Multi-purpose tree diversity and distribution assessment in Mali

2015 Annual Report

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Introduction

Trees are known to play very important roles in rural households' livelihoods and resilience of the agricultural systems in the dry areas. In the framework of the Dryland Systems CRP, surveys were conducted on multipurpose trees diversity and distribution in Koutiala, Mali and in Wa in Ghana. The current report presents the preliminary results from the survey conducted in Koutiala, Mali and Lawra in Ghana.

Material and methods

The surveys were conducted along the Wa-Bobo-Sikasso (WBS) action transect. For further evaluation of the potential impacts of foreseen research interventions on the agricultural systems and economic development in the area, one test site and one control site were defined in each country, based on a number of characteristics. In addition, one intermediate test site was defined, in order to monitor the effects of interventions along a gradient of natural, infrastructural, social, financial, and human capital assets. Data were collected on useful multipurpose trees, along with crops, animals, and aquatic species diversity and access to market.

The diversity of multipurpose trees, crops and animals was assessed through focus group discussions and household surveys. A total of 180 and 175 households were respectively (randomly) selected in the three villages identified in each country, to participate in the household survey, while the FGDs data was gender disaggregated.

We calculated the species richness (r) as the actual count of different species managed at household or at community level. To account for evenness of the distribution of species within the communities, we computed the two most widely used diversity indices: the Shannon-Weaver and Simpson's diversity indices. The Simpson's diversity index was compared with Shannon's to check for consistency in the results, as it is indicated that Simpson's diversity index is not sensitive to rare species [1].

Results

Species diversity and evenness within and between communities

In Mali, households in N'Goutjina tended to exploit higher richness of tree species. This commodity group showed higher species richness compared to the others (Figure 1). The trees' commodity group was the most diversified. Based on the relative frequencies of mentions, *Parkia biglobosa*, *Vitellaria paradoxa*, *Mangifera indica,* and *Adansonia digitata* remained for the most commonly used tree species in each of the three communities. However, this diversity is dominated by indigenous tree species.

Trees are used for multiple purposes and these included use for food, fodder, construction materials, soil fertility enhancer, medicine, stools, farm equipment, etc. (Tables 1 and 2). Farmers managed about 19 tree species in Lawra, Ghana, compared with 25 in Koutiala, Mali.

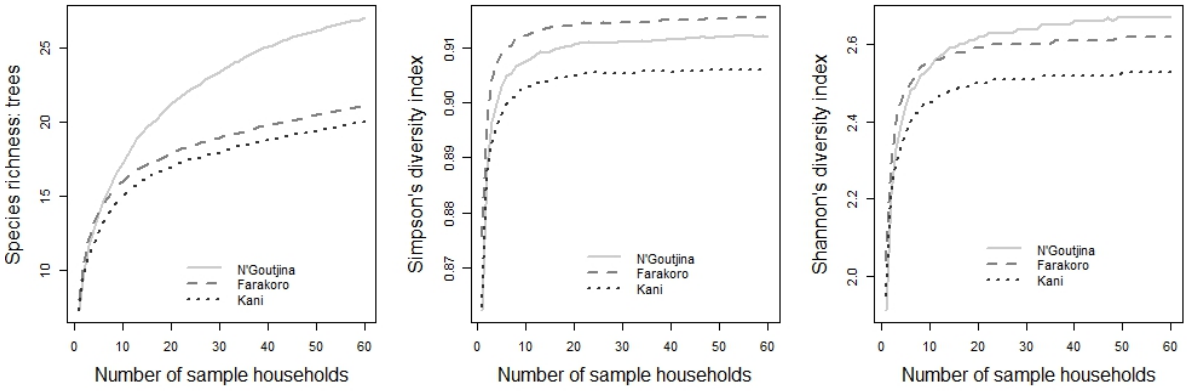

Figure 1. Estimated species richness, Simpson and Shannon's agroforestry species diversity indices in Koutiala, based on incidence data

Table 1. Identified agroforestry species with the uses by the households in Koutiala, Mali*

Species	Food	Fodder	Medicinal	Fuel	Construction	Soil.fertility	Soap	Total mentions
Parkia biglobosa	159	35	28	19	4	1	0	246
Vitellaria paradoxa	163	8	36	21	4	2	0	234
Mangifera indica	113	9	23	7	0	0	0	152
Adansonia digitata	104	4	15	1	0	0	0	124
Tamarindus indica	46	1	10	3	1	0	0	61
Borassus aethiopum	44	1	3	0	8	0	0	56
Citrus limon	38	0	5	1	0	0	0	44
Carica papaya	25	2	7	0	0	0	0	34
Anacardium occidentale	17	1	5	3	0	0	0	26
Blighia sapida	15	0	3	0	0	0	0	18
Bombax costatum	10	2	2	0	0	0	0	14
Jatropha curcas	1	0	0	2	0	9	1	13
Psidium guajava	10	0	3	0	0	0	0	13
Eucalyptus camaldulensis	0	0	0	2	7	0	0	9
Diospyros mespiliformis	4	0	1	0	0	0	0	5
Sclerocarya birrea	3	1	1	0	0	0	0	5
Ziziphus mauritiana	4	0	1	0	0	0	0	5
Lannea microcarpa	2	0	0	1	0	0	0	3
Lawsonia inermis	0	0	0	0	0	3	0	3
Azadirachta indica	0	0	1	1	0	0	0	2
Faidherbia albida	0	2	0	0	0	0	0	2
Ficus capensis	2	0	0	0	0	0	0	2
Musa acuminata	2	0	0	0	0	0	0	2
Annona squamosa	1	0	0	0	0	0	0	1
Cordyla pinnata	1	0	0	0	0	0	0	1

*The numbers in cells are the number of households that reported a specific use of the species. The most mentioned are on top.

