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RESEARCH ARTICLE

AN ASSESSMENT OF FARMER'S PERCEPTION ON THE ADOPTION OF LOCAL SPECIES IN THE FARMING SYSTEMS OF THE SUDANO-SAHELIAN ZONE OF CAMEROON

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ABSTRACT

Low herbaceous cover is a major constraint to productivity in the farming systems of Sudano-Sahelian zones. The adoption of herbaceous species for the improvement of these farming systems has been quite low in the Sudano-Sahelian zone of Cameroon. In a survey that looked at the role of herbaceous species in the farming system, farmer perception of the potential use and importance of local herbaceous species was also evaluated. Famers identified most of the species encountered with well known local uses. When grouped according to local uses, 38% were used as forage, 21% for medicinal purposes and 11% for soil cover followed by human consumption, other uses, in that order. *Arachis hypogaea* and *Hibiscus sabdarifa* were ranked highest in terms of local use, followed by *Senna obtusifolia, Sesbania rostrata* and *Crotalaria spectabilis.* Factors that are liable to facilitate adoption of local species by farmers were plant performance and productivity, especially in associations with the main crop. Prior knowledge of a species and land ownership would seem to influence farmer adoption. Governments' policy on land-use and management should be holistic, taking into account implementation of research initiatives. This will help in the improvement of productivity of farming systems and the maintenance of environmental equilibrium with the ultimate goal of poverty reduction and improved livelihoods.

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INTRODUCTION

Cover cropping technology and other forms of crop management for soil improvement have been demonstrated in most farming systems worldwide with considerable success with herbaceous leguminous species (Njiti and Galiana 1996; Mpairwe *et al*., 2002; Anikwe and Atuma 2003; Anthofer and Krschel 2005; Fofana *et al*., 2005; Mapfumo *et al*., 2005; Crammer *et al*., 2006). In North Cameroon, these species also provide high quality feed for livestock as well as being a good protein source for the household. Their adoption in the cropping systems of this region has however been slow notwithstanding several attempts at their dissemination (Onana and Yonkeu 1994; Klein 1995; Youri 1998; Olina and Dugue 1999; Asongwed-Awa *et al*., 2007). In the Sudano-Sahelian zone of Cameroon, legumes form only about 30% of the herbaceous cover and are often the most affected by bush fires and high grazing pressure (Asongwed-Awa *et al*., 2007; Onana *et al*., 2007). Generally, indigenous legume species in this cereal-based cropping system are mostly grain legumes for human consumption such as groundnuts, cowpeas, pigeon peas and a few leafy vegetables (Dugue, 1995). Their foliage are cherished as crop residues for livestock feeding and are often carried off the farms and stored for use in the dry season, thus leaving the soil bare and prone to erosion and other natural environmental hazards. Long periods of natural fallow (15 – 20years) which were the general practice for maintaining soil fertility on croplands, have today been shortened to as little as 1 – 2 years thus reducing the ability of these fallows to maintain useful plant species that could serve for soil rejuvenation (Harmand *et al*., 2003). Several studies on the evolution of soils in this region have linked the reduction in

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crop yields to a decline in soil nitrogen, phosphorus and other nutrients (M'Biandoun and Douzet 2000; Guibert *et al*., 2001; Fesneau 2004). Soil N accumulation is naturally enhanced by legume species through the conversion of atmospheric N into plant utilisable forms in association with rhizobia (Herren and Donahue 1991; Harmand *et al*., 2003; Harmand *et al*., 2004). Use has been made of these N-fixing capabilities of legumes in farming systems throughout the world to meet nitrogen requirements of degraded soils (Miles and Manson 2000). Studies elsewhere have advanced the concept of the use of indigenous legume fallows as a promising initial step to integrate these currently under-utilized resources into local farming systems (Dugue 1995; Anikwe and Atuma 2003; Mapfumo *et al*., 2005; Alhamad 2006). The integration of indigenous legumes in the farming system of the Sudano-Sahelian zone of Cameroon should aim at optimising the benefits that can be obtained from these species in terms of soil fertility improvement, increased herbaceous biomass for livestock and the maintenance of a rich floral biodiversity. This is important in this farming system where the high dependence on mineral fertilizers and feed supplements for crop and livestock production respectively depicts the need for new strategies that will increase productivity as well as enhance sustainability (Awa *et al*., 2004; Olina *et al*., 2008). This study aimed at reviewing the use and importance of herbaceous species in local farming systems and assessed farmers' perception of the adoption of local legumes in farming systems of the Sudano-Sahelian zone of Cameroon. It also examined factors that are liable to influence the adoption of local herbaceous species in the farming systems of Sudano-Sahelian zones.

