Tree species diversity in a village ecosystem in Uttara Kannada district in Western Ghats, Karnataka

Cultivating trees in the agricultural systems is one of the major practices in the tropics of South and Southeast Asia[1]. It is characterized by an intensive integration of forest trees, agricultural and horticultural crops, and shrubs with a basic objective to ensure sustained availability of multiple products as direct benefits such as food, vegetables, fruits, fodder, fuel, foliage, medicine, and raw materials for agricultural implements. Other indirect benefits and services such as ornamentals, shading, live-fencing and shelter-belt or wind-breaks are also derived[2]. Such intermixing of species of agriculture and forestry, often termed as 'agroforestry' came into international prominence as a potential source of solutions of many inter-related problems of production and conservation troubling land-use systems in the tropical and subtropical regions[3]. It has also been stated that the tree components along with field crops lead to efficient use of sunlight, moisture and nutrients in agro-ecosystems than in monocropping of either agricultural or forestry crops[1]. This kind of practice is more popular in Kerala, where home-gardens are built around coconut orchards[4]. Such home-gardens and agroforestry systems also prevail in humid tropics of the Western Ghats, Karnataka. However, there are no specific studies detailing the status of such systems in Karnataka, though a study on the use of tree biomass is available in the semi-arid zone of the state[5,6].

In recent years, people are meeting their diverse biomass needs from the trees in cultivated lands[7]. Such large-scale dependence may act as threat to reduction in tree diversity and density on the farmlands. In view of the depleting timber, NTFP resources in the wild, a diverse agro-ecosystem may help people to meet varied needs. Here, we examine the ecosystem of a village in the Western Ghats region to understand tree species diversity, species similarity, and estimate the standing biomass of species in different agro-ecosystems and end uses.

Sirsimakki village in Uttara Kannada District, Western Ghats is located at 14°35′N, 74°48′E at an elevation ranging between 545 and 615 m. The soil is lateritic and reddish-brown in colour with pH ranging from 4.5 to 5.5. The mean annual rainfall is 2626 mm. The entire Sirsimakki village ecosystem encompasses an area of 386.5 ha. The whole terrain is gently undulating with 26 hill-peaks. Table 1 gives details regarding land-use patterns and sampling. Among the 88 households of the village, 14 are landless, 9 own only paddy land, 47 own only garden lands and 18 families own both paddy and garden lands. For those owning paddy lands, the median land-holdings is 0.5 ha; the median garden land for garden-land owners is also 0.5 ha. The largest single holding is by one family with 3 ha of paddy and 3 ha of garden land. Among the 74 landholding families, 66 maintain livestock, the minimum being 1, median 5 and maximum 31. There are no goats, sheep or pigs in the catchment; however two farmers have taken up rabbit-keeping. The number of livestock is roughly one per ha of the total landholdings, including paddy crop, areca garden and *soppina betta*.

The Sirsimakki village ecosystem was defined as the boundary marked by the revenue department of the state government[8]. The boundary is mainly drawn on the basis of the land owned, cultivation, non-crop lands, settlements, streams, water bodies, roads, hills, *soppina betta**, *bena*† and community or village/minor forest lands‡. In the present study all the land-use systems and types are treated as an ecosystem. This village ecosystem consists of 28 ha of minor forest with dominant tree species such as *Randia spinosa*, *Eugenia jambolana* and *Diospyros melanoxylon*. The estimated annual harvest of biomass from minor forest is at the rate of 4.2 t/ha, which is more than eight times the level of production[8]. Out of the total biomass harvested annually, 51% is used as fuel, 37% is used as small timber and the remaining 12% is used as manure. This village ecosystem comprising 289.7 ha of *soppina betta* lands owned by the Forest Department is assigned to 65 garden owners, with an average ratio of 6.3 : 1 of *soppina betta* to areca garden land. These *soppina betta* lands are better stocked than the minor forest of the area. Croplands along the hillsides constitute about 15.17 ha. The areca gardens cover an extent of 46.03 ha, occur in three large patches and one small patch at the bottom of the valleys or downstream of irrigation tank or by a protective belt of jackfruit, mango, coconut trees. The gardens are multi-storied, comprising betel-nut palms, pepper vines, banana and cardamom.

