbon WL sanctuary, Jeypore reserve forest, Jokai reserve forest and Sola reserve forest the vegetation is influenced by *Dipetrocarpus-Mesua* tree associations where number and diversity of *Garcinia* was found higher in comparison to the other sites. The associated plant species with *Garcinia* species in different plant species were presented in Table 2.

Table 1. Species of *Garcinia* and their occurrences in different habitats of Upper Brahmaputra valley, Assam

Sl. No.	Names	Vernacular name	State of occurrence
1.	<i>Garcinia pedunculata</i> Roxb.ex Buch.-Ham.	<i>Bor thekara</i>	In forest and patch vegetations in wild condition, also found in home gardens as domesticated plant.
2.	<i>G. cowa</i> Roxb. ex Choisy	<i>Kuji thekara</i>	In forest and patch vegetations under wild condition, also found in home gardens as domesticated plant.
3	<i>G. kydia</i> Roxb.	<i>Kuji thekara</i>	In forest and patch vegetations under wild condition, also found in home gardens as domesticated plant.
4	<i>G. morella</i> (Gaertn) Desr.	-	In forest under wild condition.
5	<i>G. dulcis</i> (Roxb.) Kurz.	-	In forest under wild condition.
6	<i>G. xanthochymus</i> Hook.f. ex. T. Anderson.	<i>Tepor tenga</i>	In forest and patch vegetations in wild condition, also found in home gardens as domesticated plant.
7	<i>G. sopsopia</i> (Buch.-Ham.) Mabb.	<i>Mamoi thekara</i>	In forest under wild condition.
8	<i>G. spicata</i> Hook.f.	-	In forest under wild condition.
9	<i>Garcinia atroviridis</i> Griff. ex T. Anderson	-	In forest under wild condition.
10	<i>G. lanceifolia</i> Roxb.	<i>Rupahi thekara</i>	In home gardens as domesticated plant.

The distribution and diversity of *Garcinia* species in Assam was reported by many researchers except upper Barhamaputra Valley. In a similar study 8 species of *Garcinia* namely *G. xanthochymus*, *G. cowa*, *G. sopsopia*, *G. lancaifolia*, *G. acuminata*, *G. pedunculata*, *G. gummi-gutta* and *G. spicata* were reported from Sonitpur district of Assam (Kar et al., 2008). The number and species of *Garcinia* recorded from different R. Fs under the study were not same (Table 2). Seven (7) numbers of *Garcinia* species were recorded from Gibbon wildlife sanctuary such as *G. pedunculata*, *G. cowa*, *G. kydia*, *G. morella*, *G. dulcis*, *G. xanthochymus*, *G. sopsopia*.

In Jeypore reserve forest 6 *Garcinia* species i.e. *G. morella*, *G. xanthochymus*, *G. pedunculata*, *G. cowa*, *G. kydia*, *G. sopsopia* and *G. atroviridis* were recorded. Six (6) *Garcinia* species i.e. *G. pedunculata*, *G. dulcis*, *G. xanthochymus*, *G. kydia*, *G. cowa* and *G. atroviridis* from Jokai reserve forest. In Sola reserve forest it was *G. pedunculata*, *G. cowa*, *G. kydia*, *G. xanthochymus* and *G. sopsopia*. From Tikupani and Tipong R.F. 4 species of *Garcinia* were recorded. However, except *G. kydia*, *G. morella* other species were different. In Tinkupani reserve forest other *Garcinia* species were *G. cowa* and *G. dulcis*. Tipong Reserve Forest was recorded for habitat of *G. spicata* and *G. pedunculata* also. Holougaon R.F was habitat of 3 species i.e. *G. kydia*, *G. xanthochymus* and *G. pedunculata*. *G. xanthochymus* and *G. pedunculata* were recorded from Doiang-Tengani, Abhoipur and Kukuramora reserve forest 2 species i.e. *G. kydia*, and *G. xanthochymus* were recorded. Whereas, in Nambor reserve forest, the only species recorded was *G. xanthochymus* (Table 2).

Common plant species associated in all RFs with different species of *Garcinia* recorded were *Actinodaphne obovata*, *Artocarpus chama*, *Ailanthus integrifolia*, *Altingia excelsa*, *Albizia lucidior*, *Bischofia javanica*, *Bombax ceiba*, *Castanopsis armata*, *C. indica*, *Cinnamomum glanduliferum*, *Dipterocarpus retusus*, *Dillenia indica*, *Dysoxylum excelsum*, *Magnolia hodgsonni*, *M. insignis*, *M. kingii*, *Magnolia champaca*, *Mesua ferrea*, *Terminalia bellerica*, *T. myricarpa* and *Vatica lanceifolia*. Highest association of plant species with *Garcinia* recorded in Kukuramora Reserve Forest with 33 plant species against *G. kydia* and *G. xanthochymus*.

In Gibbon Wildlife sanctuary against 7 *Garcinia* species 22 plant species were recorded as associated plant species. Likewise, in Jeypore Reserve Forest against 7 *Garcinia* spp 20 plant species were recorded. Associated plant species of Jokai RF were 21 against 6 species of *Garcinia* and Sola RF 20 associated plant species were recorded against 5 *Garcinia* spp. Tinkupani RF was recorded for 21 associated plant species against 4 *Garcinia* spp (Table-2). Holougaon RF was recorded for 31 plant species against 3 *Garcinia* spp and Abhaypur RF was recorded for 27 associated plant species against 2 *Garcinia* spp, Nambor RF possessed 13 plant species against 1 *Garcinia* spp and Tengani RF had 10 associated plant species for *G. xanthochymus* and *G. kydia* (Table 2). The importance value Indices (IVIs) of *Garcinia* spp in different reserve forests studied is presented in Table 3. The value of IVI varies according to sites as well species. Highest IVI value of 14.47 was found in Tinkupani reserve forest followed by 13.82 in Tipong reserve forest.