MATERIALS AND METHODS

Study Site

The study was carried out in Lainde Massa, a village located 45km South of Garoua, in the North Region of Cameroon. The climate is described as Sudano-Sahelian, with an annual precipitation of 800 - 1100 mm (Onana 1995). Rainfall is monomodal, through the months of May to September (4 - 5 months). Mean temperatures are above 30° C and may go up to 40° and above during the hottest months of March - May. Relative humidity averages between 40% and 80% in the dry and rainy seasons respectively. Main soil type is Orthic Acrisols in association with Orthic Ferrasols (IFDC/USAID, 1986), with six sub soil types distinguished by farmers as per their colour and consistence with varied amounts of clay, sand or fertility status. Crop and livestock keeping are major activities at this site. Major crops are cotton, groundnuts, cowpea, cereals (maize, sorghum). Large herds are kept out of the village by cattle rearing communities while small livestock like sheep, goats and pigs are maintained in the village all year round. The area is occupied mostly by migrant populations from the Far North Region of Massa, Mundang, Tupuri and Mufu tribes, who were moved Southwards during the 1980s from the over- populated areas of the Far North Region.

Survey Method

A survey was carried out with the aid of a questionnaire at the study site (Lainde Massa), to assess farmer's knowledge of the role of local herbaceous species and response to the use of indigenous herbaceous species in local farming systems. 80 farmers were chosen at random, 40 having introduced and used a cover cropping system and 40 with no earlier knowledge of or use of cover crops. With the help of farmers, the different species encountered on the field were identified and their uses recorded. Each of the 80 farmers was presented with samples of selected indigenous species. Each farmer's opinion on the performance and suitability of each species in their farming system was recorded based on pre-defined criteria. All other characteristics which could influence the farmer's disposition for use of these indigenous species were also noted. Data collected was analysed using the Statistical Package for Social Sciences (SPSS).

RESULTS

Locally encountered species and their common uses in the herbaceous cover

Over 60 species of grass, legumes and forbs were encountered on the field and recognized by farmers for various uses (Table 1). Uses for most of the species identified are varied and well-known by some farmers as they acknowledged the multiple uses and importance of some of these species in the livelihood of the local population. Most of these species do not only serve as forage for livestock, but also provide vegetables for human consumption, have medicinal value for human and animals, as well as other common uses. When grouped according to known uses, 38% were used as forage, 21% for medicinal purposes, 11% for soil cover and soil improvement and 9% for human consumption (Figure 1). Some were used for other purposes such as construction (hut or stable), rope, mat and mattress making while others were acknowledged for their mulch accumulation and erosion control potentials.

Socio-economic characteristics of farmers at the study site: The socio-economic characteristic of farmers surveyed is presented in Table 2. The majority of farmers (heads of farm households) were men (96%), with age range from less than 30 years (17%) to above 50 years (21%). Illiteracy rate was 31% while the rest had at least primary education. Only about 50% owned 1 – 5 hectares of land, while 77% had only 1 – 5 hectares under cultivation for that year.

Characteristics of farms and farm households

Farmers were classified into four farm types based on land occupation and farming activities (Table 3). Type I farm households had less than 1 hectare under cultivation (cotton, cereals and vegetables), either through rentage or gift, for they owned no land and were generally new comers to the village. They formed 11.25% of the survey group. Type II farm households own 1 – 5hectares of land and have about the same area under cultivation. These households formed the largest group (52%), and would have spent about 5 – 10 years in the village. In addition to crop farming, they owned a few livestock (cattle, small ruminant and pigs). They grow cereals, cotton and vegetables. Type III farm households owned 5 – 10 hectares of land under cultivation. They make up about 28% and aged between 30 – 50 years old.

