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Short communication

Ficus trees in rainfed agricultural systems of Karnataka, southern India: An analysis of structure, benefits, and farmers' perceptions

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Abstract

Ficus spp. are abundant in the rainfed agricultural areas of southern Karnataka, especially in Mandya district, often in association with field crops. We describe here the structure of this less documented traditional agroforestry system and elicit the farmers' perceptions. Farmer interviews, village level group discussions, and field-walks were conducted to garner information on various aspects of *Ficus* planting in 18 villages of Mandya district. In the rainfed agricultural systems of the study area, *Ficus* trees provide fodder, shade, and fuelwood, besides performing environmental service functions such as supporting soil fertility and biodiversity conservation. The paper highlights the indigenous knowledge base and skills of farmers and the mutualistic linkages between components contributing to sustainability of the system.

Keywords: Traditional system, Ecological services, Cultural services.

Ficus (family Moraceae) is an integral component of the rainfed agricultural systems in Mandya district, in the southern dry agro-climatic zone of Karnataka. It is a large pan-tropical genus of woody flowering plants with more than 700 species (Kunwar and Bussmann, 2006). Although aspects like animal-mediated pollination and seed-dispersal mutualisms of *Ficus* and its role as keystone species in tropical ecosystems are well researched, its agroforestry potential remains unexplored except in terms of fodder value (Roder et al., 2003). Such documentations are increasingly relevant in the context of gradual disappearance of multipurpose trees from agricultural systems in the study area, owing to availability of assured irrigation water supplies, promotion of fast growing exotic trees and/or spread of intensive monocultures (Dhanya, 2011). This paper describes the structure of *Ficus* agroforestry system in Mandya in terms of its components, inter-linkages, and farmers' perceptions on the direct and indirect benefits.

Mandya district comprises of plain lands, covering an area of 4961 km^2, and lies between 76^{o}19' and 72^{o}20' east longitude and 12^{o}13' and 13^{o}04' north latitude at an elevation of 757 to 909 m and has a mean annual rainfall of 700 mm. The principal rainfed crops include finger millet or ragi (*Eleusine coracana* (L.) Gaertn.), sorghum or jowar (*Sorghum bicolor* (L.) Moench), maize (*Zea mays* L.), horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.), groundnut (*Arachis hypogaea* L.), castor (*Ricinus communis* L.) and sesame (*Sesamum indicum* L.), while paddy (*Oryza sativa* L.) and sugarcane (*Saccharum officinarum* L.) are predominantly grown in the irrigated areas. Native species like

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Ficus spp., *Azadirachta indica* A. Juss., and *Pongamia pinnata* (L.) Pierre are maintained as scattered trees on rainfed farmlands.

Farmer interviews were conducted in Mandya during 2008–09, using a two-stage stratified sampling procedure in which villages with abundance of *Ficus* trees were selected at 1% sampling intensity from each of the seven taluks of the district and six to nine *Ficus* growers (farmers who retained *Ficus* spp. in association with field crops) were randomly selected from each village. A total of 147 growers were surveyed from 18 villages in Mandya using a pre-tested semi-structured questionnaire to collect information on local agriculture. Ecological service functions (clean air, soil quality improvement, soil moisture conservation, preventing soil erosion, and supporting biodiversity) and cultural values (aesthetic, recreational, facilitating social interaction, religious, and cultural heritage services) of trees were pictorially represented in the questionnaire for ease of understanding and the farmers were asked to rank the trees based on their importance for providing these services. Composite indices for environmental and cultural services were developed by assigning a score of 1 for a tree species with a farmer's rank of 1 for a particular service function, 0.5 score for 2nd rank, 0.25 for 3rd rank, and so on and summing up the scores of all farmers for each service. Differences in compost usage between treeless farms and those with trees and reduction of crop yield due to trees were quantified based on farmer's responses, which were monetized based on market prices of finger millet grains and compost in Mandya. Two to four *Ficus* non-growers were also interviewed from each village (total sample size of 63 from 18 villages) to understand the reasons for non-planting of *Ficus*.

Additional information on cropping and tree management, landuse history, and government incentives for agriculture and agroforestry were gathered in village level group discussions. Field walks accompanied by farmer respondents were conducted to appraise the cropping pattern and record observations such as number and age of *Ficus* trees, total height and clean bole height (cbh; using multimeter), girth at breast height (gbh), and crown diameter (using measuring tape). Quantitative estimates of fuelwood and fodder yields were obtained from the respondents during the field walks, while data on timber yield and prices were collected from the timber mills. Yield data were cross-checked with timber volume estimates from biometric observations. Herbarium specimens (leaves, fruits etc.) of *Ficus* trees were made for taxonomic identification. Observations were also made on the avifauna of *Ficus* trees.

Of the 21 species of *Ficus* naturally occurring in Karnataka (Saldanah, 1984), nine were found in the agricultural systems of Mandya (Table 1). However, only four (*F. benghalensis, F. religiosa, F. racemosa,* and *F. mysorensis)* had distinct local names and all other species were interchangeably called *basari, karibasari, bilibasari, kalbasari* etc. (Table 1).

Table 1. Species of *Ficus* recorded from farmlands in Mandya, Karnataka, India.