Table 2. Identified agroforestry species with the uses by the households in Lawra, Wa, Ghana*

Species	Food	Fodder	Medicinal	Fuel	Construction	Other	Total mentions
Mangifera indica	127	55	65	29	38	3	317
Blighia sapida	82	30	18	19	26	0	175
Parkia biglobosa	41	37	18	10	36	0	142
Vitellaria paradoxa	40	27	9	11	32	0	119
Moringa oleifera	76	15	8	0	0	0	99
Crateva adansonii	62	13	2	1	1	0	79
Carica papaya	33	11	22	0	1	0	67
Anacardium occidentale	31	10	1	7	5	0	54
Citrus sinensis	25	5	8	5	3	2	48
Diospyros mespiliformis	17	4	1	9	13	0	44
Psidium guajava	8	4	7	0	0	0	19
Adansonia digitata	13	2	2	0	0	0	17
Tectona grandis	0	0	1	3	7	0	11
Citrus limon	4	0	1	0	0	0	5
Azadirachta indica	1	1	2	0	1	0	5
Vernonia amygdalina	4	0	0	0	0	0	4
Hannoa undulata	3	0	0	0	0	0	3
Icacina oliviformis	1	0	0	0	0	0	1
Musa paradisiaca	1	0	0	0	0	0	1

A number of agroforestry species were used during the lean season to cope with food shortage in both countries. In Koutiala, these were *Adansonia digitata, Borassus aethiopum, Mangifera indica, Musa acuminata, Parkia biglobosa, Vitellaria paradoxa*, and *Vitex doniana* . The main edible parts of the species were their fruits (77%) and seeds (19%). While many of them could be eaten raw, some of them required processing before consumption. About 64% of them could be eaten raw without any processing and thus played important role in child nutrition when they are outside family compounds.

Men and women managed relatively the same diversity of crop and animal breeds in Koutiala (Table 3). However, there was a significant gender difference in the management of agroforestry and the other wild-harvested species ($p<0.001$). The Simpson's index of diversity (SID = 0.88) indicated a high diversity of tree species managed in each of the three communities (Table 4). However, no significant difference in the diversity of tree species was observed within the communities ($p>0.05$). The high value for the Simpson's index means that there is a high probability that two households randomly selected in any of the studied communities will use different species. Consequently the dominance, measuring the probability that there will be dominant species in the communities is very low. The highest diversity was noted in the annual crops, compared to the other commodity groups (SID ≥ 0.90).

Table 3. ABD richness by gender, at community level, from FGD data

	N'Goutjina		Farakoro		Kani		p-value between men and women
ABD_Component	Men	Women	Men	Women	Men	Women	
Agroforestry	25	15	20	14	25	12	p<0.001
Annuals	30	30	28	31	29	28	p>0.05
Domestic animals	11	11	10	9	11	11	p>0.05
Fish and other aquatic resources	4	6	6	5	3	3	p>0.05
Purchased	33	27	57	57	19	32	p>0.05
Sold	34	29	36	30	37	27	p>0.05
Sweet potato varieties	3	2	2	2	3	2	p>0.05
Wild animals	10	8	8	14	14	11	p>0.05
Wild plants	27	10	22	8	18	10	p<0.001

Table 4. Simpson's index of diversity per type of species and per village

Commodity groups*	Village	Species richness	Average richness*	Dominance Index (D)	Simpson's Index of Diversity (SID)
Trees	Farakoro	20	5.32	0.12	0.88
Trees	Kani	19	4.97	0.12	0.88
Trees	NGoutjina	27	4.35	0.12	0.88

*number of species managed per household in average.

Relationship between tree diversity, food availability and some socioeconomic variables

Tree diversity showed significant and positive correlation with family labor ($r=0.22$, $p<0.01$), size of cultivated ($r=0.20$, $p<0.05$) and spared land ($r=0.16$, $p<0.05$), total useful diversity managed by the household ($r=0.58$, $p<0.001$), market diversity ($r=0.22$, $p<0.01$), and household food sufficiency ($r=0.18$, $p<0.05$). Also, playing a leadership role in the community and participation in civil societies and environmental activism is associated with higher diversity of trees managed by the households. For instance, responsibility of the household members in the environmental activism ($r=0.23$, $p<0.01$) or youth groups ($r=0.19$, $p<0.01$) are correlated with high tree diversity. However, there seemed to be a negative correlation with tree diversity and selling of family labor for agricultural employment ($r = -0.15$, $p<0.05$). This would mean that the households owning higher diversity of useful trees rarely sent their members to sell their labor force in the agricultural sector.

Conclusion

There is an important diversity of multipurpose trees in the survey area, with among them a great diversity of food plants. The species played significant function in household livelihoods and resilience to shocks, and this needed to be tamed into the different interventions aimed at reducing food insecurity and overall poverty in the area.

Cited references

1. Colwell RK (2013) EstimateS: Statistical estimation of species richness and shared species from samples. Version 9.1.0 User's guide. USA.