Table 1. Some commonly encountered species in the Sudano-Sahelian zone and their recognized roles/common uses

Species	Common uses
Acanthospermum hispidum	Medicinal (Fever, colds)
Ageratum conyzoides	Construction (artisanal)
Alysicarpus rugosus	Forage
Amaranthus sp	Human Nutrition
Andropogon spp	Forage, construction
Brachiaria jubata	Medicinal (alcohol), Forage
Boerhavia sp	Construction (artisanal)
Calopogonium mucunoides	Forage, Soil fertility, soil cover, erosion control
Senna spp	Medicinal (Fever), Human nutrition, Forage
Cenchrus biflorus	Forage
Chloris pilosa	Forage
Cleome viscosa	Medicinal
Commelina benghalensis	Construction (artisanal)
Corchorus sp	Forage, Rope, Human nutrition
Crotalaria retusa	Soil fertility
Cynodon dactylon	Erosion control
Cyperus esculentus	Forage, Human nutrition, deodorant, witchcraft
Dactyloctenium aegyptium	Forage, Medicinal
Desmodium spp.	Human nutrition, Forage
Digitaria horizontalis	Forage
Echinochloa spp	Forage, Soil improvement
Eleusine indica	Erosion control
Eragrostis aspera	Medicinal, Witchcraft
Euphorbia hirta	Medicinal
Hibiscus sabdarifa	Human Nutrition
Hyparrhenia rufa	Forage
Hyptis suaveolens	Soil fertility
Imperata cylindrica	Broom
Indigofera spp	Medicinal, Human nutrition
Ipomea spp	Forage
Killinga pumila	Human Nutrition (roots), Forage
Mariscus squarrosus	Medicinal (anti-poison)
Mitracarpus villosus	Medicinal (rashes, palpitations, gumboro)
Ocinum basilicum	Medicinal (Fever, colds, headache).
Oldenlandia herbacea	Forage
Panicum pansum	Forage
Physalis angulata	Medicinal (fever, hemorrhage, abscess, stomach pains) Soil fertility
Paspalum spp	Forage
Rottboellia cochinchinensis	Forage
Sesbania rostrata	Mats, Mulch
Setaria pumila	Forage
Sida spp	Broom, Rope, Gum, Stakes (goats)
Siphonochilus aethiopicus	Medicinal
Sporobolus indicus	Broom, Forage
Striga spp	Forage
Tephrosia bracteolata	Soil cover, mulch, Forage
Triompheta cordifolia	Soil cover, mulch, Rope
Waltheria indica	Medicinal (Stomach pains, tooth ache, rashes colds)
Zornia glochidiata	Human Nutrition, Forage

Table 2. Socio-economic characteristics of farmers

Variables	Modalities	Number of farmers	Percentage (%)
Sex	Male	77	96,25
	Fémale	3	3,75
Age	Less than 30 years	14	17,5
	30 - 50 years	49	61,25
	More than 50 years	17	21,25
Literacy level	No formal training	25	31,25
	Primary	33	41,25
	Secondary	22	27,5
Number of years spent in the village	Since birth	10	12,5
	Less than 5 years	8	10,0
	5 – 10 years	7	8,75
	11 – 20 years	32	40,0
	More than 20years	23	28,75
Land owned	0	9	11,25
	Less than 5ha	40	50,0
	5 – 10ha	20	25,0
	More than 10ha	11	13,75
Area under cultivation	Less than 1ha	5	6,25
	1 – 5ha	62	77,5
	6 – 10ha	10	12,5
	More than 10ha	3	3,75
Previous knowledge with cover crops	Yes	40	50
	No	40	50

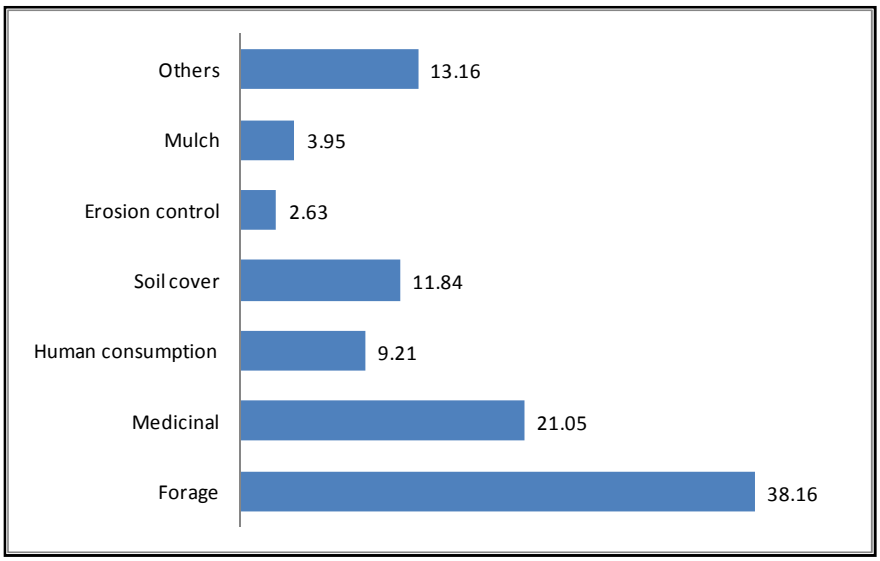

Figure 1. Proportion of common uses of local herbaceous species as identified by farmers