Table 2. Distribution of *Garcinia* in different forests and its associated tree species in the characteristic vegetations

S.No.	Study Sites	Species of <i>Garcinia</i>	Nature of vegetation	Associated tree species
1	Gibbon Wildlife sanctuary	<i>G. pedunculata</i> <i>G. cowa</i> <i>G. kydia</i> <i>G. morella</i> <i>G. dulcis</i> <i>G. xanthochymus</i> <i>G. sopsopia</i>	Semi evergreen	<i>Actinodaphne obovata</i> , <i>Ailanthus integrifolia</i> , <i>Alstonia scholaris</i> , <i>Artocarpus chama</i> , <i>Castanopsis armata</i> , <i>C. indica</i> , <i>Carallia brachiata</i> , <i>Celestrus monosperma</i> , <i>Cinnamomum glanduliferum</i> , <i>Dipterocarpus retusus</i> , <i>Dysoxylum excelsum</i> , <i>Lagerstroemia speciosa</i> , <i>Magnolia griffithii</i> , <i>M. hodgsonii</i> , <i>M. nilagirica</i> , <i>M. kingii</i> , <i>Magnolia champaca</i> , <i>Mesua ferrea</i> , <i>Sapium sebiferum</i> , <i>Syzgium sp.</i> , <i>Terminalia bellerica</i> , <i>T. myriocarpa</i> , <i>Vatica lanceifolia</i>
2	Jeypore Reserve Forest	<i>G. morella</i> <i>G. xanthochymus</i> <i>G. pedunculata</i> <i>G. cowa</i> <i>G. kydia</i> <i>G. sopsopia</i> <i>G. atroviridis</i>	Evergreen	<i>Amoora rahituka</i> , <i>Castanopsis armata</i> , <i>C. indica</i> , <i>Cinnamomum glanduliferum</i> , <i>Canarium reseniferum</i> , <i>Dillenia indica</i> , <i>Dipterocarpus retusus</i> , <i>Dysoxylum excelsum</i> , <i>Eleocarpus serratus</i> , <i>Litsea monopetala</i> , <i>Macaranga indica</i> , <i>Mangifera sylvatica</i> , <i>Magnolia hodgsonii</i> , <i>M. insignis</i> , <i>Mesua ferrea</i> , <i>Sapium eugeniferum</i> , <i>Terminalia chebula</i> , <i>T. myriocarpa</i> , <i>Syzgium fruticosum</i> , <i>Vatica lanceifolia</i> .
3	Jokai Reserve Forest	<i>G. pedunculata</i> <i>G. dulcis</i> <i>G. xanthochymus</i> <i>G. kydia</i> <i>G. cowa</i> <i>G. atroviridis</i>	Semi Evergreen	<i>Actinodaphne obovata</i> , <i>Albizia lucidior</i> , <i>Altingia excelsa</i> , <i>Neolamarckia cadamba</i> , <i>Artocarpus chama</i> , <i>A. lacoocha</i> , <i>Bombax ceiba</i> , <i>Castanopsis hystrix</i> , <i>C. indica</i> , <i>Caryota urens</i> , <i>Dillenia indica</i> , <i>Dipterocarpus retusus</i> , <i>Dysoxylum excelsum</i> , <i>Eleocarpus serratus</i> , <i>E. tectorius</i> , <i>Litsea monopetala</i> , <i>L. nitida</i> , <i>Magnolia hodgsonii</i> , <i>Mesua ferrea</i> , <i>Sloanea sterculiacea</i> , <i>Terminalia bellerica</i> .
4	Sola Reserve Forest	<i>G. pedunculata</i> <i>G. cowa</i> <i>G. kydia</i> <i>G. xanthochymus</i> <i>G. sopsopia</i>	Semi evergreen	<i>Actinodaphne gullavara</i> , <i>A. obovata</i> , <i>Altingia excelsa</i> , <i>Aquilaria malaccans</i> , <i>Artocarpus chama</i> , <i>A. lacoocha</i> , <i>Castanopsis armata</i> , <i>C. hystrix</i> , <i>Canarium resiniferum</i> , <i>Celestrus monosperma</i> , <i>Cinnamomum glanduliferum</i> , <i>Chukrasia tubularis</i> , <i>Dipterocarpus retusus</i> , <i>Eleocarpus tectorius</i> , <i>Lagerstroemia speciosa</i> , <i>Magnolia kingii</i> , <i>Mesua ferrea</i> , <i>Persea bombichina</i> , <i>Terminalia myriocarpa</i> , <i>Syzgium nervosum</i> .
5	Tinkupani Reserve Forest	<i>G. kydia</i> <i>G. morella</i> <i>G. cowa</i> <i>G. dulcis</i>	Evergreen	<i>Altingia excelsa</i> , <i>Ailanthus grandis</i> , <i>Castanopsis armata</i> , <i>Canarium resiniferum</i> , <i>Cinnamomum bejolghota</i> , <i>C. glanduliferum</i> , <i>Dipterocarpus retusus</i> , <i>Dysoxylum excelsum</i> , <i>Elaeocarpus serratus</i> , <i>E. tectorius</i> , <i>Macaranga indica</i> , <i>Magnolia griffithii</i> , <i>M. nilagirica</i> , <i>Mesua ferrea</i> , <i>Phoebe cooperina</i> , <i>Sapium eugeniferum</i> , <i>Shorea assamica</i> , <i>Vatica lanceifolia</i> .
6	Tipong Reserve Forest	<i>G. kydia</i> <i>G. morella</i> <i>G. spicata</i> <i>G. pedunculata</i>	Evergreen	<i>Altingia excelsa</i> , <i>Castanopsis indica</i> , <i>Cinnamomum glanduliferum</i> , <i>Canarium resiniferum</i> , <i>Dipterocarpus retusus</i> , <i>Dysoxylum alliaria</i> , <i>D. excelsum</i> , <i>Eleocarpus serratus</i> , <i>Horsfeldia kingii</i> , <i>Litsea monopetala</i> , <i>Macaranga indica</i> , <i>Mansona dipikii</i> , <i>Magnolia hodgsonii</i> , <i>M. nilagirica</i> , <i>Pterospermum acerifolium</i> , <i>Terminalia myriocarpa</i> , <i>Sapium eugeniferum</i> , <i>Shorea assamica</i> , <i>Sterospermum chelonoides</i> , <i>Vatica lanceifolia</i> , <i>Walsura robusta</i> .
