



Traditional Silvopastoral Systems and Farmers' Indigenous Knowledge of Fodder Trees and Shrubs in Southern Guinea Savanna, Adamawa State, Nigeria

JAMALA, G. Y. ^{1*}, OKE D. O. ² and FAJEMISIN A.N. ²

¹Federal University Dutsinma, Katsina State, Nigeria

²Federal University of Technology, Akure, Nigeria

*Corresponding author; gjamala@gmail.com

Abstract

This study was conducted to evaluate traditional silvopastoral systems and farmers' indigenous knowledge of fodder trees/shrubs and the criteria used for screening trees for fodder in the Savanna regions of Adamawa State, Nigeria. Silvopastoral survey was conducted using a pre-tested questionnaire and semi-structured questionnaire administered to 160 farmers. Farmers were also asked to rank their ten most important fodder tree species in order of importance through the method of tree matrix. A total of 160 Silvopastoralists with profound knowledge of fodder trees/shrubs were interviewed, of which 88% were males and 12% were females. The results of the t-test show a significant difference ($P < 0.05$) in gender distribution among the respondents. The results of the one-way analysis of variance indicate the presence of significant differences ($p < 0.05$) in age distribution of the respondents. Forty-Eight (48%) of farmers were in the age group 41 years and above, 40% are between 31-40 years, and the least (12%) represented age group was 21-30 years. The top eight most preferred species include: *Ficus thonningii*, *Vitellaria paradoxa*, *Anogeissus leiocarpus*, *Prosopis africana*, *Khaya senegalensis*, *Entada africana*, *Piliostigma thonningii* and *Annona senegalensis*. The most frequently mentioned criteria were the ability of the fodder to satisfy hunger, contributions to animal health, palatability and drought resistance of the tree. The study has provided important information from farmers for setting priorities of indigenous fodder trees/shrubs that can be optimized in range resources management for sustainable animal production in the savanna area of Adamawa State and Nigeria at large.

Key words: Browse, Indigenous knowledge, Silvopastoral system, Traditional

Introduction

Agroforestry comprises a set of practices that combine trees and crops and/or animals within the same area. It is a dynamic system that diversifies and sustains production with social, economic and environmental benefits for land users at all levels. In particular, Silvopastoralism is one of the oldest practices of agroforestry, a deliberate growing of woody perennials on the same unit of land as livestock in interacting combinations for multiple products or benefits from the same management unit (Nair, 1993). The 'Silvopastoral systems' can be defined as managed unit of three main components within a particular edapho-climatic context: (1) tree, (2) pasture and (3) animals (Mosquera-Losada *et al.*, 2001).

Livestock contributes 95% of draught power to agriculture and provides full time employment to about 20% of the rural population generating cash income for the rural

poor with a small amount of investment (Anon 1998). Livestock play a very important role in Nigerian agriculture contributing about 12.7% of the total agricultural GDP (CBN 2009). Nigeria is one of the four leading livestock producers in Sub-Saharan Africa. Livestock population comprised about 15.2 million cattle, 28 million goats and 23 million sheep (FAO, 2006). Small ruminants (especially goats and sheep) form an integral and important component of the pattern of animal production in most rural communities (Davendra, 1985).

Trees and shrubs are particularly important in pastoral production systems. According to Babayemi and Bamikole (2006), fodder trees and shrubs are important components of ruminant diet and they have been found to play an important role in the nutrition of grazing animals in areas where few or no alternatives are available (Van *et al.*, 2005).

Indigenous knowledge is important not just in terms of the description, proper management and harvesting of a product, but also in terms of the maintenance of the ecological processes and biodiversity linked to traditional economic activities, such as cultivation or husbandry. Recognizing indigenous people's harmonious relationship with nature, indigenous sustainable development strategies and cultural values must be respected as distinct and vital sources of knowledge. Over the past two decades, the importance of farmer's indigenous knowledge in managing their natural resources has gained increasing recognition from the scientific community (Rist, 1991) and rural development planners are paying particular attention to use of such local knowledge (Chambers *et al.* 1989).