Table 3. Typology of farm households

Types of farm	Area under cultivation	Land owned	Family size	Active members	Longevity in the village	Total number of farmers
Type I	<1 ha	Non	< 5	< 5	< 5 years	9
Type II	1 – 5 ha	<5 ha	5 - 10	< 5	5 - 10	42
Type III	6 – 10 ha	5 – 10 ha	11 - 15	5 - 10	11– 20	23
Types IV	>10 ha	>10 ha	16 - 20	11 - 20	> 20 years	6

Table 4. Farmers' appreciation of local herbaceous species

Species	Biomass productivity(a)				Competitiveness with main crop(b)				
	L	**A**	**H**	**DK**	**NA**	**SA**	**A**	**VA**	**DK**
Aeschynome sp	50	13	4	13	38	3	22	1	15
Alysicarpus sp	18	8	45	19	24	8	25	2	18
Arachis hypogaea	0	1	78	1	57	19	2	0	25
Cajanus cajan	0	1	54	25	42	1	11	0	25
Senna obtusifolia	1	2	75	4	35	16	21	2	5
Senna occidentalis	0	2	75	3	34	16	23	1	5
Crotalaria spectabilis	5	0	69	6	39	11	20	0	0
Desmodium adscendens	5	17	49	9	19	7	34	7	10
Hibiscus sabdarifa	0	0	77	3	37	29	11	0	76
Indigofera hirsuta	0	0	4	76	37	29	11	0	3
Indigofera nummulariifolia	1	2	64	13	16	10	34	1	15
Sesbania sp	1	6	67	6	38	17	19	1	5
Tephrosia sp	12	34	27	7	40	7	21	1	8
Vigna radiata	1	0	76	3	22	10	39	4	5

(a)Biomass production= L: low, A: average, H: high, DK:don't know
(b)Competitiveness : NA=not aggressive, SA=slightly, A=aggressive, VA= very aggressive, DK=don't know

Table 5. Farmers' knowledge of importance/use of selected species

Species	DK	NU	SI	O	P	F	HC
	Number of respondents						
Aeschynome sp	15	23	0	1	1	38	2
Alysicarpus sp	21	14	0	0	0	44	1
Arachis hypogaea	1	0	54	0	1	77	79
Cajanus cajan	27	15	0	1	1	30	14
Senna obtusifolia	4	0	0	0	5	62	75
Senna occidentalis	5	2	0	1	59	5	63
Crotalaria sp	13	26	3	4	3	26	9
Desmodium adscendens	14	19	0	0	2	45	1
Hibiscus sabdarifa	3	0	6	0	0	74	76
Indigofera hirsuta	76	3	0	0	0	1	0
I. nummulariifolia	14	28	0	0	1	36	1
Sesbania sp	6	11	0	50	1	18	3
Tephrosia sp	8	2	0	2	0	67	2
Vigna radiata	4	22	0	2	1	52	1

Uses: DK= Don't know, NU =not useful, SI= Soil improvement, O= others, P= pharmacopoeia, F= forage, HC = human consumption

Table 6. Farmer rating of the probability of adopting local herbaceous species in farming systems

Species	Percentage respondents					
	Yes	%	No	%	Don't Know	%
Aeschynome sp	26	32.5	37	46.25	17	21.25
Alysicarpus sp	19	23.75	40	50.0	21	26.25
Arachis hypogaea	77	96.25	2	2.5	1	1.25
Cajanus cajan	36	45.0	20	25.0	24	30.0
Senna obtusifolia	49	61.25	27	66.75	4	5.0
Senna occidentalis	37	46.25	37	46.25	6	7.5
Crotalaria sp	42	52.5	27	33.75	11	13.75
Desmodium adscendens	19	23.75	52	65.0	9	11.25
Hibiscus sabdarifa	68	85.0	9	11.25	3	3.75
Indigofera hirsuta	2	2.5	2	2.5	76	95.0
Indigofera nummulariifolia	20	25.0	48	60.0	12	15.0
Sesbania sp	45	56.25	27	33.75	8	10.0
Tephrosia sp	35	43.75	36	45.0	9	11.25
Vigna radiata	36	45.0	41	51.25	3	3.75