7	Hologaoon Reserve Forest	<i>G. kydia</i> <i>G. xanthochymus</i> <i>G. pedunculata</i>	Evergreen	<i>Actinodaphne gullavara</i> , <i>A. obovata</i> , <i>Artocarpus lakoocha</i> , <i>A. chama</i> , <i>Biscofia javanica</i> , <i>Bauhinia malabarica</i> , <i>Bombax ceiba</i> , <i>Callicarpa arborea</i> , <i>Castanopsis indica</i> , <i>Canarium resiniferum</i> , <i>Cinnamomum bejolghota</i> , <i>Dysoxylum excelsum</i> , <i>Dillenia indica</i> , <i>Dipterocarpus retusus</i> , <i>Elaeocarpus tectorius</i> , <i>Gynocordia odorata</i> , <i>Lagerstroemia speciosa</i> , <i>Litsea monopetala</i> , <i>Morus macroura</i> , <i>Oroxylum indicum</i> , <i>Persea bombicina</i> , <i>Pterospermum acerifolium</i> , <i>Salix tetrasperma</i> , <i>Sapium eugenifolium</i> , <i>Slonia sterculiacea</i> , <i>Sterculia villosa</i> , <i>Syzgium fruticosum</i> , <i>Terminalia myriocarpa</i> , <i>Tetrameles nudiflora</i> , <i>Vitex peduncularis</i> .
8	Abhaypur Reserve Forest	<i>G. pedunculata</i> <i>G. xanthochymus</i>	Evergreen	<i>Actinodaphne obovata</i> , <i>Ailanthus excelsa</i> , <i>Albizia lucidior</i> , <i>Altingia excelsa</i> , <i>Neolamarckia cadamba</i> , <i>Artocarpus chama</i> , <i>A. lacoocha</i> , <i>Bombax ceiba</i> , <i>Biscofia javanica</i> , <i>Canarium resiniferum</i> , <i>Castanopsis hystrix</i> , <i>C. indica</i> , <i>Dillenia indica</i> , <i>Dipterocarpus retusus</i> , <i>Duabanga grandiflora</i> , <i>Dysoxylum excelsum</i> , <i>Eleocarpus serratus</i> , <i>E. tectorius</i> , <i>E. sikkimensis</i> , <i>Lagerstroemia speciosa</i> , <i>Litsea monopetala</i> , <i>L. nitida</i> , <i>Magnolia hodgsonii</i> , <i>Mesua ferrea</i> , <i>Terminalia bellerica</i> , <i>T. myriocarpa</i> , <i>Vatica lanceifolia</i> .
9	Namdang Reserve Forest	<i>G. pedunculata</i> <i>G. xanthochymus</i>	Evergreen	<i>Albizia procera</i> , <i>A. lucidior</i> , <i>Actinodaphne obovata</i> , <i>Artocarpus chama</i> , <i>A. lacoocha</i> , <i>Bombax ceiba</i> , <i>Biscofia javanica</i> , <i>Castanopsis armata</i> , <i>Caryota urens</i> , <i>Cinnamomum bejolghota</i> , <i>Chukrasia tubularis</i> , <i>Dillenia indica</i> , <i>Dysoxylum excelsum</i> , <i>Elaeocarpus tectorius</i> , <i>E. serratus</i> , <i>Ficus benghalensis</i> , <i>Gmelina arborea</i> , <i>Lagerstroemia speciosa</i> , <i>Litsea monopetala</i> , <i>Magnolia hodgsonii</i> , <i>Mesua ferrea</i> , <i>Morus laevigata</i> , <i>Persea bombycina</i> , <i>Spondius pinnata</i> , <i>Syzgium fruticosum</i> , <i>Terminalia bellerica</i> ,
10	Kukuramora Reserve Forest	<i>G. kydia</i> , <i>G. xanthochymus</i>	Evergreen	<i>Actinodaphne gullavara</i> , <i>A. obovata</i> , <i>Albizia chinensis</i> , <i>A. lucidior</i> , <i>Neolamarckia cadamba</i> , <i>Artocarpus chama</i> , <i>A. lakoocha</i> , <i>Aesculus assamica</i> , <i>Balakata baccatum</i> , <i>Biscofia javanica</i> , <i>Bombax ceiba</i> , <i>Callicarpa arborea</i> , <i>Castanopsis armata</i> , <i>C. indica</i> , <i>Dipterocarpus retusus</i> , <i>Dillenia indica</i> , <i>Duabanga grandiflora</i> , <i>Dysoxylum binetiferum</i> , <i>Elaeocarpus serratus</i> , <i>E. tectorius</i> , <i>Lagerstroemia speciosa</i> , <i>Litsea monopetala</i> , <i>Vitex peduncularis</i> , <i>Macaranga indica</i> , <i>Magnolia hodgsonii</i> , <i>Mesua ferrea</i> , <i>Hydnocarpus kurzii</i> , <i>Eugenia sp.</i> , <i>Sloanea sterculiacea</i> , <i>Premna benghalensis</i> , <i>Pterospermum acerifolium</i> , <i>Terminalia myriocarpa</i> , <i>Vatica lanceifolia</i>
11	Nambar Reserve Forest	<i>G. xanthochymus</i>	Semi evergreen	<i>Actinodaphne gullavara</i> , <i>A. obovata</i> , <i>Artocarpus chama</i> , <i>A. lacoocha</i> , <i>Canarium resiniferum</i> , <i>Carallia brachiata</i> , <i>Cinnamomum bejolghota</i> , <i>Dysoxylum excelsum</i> , <i>Eleocarpus tectorius</i> , <i>Lagerstroemia speciosa</i> , <i>Magnolia hodgsonii</i> , <i>Mesua ferrea</i> , <i>Wrightia coccinea</i> .
12	Tengani Reserve Forest	<i>G. xanthochymus</i> <i>G. kydia</i>	Semi evergreen	<i>Actinodaphne gullavara</i> , <i>Albizia lucidior</i> , <i>Bombax ceiba</i> , <i>Elaeocarpus tectorius</i> , <i>Gynocordia odorata</i> , <i>Lagerstroemia speciosa</i> , <i>Litsea monopetala</i> , <i>L. nitida</i> , <i>Premna benghalensis</i> , <i>Tetrameles nudiflora</i> .