The sample plots were randomly laid in each land-use system such as home-gardens, paddy and areca boundaries, stream boundary and tank bunds, *soppina betta*, minor forest and adjacent reserve forest. Details of area sampled are given in Table 1. The total length of areca, paddy and stream boundary was estimated using the village maps. The total length of stream and areca boundary (along the edge of the areca gardens) was 1645 m, while paddy boundary was 535 m and tank bund was 200 m. The width maintained for these boundaries was 2 m. Data regarding species name, GBH, total tree height, etc. were collected in five locations sampled in 1991, where trees greater than 10 cm diameter at breast height were recorded. Information regarding nativity of species (exotic or native) and their physiognomic characters (evergreen or deciduous) was obtained from the literature. Shannon–Weiner's species diversity index and Sorenson's similarity index were calculated following Krebs[9]. The index was calculated for all samples pooled over each land-use category. End-use and domestication patterns of several species that are grown in their home-gardens were collected through household interviews.

Stem diameter and tree height account for larger proportion of variability in woody biomass of trees[10]. Basal area and height were used for estimating biomass using equations as suggested by Murali *et al.*[11].

Regarding tree resources in home-gardens, there were 673 individuals belongings to 68 tree species in 34 home-

*State-owned forest land assigned to areca garden owners for enjoyment of usufructs, provided they maintain a minimum tree density of 100 per ha.

†Privately owned land often converted to grassland with minimum tree growth.

‡Open accessible lands meant for community use.

gardens over a sampling area of 1.28 ha. The dominant species were *Mangifera indica*, *Artocarpus heterophyllus* and *Erythrina indica*. The estimated tree density was 525 per hectare, and species diversity was 3.21 (Table 2).

Considering tree resources in areca garden boundary, there were 239 individuals belonging to 45 species sampled over 0.3 ha area. The dominant tree species were *Vateria indica*, *Casuarina equisetifolia*, *Artocarpus heterophyllus* and *M. indica*. Areca garden boundary comprised 735 trees/ha and a species diversity index of 3.05, which is slightly lower than the home-garden (Table 2).

Regarding tree resources in paddy boundary, there were 40 individuals belonging to 15 species in the sampled area of 0.11 ha. The dominant tree species were *Cocos nucifera* and *Cassia siamea*, with an estimated density of 373 trees per hectare. There were less trees compared to areca boundary and home-gardens. Paddy boundary has species diversity of 2.35.

Considering tree resources in village ecosystem, there were 952 individuals belonging to 93 species in a sampled area of 1.7 ha of Sirsimakki agro-ecosystem. Further, additional 44 species were encountered on non-agricultural lands in the village ecosystem, which includes *soppina betta*, minor forest and reserve forest.

Out of the species present in the agro-ecosystem, the predominant ten species account for 55.1% of the total tree population. Among the top ten species, five are local and five are exotic. Among the 93 species encountered in the agro-ecosystem, local fruit-yielding species like *M. indica* topped the list followed by *A. heterophyllus* (Table 3). The estimated standing biomass was 0.16 tons per capita and 34.59 tons ha^{-1} of agro-ecosystem. Local multipurpose tree species such as *M. indica*, *A. heterophyllus* and *Careya arborea* dominated the standing biomass (Table 3).

The proportion of evergreen species was more in tank bund, stream and areca boundary. However, the nearby reserve forest had higher proportion of deciduous species. Except in paddy boundary all the other plots have significantly higher proportion of native species (Table 4).

The value of Shannon index of diversity was highest in streams and lowest in *soppina betta* in the village ecosystem (Table 2). The overall agro-ecosystem had 556 trees/ha, with a diversity index 3.5, while the non-agro ecosystem had 354 trees/ha and a species diversity of 3.87. The overall diversity of the village ecosystem, including agro and non-agro ecosystem was 4.07, with a tree density of 418.8 per ha. There were 144 species in the village ecosystem with 2238 individuals in the sampled area of 5.34 ha. The total number of species in non-agro ecosystem was 104 with 1286 individuals.

Sorensen's index of similarity (IS) values ranged from 4 to 65 among different land-use systems studied (Table 5). The IS values of home-garden, paddy and areca boundary were lower than reserve forest, *soppina betta* and minor forest, indicating less similarity in species composition among them.