They have larger families and keep a good number of cattle amongst its livestock which is often used for ploughing the field. This group is more versed with the use of cover crops for soil improvement through their cooperation with SODECOTON. Type IV households own above 10 hectares and constitute the longest occupants of the area (>20years). They are more diversified in crop production given their large land area and bigger families. They grow cotton, cereals and a host of vegetables and keep larger numbers of livestock. They formed just about 14% of the survey group. Types II and III households constituted the majority of farm households and are also the groups with the greatest percentage (78%) of farmers with knowledge in the use of cover crops for soil improvement.

Farmers' appreciation of local herbaceous species

Farmers were able to quantify the herbage productivity of selected local herbaceous species common in their environment as well as their effect on associated crops (Table 4). *Arachis hypogaea*, *Hibiscus sabdarifa* (foléré), *Vigna radiata* and *Senna obtusifolia* (Tasba) were ranked 1st, 2nd, 3rd and 4th respectively by 97.5%, 96.25% and 95% respondents in terms of herbaceous biomass productivity. In terms of competitiveness with associated crop, *Arachis hypogaea* was considered least aggressive in associations by 71.25% of respondents, followed by *Cajanus cajan* (52.5%), and *Tephrosia sp*. (50.0%), while *Indigofera nummulariifolia, Desmodium adscendens*, *Vigna radiata* and *Alysicarpus sp*. though considered not aggressive by some farmers, were termed most aggressive by others.

Farmers' knowledge of importance/use of selected species

The most common uses of the selected herbaceous species as identified by farmers were for human consumption, forage, traditional pharmacopoeia and artisanal use (roofing, broom, mats, etc) (Table 5). *Arachis hypogaea* (96%), *Hibiscus sabdarifa* (91%), *Senna obtusifolia* (72%) and *Senna occidentalis* (68%) were noted for human consumption as well as forage for livestock. Noted mostly for forage were *Tephrosia sp* (82,50 %), *Vigna radiata* (63,75 %), *Aeschynome sp* (47.50 %), *Alysicarpus sp* (55,00 %), *Desmodium adscendens* (55 %), *Indigofera nummulariifolia* (43,75), *Cajanus cajan* (27,50%), *Crotalaria spectabilis* (28,75 %), *Senna occidentalis* (6,25 %), *Sesbania sp* (13,75 %) and *Indigofera hirsuta* (1,25 %). These species are most commonly found in pastures. Traditional pharmacopoeia is another very important use of herbaceous species in local farming systems. *Arachis hypogaea, Cajanus cajan, Desmodium adscendens, Vigna radiata, Sesbania sp, Indigofera nummulariifolia,* are all used in local medicine even though *Senna occidentalis* is the most used according to 68.75% of respondents in the treatment of malaria, fevers, rheumatism, typhoid etc. As for soil fertility restoration, only 3.75% of respondents could assess the soil improvement potential of some of these species. Other usage included roof, fence, mat and broom making.

Farmers' perception of the potential use/adoption of selected local species in local farming systems

The probability of adopting the different species in local farming systems as reported by the farmers is presented in Table 6. *Arachis hypogaea* and *Hibiscus sabdarifa* were placed highest by respondents with 96.25 and 85% respectively. It is followed by *Senna obtusifolia (61.25%), Sesbania sp. (56.25%) and Crotalaria sp. (*52.5%). These species are mostly those noted for use in human and animal consumption, with some potential in soil improvement. *Desmodium adscendens* was the lowest rated for probable adoption (2%), where 95% of respondents did not know whether or not this species would be adopted, given that knowledge of it is related to its incidence on poor soils where it is thought to be a cause of soil degradation rather than a consequence. Thus in terms of adoption, *Arachis hypogaea, Cajanus cajan, Senna obtusifolia, Crotalaria sp,* and *Hibiscus sabdarifa* seem to have a high probability of being adopted by farmers since they already appreciate their performance and use in their day to day activity. They had a higher yes percentage probability than no.