Table 3. Importance value index (IVI) of *Garcinia* species in different forest areas

Name of species	Family	Gibbon Wildlife Sanctuary	Nambar Reserve Forest	Tengani Reserve Forest	Sola Reserve Forest	Abhaypur Reserve Forest	Jeypore Reserve Forest	Jokai Reserve Forest	Tinkupani Reserve Forest	Tipong Reserve Forest	Namdang Reserve Forest	Kukmora Reserve Forest	Hologao Reserve Forest
<i>Actinodaphne gullavara</i> (Buch.-Ham. ex Nees) M.R.Almeida	Lauraceae		16.37	17.16	2.33							4.87	6.13
<i>Actinodaphne obovata</i> (Nees) Blume	Lauraceae	4.59	5.42		3.82			7.34			3.15	1.82	9.72
<i>Aesculus assamica</i> Griff.	Sapindaceae											8.39	
<i>Ailanthus excelsa</i> Roxb.	Simaroubaceae					5.99							
<i>Ailanthus integrifolia</i> Lam.	Do	2.73			3.75				6.19				
<i>Albizia chinensis</i> (Osbeck) Merr.	Mimosaceae											3.49	
<i>Albizia lucidior</i> (Steud.) I.C.Nielsen	Mimosaceae		7.04	8.65				2.26		6.86		4.66	
<i>Albizia procera</i> (Roxb.) Benth.	Mimosaceae		2.86								17.97		
<i>Altingia excelsa</i> Noronha	Altingiaceae				5.91	24.84		4.65	9.1	6.07			
<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	4.13	4.48			9.28		2.17					
<i>Antidesma montanum</i> Blume	Phyllanthaceae											1.59	
<i>Aphania danura</i> Radlk.	Sapindaceae						3.3						
<i>Aporosa wallichii</i> Hook.f.	Euphorbiaceae			20.64	6.22			3.71			11.43	4.93	
<i>Aquilaria malaccensis</i> Lam.	Thymilaceae				2.27								
<i>Ardisia macrophylla</i> Reinw. ex Blume	Primulaceae	6.46			11.04								
<i>Ardisia solanacea</i> Roxb.	Primulaceae	2.42											
<i>Artocarpus chama</i> Buch.-Ham.	Moraceae	4.79	16.55	14.05	15.29	11.76		22.95			21.45	8.91	7.87
<i>Artocarpus lacucha</i> Buch.-Ham.	Moraceae		7.76	9.79	9.08	2.94		3.03			10.71	3.45	4.81
<i>Aquilaria malaccensis</i> Lam.	Thymelaeaceae				2.27								
<i>Baccaurea ramiflora</i> Lour.	Phyllanthaceae		12.35	5.12		8.69	2.2	1.66				7.49	6.45
<i>Balakata baccata</i> (Roxb.) Esse	Euphorbiaceae					4.38						7.56	
<i>Bischofia javanica</i> Bl.	Euphorbiaceae			4.9							14.49	5.23	12.11
<i>Bombax ceiba</i> Burm.	Malvaceae			18.65				16.56			24.93	20.65	22.19
<i>Callicarpa arborea</i> Roxb.	Lamiaceae					2.52						3.4	
<i>Caltis tetrandia</i> Roxb.	Ulmaceae						2.21						
<i>Canarium resiniferum</i> Bruce ex King	Burseraceae	9.45	6.94	8	11.77	7.65	4.48		18.61				4.71
<i>Canthium glabrum</i> Blume	Rubiaceae				1.56								
<i>Carallia brachiata</i> (Lour.) Merr.	Rhizophoraceae	2.17	5.97		6.31			6.75					
<i>Caryota urens</i> L.	Arecaceae							4.18			3.71		4.08
<i>Castanopsis armata</i> (Roxb.) Spach	Fagaceae	5.01			1.66		5.27		8.44		10.83	4.22	
<i>Castanopsis hystrix</i> A.D.C	Fagaceae				3.75			2.64					
<i>Castanopsis indica</i> (Roxb. ex Lindl.) A.DC.	Fagaceae	2.4			11.17		2.07	1.86		5.2		3.97	12.93
<i>Catuneragum spinosa</i> (Thunb.) Tirveng.	Rubiaceae				1.56			1.51					
<i>Celastrus monosperma</i> Roxb.	Celestraceae	2.31			2.46								
<i>Chukrasia tabularis</i> A.Juss.	Meliaceae				1.64						7.62		
<i>Choerospondias axillaris</i> (Roxb.) B.L.Burt & A.W.Hill	Anacardiaceae							9.01	12.48	9.83			