Distribution of tree population based on end-use in Sirsimakki village agro-ecosystem is given in the Table 6. It shows that fruit and vegetable trees such as *M. indica*, *Citrus* spp., *Musa* spp., etc. are in significantly higher proportion comprising 29.72%, followed by income-generating crop species such as areca, coconut and *Anacardium* comprising 18.06%. Farmers maintained 8.19% of individuals belonging to fuel wood and foliage species such as *Careya arborea*, *Aporosa lindleyana* and *Terminalia* spp.

Traditional societies of Asia, largely residing in uplands such as the Western Ghats and Himalayan region in India are often closely linked with biodiversity-rich ecological situations, much of the biodiversity in the low lands having

Table 1. Details of the land-use categories and area sampled in Sirsimakki village ecosystem of Uttara Kannada District

Land-use category	Total area (ha)	Sampled area (ha)	Sampled area and number
Home-garden	2.960 (88 households)	1.280 (34 households)	Entire area of home-gardens
Areca boundary	0.636	0.329	1645 m × 2 m transect
Paddy boundary	0.975	0.107	535 m × 5 m transect
Stream boundary	1.611	0.329	1645 m × 2 m transect
Tank bund	0.2	0.2	100 m × 10 m, two transects
Minor forest	28.00	1.000	100 m × 100 quadrat
Betta lands surround hillock	289.74	1.000	100 m × 100 quadrat

Table 2. Characteristics of vegetation in different land uses in Sirsimakki village ecosystem of Uttara Kannada District

Land-use category	Number of individuals	Number of species	Shannon (*H*) (diversity)	Tree density/ha
Home-garden	673	68	3.21	525
Paddy boundary	40	15	2.35	373
Areca boundary	239	45	3.05	735
Total (agroecosystem)	952	93	3.5	556.1
Stream boundary	514	65	3.39	319
Tank bund	65	21	2.72	325
Soppina betta land	360	23	2.33	673
Minor forest	152	26	2.78	152
Reserve forest	195	27	2.48	195
Total (non-agro ecosystem)	1286	104	3.87	354.1
Total village ecosystem	2238	144	4.07	418.8

already declined due to human exploitation. For the land use-based economic activities of these upland communities, biodiversity is a driving force for sustainable livelihood[12]. They attach differential values to biodiversity[13] and often manipulate it in a variety of ways, both in their natural and their multi-species complex agro-ecosystems.

A total of 144 species were found in the entire village ecosystem. Among these, 93 (64.58%) tree species were found in agro-ecosystem area (including home-gardens, paddy and areca garden boundary) and 104 species were recorded on non-agricultural lands such as *soppina betta*, minor and reserve forest. The village agro-ecosystem area is dominated with multiple use species such as *M. indica* and *A. heterophyllus*, indicating farmers' selectivity for retaining those trees that are known for their valuable fruits, fodder and leaf manure, etc. Standing biomass in agro-ecosystems (34 t/ha) is more compared to *soppina betta* and minor forests[8]. These home-gardens supported higher species diversity than Ungara village ecosystem in the semi-arid region of Karnataka[5]. This reveals that humid environment is favourable for tree regeneration and establishment, than dry areas. In the Maya region (southern Mexico and Central America), home-gardens have 60–80 tree species each and as many as 200 species in a village ecosystem[14]. The village ecosystem con-

Table 3. Standing biomass and tree population in agro-ecosystem of Sirsimakki village of Uttara Kannada District

Species	Total individuals	Percentage	Estimated standing biomass (*t*)	Percentage
Mangifera indica L.	100	14.7	18.44	31.13
Artocarpus heterophyllus Lamk.	74	10.9	6.74	11.36
Casuarina equisetifolia Forst.	42	6.2	0.61	1.03
Citrus spp.	36	5.2	1.10	1.86
Erythrina indica Lamk.	25	3.6	0.24	0.41
Vateria indica L.	25	3.6	1.35	2.29
Terminalia crenulata Roth.	20	2.9	1.55	2.62
Anacordium occidentale L.	16	2.3	0.07	0.13
Leucaena leucocephala (Lam.) de wit	16	2.3	0.01	0.03
Careya arborea Roxb.	14	2.0	1.85	3.12
Others*	313	45.9	27.22	45.95
Coconut plant	127			
Banana plant	99			
Areca plant	45			
Total	952	100	59.2285	100

*Others include 82 species in homestead gardens, and areca and paddy boundary.