DISCUSSION

Farmers' identification of about 60 species as being important in the livelihood of the local population with varied uses is an important tool for local improvement schemes. These common uses mentioned by farmers are an indication of how well they are acquainted with these species. Some were known for their mulch accumulation and erosion control qualities which they acknowledge are helpful to the soil. This common knowledge

of local species is of advantage especially as we look into selecting and introducing local species with specific roles for the improvement of local farming systems, having so far failed with exotics. A concept viewed as a promising step in the integration of these hitherto under-utilized plant resources into local farming systems especially given their role in biological nitrogen fixation (Dugue 1995; Anikwe and Atuma 2003; Mapfumo *et al*., 2005; Alhamad 2006; Njiti and Galiana 1996; Mpaiwe *et al*., 2002; Anthofer and Kroschel 2005; Fofana *et al*., 2005; Crammer *et al*., 2006). Four classes (Types) of farmers were encountered during our survey; Type I with small land areas and often new comers to the village (11.25%), Type II who occupied 1-5hectares of land and owned a few animals (52%), Type III who were established farmers owning 5-10 hectares of land under cultivation (28%) and Type IV owning over 10 hectares of land with a good number livestock (14%). Knowledge of local species and willingness to work with development organizations was observed with members of Types II and III. These groups were generally middle-aged (30-50 years old), with an open mind and ready to share experiences. They are pressured by land shortage and are willing to carry out ventures that will improve on productivity. This is in line with results by Isabirye *et al*. (2010) where adoption of belowground biodiversity technologies by small holder farmers was significantly driven by farm size, household size and farmer status amongst others.

Farmers recognized different species for their different roles in the farming system. *Arachis hypogaea* and *Hibiscus sabdarifa* were ranked highest in terms of local use, followed by *Senna obtusifolia, Sesbania rostrata* and *Crotalaria spectabilis.* The highest ranked species were mostly those noted for use in human and animal consumption, with some potential in soil improvement and thus have the highest probability of being adopted because of this previous knowledge. All the other species were also noted though at lower rates. The farmers' perception of fertility improvement is the presence of dark soils under these species. This could be a result of organic matter deposition from accumulated mulch. *Indigofera nummulariifolia, Desmodium adscendens*, *Vigna radiata* and *Alysicarpus sp*. were perceived by some farmers as important by the fact that these species have a good spreading capacity and quickly cover the soil where they are found. Generally, farmer's perception of species importance was influenced by their local use. *Crotalaria sp*. was recognized by 2.5% of the farmers as an inhibitor of an important weed Striga *sp*. in intercrops with cereals. However, a relatively unknown species such as *Desmodium adscendens* which also seems to have an effect on the incidence of *Striga spp*. cannot be neglected even though its role in weed suppression was not recognized by farmers, given that knowledge of it (*Desmodium adscendans*) is related to its incidence on poor soils where it is thought to be a cause of soil degradation rather than a consequence. This is probably because this species is rather commonly encountered mostly in pastures. Asongwed-Awa *et al.* (2006) reported significant reductions in *Striga spp*. populations in cereal associations with *Desmodium adscendens*. This can be further elaborated in the development of biological control strategies in the fight against this and other obnoxious weeds. The most highly rated species for probable adoption were *Arachis hypogaea, Cajanus cajan, Senna obtusifolia, Crotalaria sp,* and *Hibiscus sabdarifa*, most probably due to their already known performance and use in farmers' day to day activity.

Based on farmers' comments, factors that are liable to facilitate adoption of local species by farmers were identified to include: plant performance and productivity, especially in associations with crop. Farmers are still hesitant to spare land that is needed for crop production even when the signs of degradation are highly visible. Factors related to the farm house hold include land ownership, labour availability, prior knowledge of the use/importance of the species and a mastering of the management technique of the said species. This confirms studies reported elsewhere of personal or self-owned land being an important pre-requisite in the adoption of cover crops, since farmers would most likely engage in land improvement strategies only when they are sure to continue using the said piece of land (Bationo *et al*., 2007; Isabirye *et al*., 2010).

Conclusion

Farmers' perception of the potential use and adoption of local species in farming systems was influenced by both socio-economic and technical factors reflected by the farm size and knowledge of local species. Generally most positive appraisals were given for already known species with common uses in the local farming system such as *Arachis hypogaea* and *Senna spp*. This is an indication that compared to exotic herbaceous legumes; local species would be more easily adopted in local farming systems. Unfortunately, farmers' local knowledge is hardly realized or taken into consideration when developing strategies for the improvement of local farming systems. The sustainability of this local knowledge is questionable if its acquisition and transfer from generation to generation is not documented. This study has revealed the role of these species in local farming systems and the need for their management in the improvement of the farming system. To enhance adoption, farmers' production needs should be taken into consideration.

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