Roothaert (2000) hypothesized that knowledge of individual farmers would be consistent enough to form a basis for selecting the most useful fodder species. In addition, farmer's preferences and cultural practices also need to be considered when species are screened for their appropriateness. Farmers in some parts of the world have some practical knowledge about the quality of fodder trees (Bayer, 1990, Thapa *et al.*, 1997). Taping this knowledge would be much faster and cheaper than carrying out elaborate analysis in laboratories, for the purpose of screening the nutritive values of trees. However, previous studies in this field have shown variable correlation between farmer's knowledge and laboratory assessment (Thapa *et al.*, 1997).

It is now widely acknowledged by the scientific community that success in development is more likely to be achieved when local people's knowledge is taken into account in project planning and development. However, relatively little work has so far been conducted on farmer's indigenous knowledge on fodder trees and shrubs in the savanna regions of Adamawa State, Nigeria. But traditional

knowledge and management practices on fodder trees offer relevant techniques and insights for foresters and other relevant scientists. This study was carried out to assess farmer's indigenous knowledge of fodder trees/shrubs in traditional silvo-pastoral system and the criteria used for screening trees for fodder.

Materials and Methods

The Study Area

The study was carried out in and around Nyibango Forest Grazing Reserve, in Jada Local Government Area, Adamawa State, Nigeria. The Local Government Area is located between latitude 8° 46' and 8° 77' N and longitude 12° 9' and 12° 15' E. It is bounded by Ganye to the east, Mayo-Belwa and Taraba State to the west, Toundou to the south and to the east Cameroon republic (Adebayo, 1999). It has a land area of about 2291.42km² and a population of 164,087 (NPC, 2007). The mean annual temperature of the study area is 26.7°C while the mean annual rainfall ranges between 1100mm and 1600mm with a distinct dry season which begins in November and ends April and the wet season begins in April and ends in October or sometimes in November. The area is located within the Guinea Savanna vegetation zone and is mainly dominated by agro-pastoral farmers. The main land use system is subsistence agriculture and livestock management including cattle, goats, sheep and poultry.

Sampling Technique

Ten villages around the forest grazing reserve were randomly selected for this study. In each of the villages stratified random sampling technique was adopted. As rearing of livestock and the utilization of fodder trees/shrubs are the functions of land holding capacity of the households, the farmers were stratified into marginal (0.21-0.50 ha), Small (0.51-1.00 ha), medium (1.01-2.00 ha) and large (above 2.00 ha). Sixteen (16) households from each village four of which belongs to each stratum were

selected randomly making a total of 160 households.

Methods of Data collection

Data for this study were collected through interview method using pre-tested and semi-structured questionnaire administered to 160 farmers. Farmers were also asked to rank their ten most important fodder tree species in order of importance through the method of tree matrix. Total score of each species was determined.

Methods of Data Analysis

The data collected were analyzed using descriptive statistics such as frequencies and percentages. Inference was drawn using T-test and analysis of variance (ANOVA). To assess farmers' perceived knowledge of fodder trees/shrubs, seventeen items statement were presented and assessment was based on a five point Likert-type rating scale of Strongly agree (5), Agree (4), Undecided (3), Disagree (2) and Strongly disagree (1). Responses were categorized according to their mean scores. In terms of farmers' perceived knowledge of evaluating fodder trees/shrubs, mean scores of 2.00 or above was classified as perceived knowledge, while mean scores below 2.00 were taken otherwise. All data were analyzed with SPSS (Ver. 18).

Validation and Reliability of the Instrument

The instrument was face-validated by some experts and experienced researchers. To test the reliability of the instrument a pilot study was conducted in the study area. The pilot study involved groups that have similar characteristics with the research sample, but was not part of the main study. The reliability of the instrument was determined using the split half method. The instrument has a reliability value of 0.89.