Table 4. Composition of evergreen and deciduous, and native and exotic tree species and percentage (in parenthesis) of individuals in different locations in agro and other land-use systems in Sirsimakki village ecosystem of Uttara Kannada District

	Number of species		Number of species	
Land-use system	Evergreen	Deciduous	Native	Exotic
Home-garden	26 (67)	42 (33)	36 (64.5)	32 (35.5)
Areca boundary	24 (81.1)	21 (18.9)	36 (58.9)	9 (41.1)
Paddy boundary	7 (47.5)	8 (52.5)	8 (30)	7 (70)
Tank bund	16 (84.6)	5 (15.4)	20 (98)	1 (2)
Stream canal boundary	35 (62.8)	30 (37.2)	50 (71.8)	15 (28.2)
Betta land	8 (26.6)	15 (73.4)	23 (100)	–
Minor forest	11 (34.8)	15 (65.2)	26 (100)	–
Reserve forest	4 (5)	23 (95)	27 (100)	–

Table 5. Sorenson's index (IS) of percentage similarity in agroforestry and other land-use system in Sirsimakki village ecosystem of Uttara Kannada District

	Paddy boundary	Areca boundary	Stream boundary	Home garden	Tank bund	*Betta* land	Minor forest
Areca boundary	23.3						
Stream boundary	32.5	53.3					
Home-garden	26.1	38.5	45.7				
Tank bund	5.5	42.4	37.2	24.9			
Betta land	26.3	15.7	23.7	15.2	27.2		
Minor forest	19.5	14.0	28.5	10.5	17.2	65.3	
Reserve forest	14.2	22.2	17.3	10.4	4.1	16.0	11.3

sists of more than 25,000 ha. In another study, the home-garden of Xuilub in the state of Yucatan, Mexico, 339 species of flowering plants were recorded in 52 gardens with an average garden size of 19.76 ha (ref. 15). A total of 168 species were encounterd in 21 home-gardens at Santo Rosa, Amazonia. This high number could be due to inclusion of herbaceous plants in the sample[16]. On an average, the home-gardens in Sri Lanka recorded nearly 250 individual woody perennials of 29 species[17]. Considering the above home-gardens, Sirsimakki village ecosystem recorded 93 tree species in 1.7 ha. Further, it can be noted that in Sirsimakki the average area of home-garden is 376 m^2. The number of tree species varies between 20 and 40 in a given home-garden, indicating that these gardens are highly diverse compared to those in Mexico and Brazil.

Tree diversity index in the home-garden (3.21) is high followed by areca boundary (3.05). These values were similar to those recorded in tropical rainforest[18–20]. Sorenson's similarity index clearly indicates that species found in the home-gardens are similar to those in stream boundaries than the species found in agricultural systems such as areca and paddy boundaries. Farmers have selectively promoted some of the species that they find useful at appropriate places. It was suggested[16] that mixing of exotic species with the local one was mainly for economic returns. Such mixing would help exotic species to escape pest attacks, at least for a while. The higher proportion (81%) of evergreen species such as *V. indica*, *M. indica* and *A. hirsutus*, *C. nucifera* along the areca garden boundary is essential to protect areca palms from scorching sunlight, as wind-breaks, shelter belts, live fence (protection) and to improve soil fertility[21]. There are no set rules for spacing at the time of planting, but in the first few years of home-garden establishment, attempts were made to ensure wide gaps between the plants. But the farmers preferred to retain only 47% evergreen species along paddy boundary. This is primarily because trees may not withstand water logging, and the presence of trees may reduce yield of paddy due to shading and competition for nutrients. Thus the farmers are aware of the ecological significance and ecological value of species that need to be planted and retained at different locations.

Home-gardens serve as sites for domestication of plants and performance of the species is assessed by the owner of the family with utmost protection. So these sites become sources of germplasm[16]. This could be one of the reasons for higher diversity of the species in home-gardens in the study area.