Continue.....

<i>Cinnamomum bejolghota</i> (Buch.-Ham.) Sweet	Lauraceae		5.5							7.02			
<i>Cinnamomum glanduliferum</i> (Wall.) Meisn.	Lauraceae		5.78		14.09			3.54	9.78				
<i>Cinnamomum glaucescens</i> (Nees) Hand-Mazz.	Lauraceae	15.79					2.62			3.42			
<i>Crateva nurvala</i> Buch.-Ham.	Capparaceae									3.92	2.92		
<i>Croton persimilis</i> Müll.Arg	Euphorbiaceae	7.78		8.89				1.76					
<i>Cryptocarya amygdalina</i> Nees.	Lauraceae							3.53					
<i>Cyathea brunoniana</i> C.B. Clarke	Cyatheaceae						3.39						
<i>Dalbergia assamica</i> Benth	Caesalpiniaceae			2.34									
<i>Dasymaschalon longiflorum</i> (Roxb.) Finet & Gagnep.	Annonaceae	2.34							5.41				
<i>Dillenia indica</i> L.	Dilleniaceae		10.71			11.19	2.44	14.34		3.16	12.22	3.14	
<i>Dillenia scabrella</i> (D.Don) Roxb. ex Wall.	Dilleniaceae							1.47					
<i>Dipterocarpus retusus</i> Bl.	Dipterocarpaceae	19.26				35.72	46.49	3.11	83.7	24.76		20.64	16.78
<i>Drimycarpus recemosus</i> Hook.f.	Anacardiaceae			3.86	7.39	2.52							
<i>Duabanga Grandiflora</i> (Roxb.exDC.) Wall.	Lythraceae					7.03						5.78	
<i>Dysoxylum excelsum</i> Blume	Meliaceae	2.15	14.31		9.46	8.34	5.57		13.47	9.33	4.92		4.38
<i>Dysoxylum gotadhora</i> (Buch.-Ham.) Mabb.	Meliaceae											6.9	
<i>Elaeocarpus sikkimensis</i> Mast.	Elaeocarpaceae									2.62			
<i>Elaeocarpus sphaericus</i> (Gaertn.) K. Schum	Elaeocarpaceae		8.17				5.44	5.95	7.45	15.04	7.79		
<i>Elaeocarpus stapfianus</i> Gagnep.	Elaeocarpaceae	4.4						2.75			5.53	6.27	
<i>Elaeocarpus tectorius</i> (Lour.)Poir.	Elaeocarpaceae		32.39	21.47	9.48	9.77	2.94	3.12	6.25	2.75	14.51	8.72	2.16
<i>Endospermum chinense</i> Benth.	Euphorbiaceae	4.39				7.68	11.76			11.38			
<i>Entada rheedii</i> Spreng.	Mimosaceae											1.77	
<i>Eugenia balsamea</i> Wight	Myrtaceae										3.74		
<i>Eurya acuminata</i> DC.	Pentaphragmaceae				1.66								
<i>Evodia meliifolia</i> (Hance ex Walp.) Benth.	Rutaceae				2.43								
<i>Ficus auriculata</i> Lour.	Moraceae								2.68				
<i>Ficus benghalensis</i> L.	Moraceae									5.61			
<i>Ficus benjamina</i> L.	Moraceae			5.12		4.98							
<i>Ficus hirta</i> Vahl.	Moraceae							4.17				6.84	
<i>Ficus hispida</i> Vahl.	Moraceae			5.46								4.62	
<i>Ficus nervosa</i> Hayne ex Roth.	Moraceae	8.28	8.78			2.55							
<i>Ficus racemosa</i> L.	Moraceae			4.9			3.53	1.98				8.86	5.99
<i>Ficus semicordata</i> Buch-Ham. Ex J.E.Sm.	Moraceae									2.72		4.2	
<i>Garcinia atroviridis</i> Griff. ex T. Anderson	Clusiaceae						9.88	3.12					
<i>Garcinia cowa</i> Roxb.	Clusiaceae	4.41			3.9		3.75	1.65	3.59				
<i>G. dulcis</i> (Roxb.) Kurz.	Clusiaceae	4.34			-		-	11.88	8.29	12.65			
<i>G. kydia</i> Roxb.	Clusiaceae	8.24		2.48	5.12		5.77	10.6	14.47	13.82		3.92	8.21
<i>G. morella</i> (Gaertn) Desr.	Clusiaceae				-		4.71	-	3.87	2.61			
<i>G. pedunculata</i> Roxb.ex Buch.-Ham.	Clusiaceae	5.24			10.41	2.50	4.54	-	-	2.63	7.81		2.77

Continue.....