Results and Discussion

The results of this study reveals the status of some of the main aspects that underline important socio-economic characteristics of the Silvopastoral community including gender, age

group, and educational levels of the respondents (Table 1). A total of 160 Silvopastoralists with a profound knowledge of fodder trees/shrubs were interviewed, of which 88% were males and 12% were females. The results of the t-test show a significant difference ($P < 0.05$) in gender distribution among the respondents. The proportion of males is significantly higher than that of females. Little participation of women in the survey was culturally related. The knowledge reported by female respondents on fodder trees/shrubs and uses was similar to that reported by the male respondents. This indicated that women are also involved in livestock management activities, due to the roles livestock resources play in the community. According to Alonge and Alonge (2006) individual men and women in each new generation adapt and add to traditional knowledge and socio-cultural practices in a constant adjustment to changing circumstances and environmental condition.

The results of the one-way analysis of variance indicate the presence of significant differences ($p < 0.05$) in age distribution of the respondents. Most farmers (48%) were found in the age group 41 – 50 and above years, 40% are between 31-40 years, and whereas the least (12%) represented age group was 21-30 years. This shows that there was a wide variation in distribution of respondents over different age groups.

Several studies indicated that older people know more about plant uses than young ones (Benz et al 2000; Van der Merwe et al 2001; Latoya et al 2003). These results indicated that, the knowledge obtained in this study is significantly reliable as to the maturity of the respondents whom the majorities were above 40 years in age. This corroborates with the long-standing belief that only the older people possess the knowledge of their environment and have a strong tendency to keep these knowledge secret. Generally, the traditional knowledge on the use of plant species is decreasing due to several

reasons including change in approach towards a more Western lifestyle and declining interest of younger generations to carry forward the tradition (Luseba and Van der Merwe 2006). This is a concern for knowledge transfer. As for education status, 56% had no formal education. 23% of respondents had secondary education, only 2% with tertiary education.

It was observed that the primary occupation of the majority (84%) of the respondents was farming (Table 1). This was followed by the civil service (8%). This confirms that apart from crop production, Silvo-pastoralism is the commonest primary occupation of respondents in the study areas.

Table 1: Socio-Economic Characteristics of the Respondents

Gender	Frequency	N=160	Percentage
Male	141		88.1
Female	19		11.9
Total	160		100
t-test results - P=0.000, *Significant (P<0.05)			
Age (years)			
21-30	19		11.9
31-40	64		40.0
41-50	38		23.8
>50	39		24.4
Total	160		100
ANOVA result - P=0.002. - *Significant (P<0.05)			
Educational Qualification			
No Formal Education	90		56.3
Adult Education	12		7.5
Primary Certificate	19		11.9
SSCE	36		22.5
Advance Certificate	3		1.9
Total	160		100

Source: Field Survey (2014)

The results of the practice of Silvo-pastoral systems by respondents are presented in Table 2. It was found that all (100%) of respondents possess different type of farm animals ranging from Cattle (5%), Sheep (13%), Goats (27%) and the greater proportion (55%) maintained the combination of Goat/Sheep. According to these farmers (82% and 77%), the

sources of fodder trees and shrubs are trees on farmland and the forest grazing reserve respectively. The farmers maintained that they retained all trees with good characteristics of fodder on their farmlands to provide feed for their animals and also to supply edible fruits, timber, and herbs. Only a few (0.6) farmers purchase fodder tree leaves from sellers to feed their animals.

Table 2: Silvo-pastoral Practices and Pattern of Fodder trees/shrubs utilization

Possession of Animals	Frequency	N=160	Percentage
Yes	160		100
No	0		0.0
Total	160		100
Type of farm Animal			
Sheep	21		13.1
Cattle	8		5
Goat	43		26.9
Goat/Sheep	88		55
Total	160		100
Source of Fodder tree			
Trees on Farmland	82		51.2
Grazing Reserve	77		48.1
Local Sellers	1		0.6
Total	160		100
Animal types dependence on browse			
Goats	134		83.8
Sheep	11		6.9
Cattle	15		9.4
Total	160		100
Fodder Parts fed the Animals			
Leaves	73		45.6
Twigs/leaves	85		53.1
Flowers	1		0.6
Pods & seeds	1		0.6
Total	160		100
Fodder state preferred by the Animals			
Fresh	134		83.8
Dry	15		9.4
Wilted	11		6.9
Total	160		100
Period of Feed scarcity			
January-April	114		71.3
May-August	23		14.4
September-December	23		14.4
Total	160		100