Farmers have a good knowledge of growth rates and useful products of many tree species, and were able to learn about exotic species also. All farmers identified species that serve as shade, wind-break, live fence, and their importance to maintain soil fertility. Thus people are aware of the inter-related benefits of a balanced mix of species for the home-garden. People of this region plant less fuelwood species and they are less dependent on home-garden trees for such purpose. Most of the households in the studied village are using fuel-efficient stoves or biogas for cooking, except marginal farmers[22]. Probably this could be the reason for people opting fruit-yielding tree species for self-consumption than going for timber or firewood species.

Table 6. Distribution of tree population according to end uses in Sirsimakki village agroecosystem of Uttara Kannada District

End uses	Example	Tree population (existing)	Percentage individuals
Fruits + vegetables + wind-break	*Musa paradisiaca* L. *Citrus* sp. *Mangifera indica* L. *Moringa oleifera* Lam. *Psidium guajava* L. *Cilicia* sp.	283	29.72
Income + consumption	*Areca catechu* L. *Cocos nucifera* L. *Sapindus laurifolia* Vahl. *Anacardium occidentale* L.	201	18.06
Foliage + shade + wind-break	*Careya arborea* Roxb. *Terminalia* sp. *Aporosa lindleyana* (Wt.) Baill *Vateria indica* L.	78	8.19
Timber + fruit	*Artocarpus heterophyllus* Lamk. *Tectona grandis* L. f.	76	7.77
Fencing + leaf manure	*Gliricidia maculata* Steud. *Citharexylum subserratum* Sw.	61	6.40
Fuel + pole	*Casuarina equisetifolia* Forst. *Acacia auriculiformis* A. Cunn. (Ex. Benth) *Cassia siamea* Lam.	58	6.09
Fodder	*Erythrina indica* Lamk. *Leucaena leucacephala* (Lam.) de wit	41	4.30
For worshiping (flower + fruit)	*Thevetia nereifolia* Juss. *Plumeria alba* L. *Nerium oleander* L. *Caesalpinia pulcherrima* L.	29	3.04
Keystone species	*Ficus* sp.	16	1.68
Others	–	136	6.40
Total	–	952	100

Such a phenomenon has been reported from Bangladesh, where people promote higher (40%) fruit-yielding trees for family consumption and are not dependent on home-gardens for firewood[23].

Our study has revealed that the species found in the agro-ecosystems are similar to those found in adjacent forests, indicating the willingness of the farmers to mimic the natural forests in their agro-ecosystems. Thus it is appropriate to consider local community as an integral part of ecosystem function for effectively managing agro-ecosystems in the tropics, with a concern of biodiversity. Although this study analyses tree diversity and end uses of tree species in different locations in Sirsimakki village ecosystem, many questions concerning agro-ecosystems have to be answered to understand the suitability of species in different land uses of the village ecosystem. Some of these aspects to be studied include influence of forest trees on horticultural crops, lopping methods, contribution of these trees for nutrient cycling and determination of tree crop/field crop combination.