Sl. No.	Scientific Name	Vernacular Name
1	*Ficus benghalensis* L.	*Ala*
2	*Ficus religiosa* L.	*Arali*
3	*Ficus racemosa* L.	*Athi*
4	*Ficus mysorensis* var. *pubescens* Roth.	*Goni*
5	*Ficus amplissima* Sm.	*Basari / Kalbasari/Bilibasari*
6	*Ficus caulocarpa* Miq.	*Basari/ Kalbasari/Karibasari*
7	*Ficus tsjahela* N.	*Basari / Kalbasari/Karibasari*
8	*Ficus virens* Aiton	*Basari / Kalbasari/Karibasari*
9	*Ficus parasitica* Koening ex.Willd	*Basari / Kalbasari/Karibasari*

Botanical identification in field was complicated due to a pronounced mismatch between taxonomic nomenclature and vernacular names, compounded by absence of figs on trees during field visits and the polymorphic nature of leaves. Rainfed crops like finger millet, sorghum, groundnut, horse gram, sesame and maize were important components of the *Ficus*-based agroforesty systems.

Ficus benghalensis was the most preferred species, retained by nearly 95% of the *Ficus* growers surveyed. Forty three percent of the respondents retained any two species, while 31% grew three *Ficus* species. Occurrence of only single species or more than three species together on the same farm was sporadic. *Ficus* trees were maintained at an average density of 16 trees ha^{-1} and the average age of trees was 20 years. Biometric observations on *F. benghalensis* revealed an average gbh of 1.55 m, total height of 14 m, cbh of 2.6 m, and crown diameter of 20 m, while *F. religiosa* trees had an average gbh of 1.71 m, total height of 14.75 m, cbh of 3 m and crown diameter of 10 m.

Ficus religiosa is usually dispersed by birds and the farmers selectively retained them on their lands. Other species are, however, propagated by planting large cuttings (2.5 to 3 m long) on farm boundaries or inside the fields in a scattered fashion at the beginning of the rainy season (June–July) and are fenced using locally available materials (bamboo thorns, coconut fronds etc.). Watering is done during summer for two years. Once the canopy opens up, trees are pruned, usually during summer (March–May) once in two-three years to reduce competition with agricultural crops. Roots are invariably pruned during the ploughing operations. Trees are lopped regularly for fodder and firewood and the final harvest is at around 20 years, when the trees are selectively harvested after ensuring replanting to sustain the system.

Ficus provides multiple products (Table 2) and services, which would probably explain its abundance in the farmers' plots. Among the ecosystem services, soil quality enhancement through litterfall had the maximum aggregate score across respondents (137), followed by biodiversity conservation (129) and prevention of soil erosion (107). Fifty percent of respondents also reported lower compost application in farms with *Ficus* trees due to its soil enrichment potential, saving Rs. 1093/ha on compost usage. The annual loss of crop yields due to shading, however, was to the tune of Rs. 4463/ha for finger millet. Nonetheless, 75% of respondents felt that this loss was compensated by the regular accrual of various benefits from trees and could be further minimized by silvicultural operations.

Ficus-based systems were also more "biodiverse" and hence more ecologically sustainable. Birds like coppersmith barbet (*Megalaima haemacephala* Muller), common myna (*Acridotheres tristis* L.), and red-whiskered bulbul (*Pycnonotus jocosus* L.) and

Table 2. Direct benefits from *Ficus* species in farmlands of Mandya, Karnataka, India.

Benefit	Percentage of responses	Quantity*/ Value*	Remarks
Fodder	37	200 kg/year	Supply fodder in summer when alternative sources are scarce. Beyond the reach of browsing animals; hence requires no protection (Roder et al.,2003)
Shade	26	–	Relief to farmers from hot weather
Fuelwood	14	100 kg/year	Household use and sold as fuel for brick kilns
Lumber	11	0.85 m^3	Used for ceiling, windows and doors in traditional houses. Locally fetch Rs.8825/m^3
Money on sales	5	Rs. 7500	Helps to tide over financial contingencies in family

* From a 20 year old *F. benghalensis* tree

small mammals like bats help in propagation of *F. religiosa*, while black ibis (*Pseudibis papillosa* Temminck*)* control millet pests (Soni, 2008). However, 17% of the respondents reported crop loss on account of herbivory by birds. *Ficus* is highly valued for social and cultural services also, especially for providing a platform for social interactions like village meetings (aggregate score 144), religious functions (score 126), and recreational activities (score 99), which is a good indication of its cultural acceptability. However, such values may be more applicable to the *Ficus* trees near temples or near common meeting places.

Tree management including pruning, lopping for fuelwood and harvest are usually carried out during non-cropping periods (February-April), implying seasonal division of labour and complementarity in labour utilization. Although family labour is largely used for tree management, these systems are capable of generating alternate employment avenues. Indications are that *Ficus* agroforestry system in Mandya with an average holding size of 2.2 ha can generate upto 150 labour days per year per farm. In addition, *Ficus*-based agroforestry systems provide grains, fuelwood, timber etc. to the household. Fodder and straw are fed to livestock, which provides dairy products and farm yard manure. Birds, small mammals and insects help pest control and facilitate tree propagation.

On the whole, the present study revealed the potential of *Ficus* as an agroforestry species for the drylands of southern Karnataka. Ability of the species to survive under harsh conditions, cultural acceptability, multiple use benefits, and ability to provide vital ecological services and reduced dependence on external inputs are plausible explanations. Despite this, a declining trend in *Ficus* planting was noted, which may be due its low timber value (29% of responses) and the longer duration to attain maturity (29%). Yet another reason for non-adoption is non-availability of planting material and absence of government incentives. While *Eucalyptus*, teak (*Tectona grandis* Linn.f.), silver oak (*Grevillea robusta* A. Cunn. ex R. Br.), and various horticultural trees were ubiquitously distri-buted by government agencies in the study area at subsidised prices, *Ficus* sapling distribution was noticed only in three out of the 18 villages surveyed. It calls for a relook of the extension programmes, in which native species like *Ficus* should be promoted.

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