<i>G. sopsopia</i> (Buch.-Ham.) Mabb.	Cluciaceae	5.53			-		2.33	-	-	-			
<i>G. spicata</i> Hook.f.	Cluciaceae				-		-	-	-	10.82			
<i>G. xanthochymus</i> Hook.f. ex. T. Anderson.	Cluciaceae	-	5.28	5.69	9.7	2.25	2.41	5.65	-	-	3.26	1.60	5.32
<i>Garuga pinnata</i> Roxb	Bursaraceae												10.06
<i>Glochidion multiloculare</i> (Wall.) Voigt	Euphorbiaceae		2.63					1.43					
<i>Glochidion ramiflorum</i> J.R.Forst. & G.Forst.	Euphorbiaceae			2.34	3.08			3.78	3.72	5.22			
<i>Gmelina arborea</i> Roxb.	Verbenaceae					3.74					4.92		
<i>Gynocordia odorata</i> R. Br.	Flacourtiaceae		6.42			3.81		1.58			3.79	3.47	4.37
<i>Heteropanax fragrans</i> (Roxb.) Seem.	Araliaceae								3.72				
<i>Horsfieldia amygdalina</i> (Wall.) Warb.	Myrsinaceae									15.78			
<i>Hydnocarpus kurzii</i> (King) Warb.	Achariaceae											4.45	
<i>Ilex godajam</i> (Colebr.) Wall. ex Hook.f.	Aquifoliaeae				2.16	3.13		3.28					
<i>Kydia calycina</i> Roxb.	Malvaceae						4.74						1.96
<i>Lagerstroemia speciosa</i> (L.) Pers.	Lythraceae		27	20.6	41.57	6.28		37.02			23.65	13.03	9.72
<i>Lannea coromandelica</i> (Houtt.) Merr.	Anacardiaceae									3.99			
<i>Leea guineensis</i> G. Don	Leeaceae	4.23											
<i>Leea indica</i> (Burm. f.) Merr.	Leeaceae				1.64				3.61	4.28			
<i>Lindera assamica</i> (Meisn.) Kurz										2.6			
<i>Litsea glutinosa</i> (Lour.) C.B.Rob.	Lauraceae				3.98								
<i>Litsaea laeta</i> Benth & Hk.f	Lauraceae			2.41				3.98					2.84
<i>Litsea lancifolia</i> (Roxb. ex Nees) Fern.-Vill.	Lauraceae											1.69	
<i>Litsaea monopetala</i> Pers.	Lauraceae	15.96				4.83	2.33	1.48		2.66	6.69	7.62	8.57
<i>Litsea nitida</i> Roxb. Ex Wall.	Lauraceae		7.53			4.67							
<i>Litsea noronhae</i> Blume	Lauraceae									3.18			
<i>Litsea oblonga</i> (Wall. Ex Nees) Hk F	Lauraceae						2.2						
<i>Macaranga denticulata</i> (Blume) Müll.Arg.	Euphorbiaceae	2.7					2.47					1.48	
<i>Macaranga peltata</i> (Roxb.) Muell.-Arg.	Euphorbiaceae		2.41				2.26		3.72	3.88			
<i>Machilus glaucescens</i> (Nees) Wight	Lauraceae		2.48										
<i>Magnolia champaca</i> (L.) Baill. ex Pierre	Magnoliaceae	18				7.81							
<i>Magnolia griffithii</i> Hook.f. & Thomson	Magnoliaceae	9.31			2		11.97		4.29	3.07			
<i>Magnolia hodsonii</i> (Hook f. & Th) Keng	Magnoliaceae	8.77	8.6			4.73		3.1		2.82	10.18	10.95	
<i>Magnolia insignis</i> Wall.	Magnoliaceae						13.92						
<i>Magnolia mannii</i> (King) Figlar									4.29				
<i>Magnolia montana</i> (Bl) Figlar	Magnoliaceae	8.57			2.68			2.93					
<i>Magnolia nilagirica</i> (Zenker) Figlar	Magnoliaceae	4.24		17.13					9.44	6.86			
<i>Magnolia pterocarpa</i> Roxb	Magnoliaceae							1.51					
<i>Mallotus ferrugineus</i> (Roxb.) Müll.Arg			2.31										
<i>Mangifera sylvatica</i> Roxb.	Anacardiaceae					3.65	2.25	3.17					
<i>Mansonia dipikae</i> Purkayastha	Sterculiaceae									3.85			
<i>Morus laevigata</i> Wall.	Moraceae										3.42		7.87
<i>Mesua ferrea</i> L.	Cluciaceae	44.14	29.58	19.39	15.38	25.02	31.06	20.26	18.75		20.14	10.27	
<i>Neolamarckia cadamba</i> (Roxb.) Bosser	Rubiaceae			11.81		3.76		2.29				3.56	

Continue.....