1. Fernendes, E. C. M. and Nair, P. K. R., *Agric. Syst.*, 1986, **21**, 279–310.
2. Michon, G., Bompard, J., Hecketseiler, P. and Ducatillion, C., *Agrofor. Syst.*, 1983, **1**, 117–129.
3. Raintree, J. B., in *Agroforestry: Selected Readings* (eds Hegde, N. G. and Kelkar, V. D.), BAIF Publication, Pune, 1987, pp. 14–28.
4. Nair, M. A. and Sreedharan, C., *Agrofor. Syst.*, 1986, **4**, 39–363.
5. Ravindranath, N. H., Mohan Nayak, M., Hiriyur, R. S. and Dinesh, C. R., *Biomass Bioenergy*, 1991, **1**, 9–16.
6. Ravindranath, N. H., Nagaraju, M. S., Somashekar, H. I., Chenneswarappa, A., Balachandran, B. N. and Reddy, A. K. N., *Biomass*, 1981, **1**, 61–76.
7. Dhanda, in Proceedings of the National Workshop (eds Hegde, N. G. and Daniel, J. N.), 8–31 January 1991, Pune, BAIF Publication, 1992, pp. 105–112.
8. Gadgil, M., Technical Report Number 49, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, 1987.
9. Krebs, J., *Ecology: The Experimental Analysis of Distribution and Abundance*, Harper and Row Publishers, New York, 1985.
10. Avery, T. E. and Burkhart, H. E., *Forest Measurements*, McGraw Hill, New York, 1983.
11. Murali, K. S., Bhat, D. M. and Ravindranath, N. H., CES Technical Report Number 81, Centre for Ecological Sciences, Indian Institute of Science, Bangalore, 2000.
12. Ramakrishnan, P. S. *et al.* (eds), *Ecosystem Rehabilitation of Rural Landscape in South and Central Asia: An Analysis of Issues*, Spl Publ., UNESCO, New Delhi, 1994, pp. 29.
13. Ramakrishnan, P. S., Saxena, K. G. and Chandrashekara, U. M. (eds), *Conserving The Sacred: For Biodiversity Management*, UNESCO and Oxford & IBH Publications, New Delhi, 1998, pp. 480.
14. Gomez-Pompa, A., in *Biodiversity, Science and Development: Towards a New Partnership* (eds di Castri, F. and Younes, T.), CAB International, UK, 1996, pp. 347–356.
15. Herrera, N., Gomez-Pompa, A., Cruz Kuri, L. and Flores, J. S., *Biotica. Nueva Epoca*, 1993, **1**, 19–36.
16. Smith, N. J. L., *Int. Tree Crops J.*, 1996, **9**, 11–30.
17. Everet, Y., in *Indigenous Knowledge Systems: The Cultural Dimension of Development* (ed. Warren, D, M.), Kegan Paul International, New York, 1991.
18. Knight, D. H., *Ecol. Monogr.*, 1975, **45**, 259–284.
19. Singh, J. S., Singh, S. P., Saxena, A. K., Rawat, Y. S., Report on the Silent Valley Study, Ecology Research Circle, Kumaun University, Nainital, 1981, pp. 86.
20. Chandrashekara, U. M. and Ramakrishnan, P. S., *J. Trop. Ecol.*, 1994, **10**, 337–354.
21. Huxley, P. A., in *Attributes of Trees as Crop Plants* (eds Cannell, M. G. R and Jackson, J. E.), Institute of Terrestrial Ecology, Natural Environmental Research Council, Kendal, UK, 1985, pp. 13–35.
22. Ravindranath, N. H. and Hall, D. O., *Biomass, Energy and Environment: A Developing Country Perspective from India*, Oxford University Press, 1995.
23. Hocking D., Hocking, A. and Islam, K, *Int. Tree Crops J.*, 1998, **9**, 283–302.

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Basidiocarp production in *Agaricus heterocystis* Heinem. and Gooss. in nutrient agar media

The genus *Agaricus* consists of many well-tried edible species. The comprehensively studied and most widely used commercial species is *Agaricus bisporus* (J. Lange) Imbach[1]. Other edible mushrooms which are cultivated on a commercial basis include *Flammulina velutipes*, *Lentinula edodes*, *Pleurotus ostreatus* and *Volvariella volvacea*. A thorough knowledge of the eco-physiology of basidiocarp formation of these mushrooms would be of immense value[2]. This is possible by controlling 'fruiting' of these fungi in axenic culture. But getting most of these edible fungi to 'fruit' in axenic culture is a difficult task, although non-edible fungi, like species of *Coprinus* and *Schizophyllum commune* have been made to 'fruit' in axenic culture with ease[2]. This is a report of *Agaricus heterocystis* Heinem. and Gooss. producing fully mature basidiocarp in nutrient agar medium. This is of considerable importance keeping in mind that many species of *Agaricus* are edible.

The culture of *A. heterocystis* used in the present study was isolated from basidiocarps collected at the Guindy Campus of the University of Madras, Chennai. Pure culture of this species was made and subsequently maintained on potato dextrose agar (PDA) medium. This fungus has not been isolated as pure culture earlier. Production of basidiocarps in different media, viz. PDA, potato sucrose agar (PSA), malt extract agar (MEA), oat meal agar (OMA) and corn meal agar