<i>Oroxylum indicum</i> Vent.	Bignoniaceae												3.61
<i>Ostodis paniculata</i> Bl.	Euphorbiaceae						1.82						
<i>Parsia bombicina</i> (King ex Hook.f.) Kostel	Lauraceae			2.04							5.74	3.95	2.46
<i>Phoebe cooperiana</i> P.C.Kanjilal & Das	Lauraceae					2.75		3.72	3.2				
<i>Premna latifolia</i> Roxb.	Lamiaceae		2.94				2.41						4.65
<i>Premna bengalensis</i> C.B. Clarke	Lamiaceae											5.01	
<i>Prunus jenkinsii</i> Hook.f. & Thomson	Rosaceae												3.64
<i>Pterospermum acerifolium</i> Willd.	Malvaceae		3.08							2.66		1.88	5.15
<i>Rhus succedanea</i> L.	Anacardiaceae	2.13											
<i>Rhus chinensis</i> Mill.	Anacardiaceae											1.95	
<i>Salix tetrasperma</i> Roxb.	Salicaceae												2.47
<i>Sapium sebiferum</i> (L.) Roxb.	Euphorbiaceae	2.66	3.37										
<i>Saprosma ternatum</i> Hook f	Rubiaceae					4.44	3.05		2.69				
<i>Saurauia napaulensis</i> DC.	Saurauiaceae	4.24											3.84
<i>Schima wallichii</i> Choisy	Theaceae											1.95	
<i>Shorea assamica</i> Dyer.	Dipterocarpaceae							10.2	9.21				
<i>Sloanea sterculiacea</i> var. <i>assamica</i> (Benth.) Coode	Elaeocarpaceae						8.43					10.05	5.89
<i>Spondias pinnata</i> (L. f.) Kurz	Anacardiaceae											3.33	
<i>Stereospermum colais</i> Mabblerley	Bignoniaceae		8.26	3.97	3.65		8.79		5.94				
<i>Sterculia villosa</i> Roxb.	Sterculiaceae			3.14									4.63
<i>Sterculia lanceifolia</i> Roxb.	Sterculiaceae	4.24											
<i>Streblus asper</i> Lour	Moraceae				1.81								
<i>Syzygium fruticosum</i> L.	Myrtaceae	4.31		5.75	3.65	4.55	4.91	1.51		3.45	3.76	2.33	
<i>Syzygium nervosum</i> A.Cunn. ex DC.	Myrtaceae				5.11		4.63						
<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Combretaceae	3.68	4.13		3.24	6.2		5.18		12.63	5.51	3.56	
<i>Terminalia chebula</i> Retz.	Combretaceae		2.84	3.12	4.18		2.28					3.89	
<i>Terminalia myriocarpa</i> Van Heurck & Müll. Arg.	Combretaceae	5.43			4.73	11.64	5.62			18.8		12.58	14.65
<i>Tetrameles nudiflora</i> R. Br.	Datisceae			11.68									14.33
<i>Toona ciliata</i> M. Roem	Meliaceae		6.98							3.59			
<i>Trema orientalis</i> (L.) Blume	Cannabaceae			2.54								4.12	
<i>Trevesia palmata</i> (Roxb. ex Lindl.) Vis.	Araliaceae						2.44	4.72					1.66
<i>Trewia nudiflora</i> L.	Euphorbiaceae												5.14
<i>Triadica cochinchinensis</i> Lour	Euphorbiaceae			7.71		7.34	13.75	3.61	14.48	16.46			12.84
<i>Walsura robusta</i> Roxb.	Meliaceae									16.78			
<i>Wrightia coccinea</i> (Roxb. ex Hornem.) Sims	Apocynaceae		3.03										
<i>Vitex peduncularis</i> Wall. ex Schauer	Lamiaceae							3.04					3.44
<i>Vatica lanceaefolia</i> Bl.	Dipterocarpaceae	35.03				20.75	35.48	5.15	7.12	4.19			16.20
<i>Zanthoxylum nitidum</i> (Roxb.) DC	Rutaceae							5.13					1.6
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae												1.61
<i>Ziziphus nummularia</i> (Burm.f.) Wight & Arn.	Rhamnaceae						4.69						

Table 4. Traditional Ethno-botanical usages of some species of *Garcinia*

Sl no	Name of species	Traditional uses
1.	<i>G. pedunculata</i>	Fruits are found to use as acidifying agents for traditional curry, as pickles, as medicine for dysentery. Traditionally the fleshy outer covering of the seed coat is used for making cold drinks (<i>sherbet</i>). Boiled unripe fruit is used as the medicine in dysentery; it is also eaten as with traditional food. The unripe fruits are used in <i>Bohag bihu</i> festival. The wood is used for construction of traditional houses, making <i>dhaki</i> - the traditional rice husking implements, fuel wood.
2.	<i>G. kydia</i>	Pericarps of fruit are used as acidifying agents for traditional curry. The fleshy outer cover of seeds of ripe fruits is eaten as raw. Dry sliced pericarp of the fruits are preserved for its medicinal value, it is used as medicine against dysentery, constipation. The juice prepared from the dry sliced pericarp is eaten as <i>sherbet</i> because of its sour test. The extract of dry sliced fruit is used as medicine for high blood pressure and stomach disorder for human as well as domestic animals. The stem is used as pole for construction of traditional house, making <i>dhaki</i> - the traditional rice husking implements, fuel wood.
3.	<i>G.cowa</i>	Pericarps of the fruits are used as acidifying agents for traditional curry. The fleshy outer covers of seeds of ripe fruits are eaten as raw. Dry sliced pericarp of the fruits are preserved for its medicinal value, it is used as medicine against dysentery, constipation. The juice prepared from the dry sliced pericarp is eaten as <i>sherbet</i> because of its sour test. The extract of dry sliced fruit is used as medicine for high blood pressure and stomach disorder for human as well as domestic animals. The stem is used as pole for construction of traditional house
4.	<i>G. lanceifolia</i>	Leaves are taken as vegetables. The pericarps of fruits are eaten in raw and as pickles. The dry sliced prepared from pericarps are used as acidifying agent for traditional curry, medicine against stomach trouble. The juice prepared from the dry sliced pericarp is drink as <i>sherbet</i> during warmer days to get relief from hot.

In case of *G. dulcis* IVI at Jokai reserve forest was 10.88 and for *G. spicata* and *G. pedunculata* it was 10.82 and 10.41 respectively for Tipong and Jokai reserve forest (Table 3). This may indicate the history of abundance of *Garcinia* and its associated species in the forests. The study sites Nambor, Doiang-tengani located in western part of the valley had two species *G. kydia* and *G. xanthochymus*. The species recorded from patch vegetation and homestead gardens were *G. kydia* and *G. pedunculata*. The species *G. dulcis* had been recorded for three sites Gibbon WL sanctuary, Jokai and Tinkupani reserve forest. The association of *Garcinia* with other species of the study sites were recorded (Table 2). Out of the 10 species recorded *G. pedunculata*, *G. kydia*, *G. cowa* and *G. lanceifolia* were found to be important for the people for its fruits and therefore, these species may be considered as economically important species. The results of ethno-botanical study of these species show that pericarp of the fruits is used as acidifying agent of traditional curry. The fruit juice prepared from dry sliced pericarp is used for preparation of *sherbet*. The fresh pericarp is also used for preparation of pickles. The extract prepared from the dry sliced pericarp of *G. kydia*, *G. cowa* and *G. lanceifolia* are used as medicine for diarrhea, dysentery and blood pressure. It is believed that the medicinal values of these dried sliced pericarps increase on storage. The leaves of *G. lanceifolia* are eaten as vegetable (Table 4). The straight stem portion of *G. pedunculata*, *G. kydia* and *G. cowa* is valuable as timber that is durable and therefore, people prefer to use it as pole for construction of traditional houses. The wood of *Garcinia* is used for making *Dheki*, the traditional rice husking implement.

The other uses of wood are for making the handles of tools and implements (Table-4). A numbers of research works also reveals that *Garcinia* species were potential for modern drugs formulations excluding the use of traditional medicine (Bora et al., 2014; Chowdhury, 2014; Chowdhury and Handique, 2012). Parthasarathi et al., 2013 form a study with the help of Arc GIS software predicted that the different areas of the states Assam Meghalaya, Nagaland, Mizoram Tripura in North Eastern region having same rainfall and altitude are suitable areas for *Garcinia*. They also reported that two species *G. pedunculata* and *G. cowa* are endemic to the region. The present study also documented almost 152 plant species of 50 families associated with 9 species of *Garcinia* from the Upper Brahmaputra valley, Assam (Table 3).

The highest 16 numbers of species was recorded for Lauraceae family, followed by Euphorbiaceae with 13 species and Moraceae with 12 species. Other important plant family such as Magnoliaceae and Anacardiaceae associated with 7 species each, Elaeocarpaceae and Meliaceae with 5 species each; Dipterocarpaceae, Lamiaceae, Mimosaceae, Myrsinaceae, Rubiaceae and with 4 species each. Such study was not done any researcher so far particularly in Assam.

The important tree species recorded in different forest types of the valley by Champion & Seth, 1968 such as *Altingia excelsa*, *Artocarpus chama*, *Castanopsis armata*, *Chukrassia tubularis*, *Dipterocarpus retusus*, *Duabanga grandiflora*, *Dysoxylum spp.*, *Gmelina arborea*, *Mesua ferrea*, *Magnolia champaca*, *Terminalia myriocarpa* etc. were also recorded during the study. Parthasarathy and Nandakishore (2014) reported that many *Garcinia* species have edible arils and are eaten locally. Similar traditional uses such as food, medicine and other uses of all the *Garcinia* species were presented in table 4. Fruits of *G. pedunculata* is being used in traditional curry items, as pickles, as medicine for dysentery and the plant is used as timber. Wood of *G. pedunculata* and *G. kydia* traditionally used for making rice grinding tool- *dheki*.

The phyto-resources of different forest types of the valley have large number of wild edibles and medicinal plants (Dutta, et al., 2017; Pegu, et al., 2013; Patiri and Borah, 2007). Sarma and Devi (2015) reported similar traditional used of *Garcinia pedunculata* (Bor thekera) fruit products for treatment of dysentery, diarrhea and jaundice. As observed, the anthropogenic pressure like reduction of forest areas for other land uses, illegal felling of trees for fuel wood, timber in reserve forests is responsible for near disappearance of the *Garcinia* species. Similar observation was also reported in case of *G. pedunculata* in Kamrup district, Assam (Sarma and Devi, 2015). The destructive harvesting of the fruits by human inside forests areas was found to be a major cause of disappearance of species like *G. pedunculata*, *G. cowa*, *G. kydia*. The coal mining activities near Tipong and Tinkupani Reserve Forests was also found to be serious threat to *Garcinia* along with its associated species. Considering the importance of the tree as food, medicine and timber, mass awareness for conservation of *Garcinia* under *ex-situ* and *in-situ* condition is required.

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