Source: Field Survey (2014)

Pattern of Fodder trees and shrubs utilization

According to results of the survey shown in Tables (2) and (3) and the field observations, it was clear that fodder trees and

shrubs makes up an important animals feed sources in the area as indicated by 48% and 92 % of the farmers who use native fodder trees and shrubs for feeding their livestock during dry and raining season respectively. Farmers stated that

native fodder trees and shrubs accounted for 71% of the total feed consumed by goats in dry season. For raining season fodder trees and shrubs accounted for more than 83% of the total quantity of feed consumed (Table 3).

This indicates that fodder trees and shrubs were utilized in both dry and wet seasons. The findings indicated that majority of the respondents (71%) are into extensive (free range) and semi-intensive livestock management system in the dry season and during the raining season 75% of the respondents maintained that they were into the intensive system of cut-and carry and tethering methods of management (Table 3). Based on observation and field study, there was variation with regards to the management systems practiced by the respondents, ranging from extensive in the dry season to intensive system during the raining season. The results indicated that there was variation in management system with regards to the season of the year; this could be due to the high demand of farmlands for the purpose of crop cultivation in the raining season. The trend is usually reversed during the dry season, but for farmers who practice livestock fattening the system remains the same irrespective of the season of the year.

In relation to fodder state preferred by the animals, 84% of the respondents stated that the freshly cut fodder were more accepted by the animals (Table 2). The period of animal feed scarcity according to the respondents (71%) was the month of January to April. This indicates that fodder trees and shrubs were mainly utilized in the dry season i.e. from (January to April) and sometimes through to the month of May with browsing reaching an extensive point when rains delay or fail. This finding agrees with those of Kadzere, (1995) who reported that, the longer and more intensive the dry season, the greater is the degree of dependence of livestock on fodder trees/shrubs. Ruminants on free ranging were observed browsing the leaves from trees and

shrubs, of the fallen ones, flowers, pods and to a varying extent some fruits and bark of certain tree species such as *Khaya senegalensis* and *Vitex doniana*. Herders tend to loop branches from various palatable browse trees such as *Ficus thonningii*, *Vitellaria paradoxa*, *Anogeissus leiocarpus*, *Prosopis africana*, *Khaya senegalensis*, *Entada africana*, *Piliostigma thonningii* and *Annona senegalensis* (Plate 1). This typically indicate the browse importance on Forest grazing reserve in the study area and that, the fodder trees/shrubs is perceived by the Silvopastoralist herders as important component of livestock feeds during dry season and hence the farmers tend to retain these species on their farmlands.

Farmer's most preferred fodder trees/shrubs and their perceived knowledge

The top eight most preferred species includes *Ficus thonningii*, *Vitellaria paradoxa*, *Anogeissus leiocarpus*, *Prosopis africana*, *Khaya senegalensis*, *Entada africana*, *Piliostigma thonningii* and *Annona senegalensis* (Table 4). The most frequently mentioned criteria used for assessing fodder trees/shrubs acceptability by the animals were the ability of the fodder to satisfy hunger, contributions to animal health, palatability and drought resistance of the tree.

Farmer's criteria for evaluating fodder trees were either animal-related (such as satisfies animal's hunger, improves health of animals palatability/liked by animal or effects on animal nutrition) or tree-related (such as drought resistance, it abundance, ease of lopping and high biomass production etc) as can be seen in the Table 5. In all farm categories, farmers' perceived knowledge of fodder trees/shrubs were based on the seventeen items statement presented (Table 5) which are both animal and plant related criteria. This indicates that traditional Silvo-pastoralists are knowledgeable of the vast fodder trees/shrubs available in the

study area. This is in line with the report of Ivory (1990), that suitable trees or shrubs for fodder production are considered by animal scientists to have several characteristics: high nutritive value, palatability, and biomass production, persistence after frequent pruning, resistance to drought, pests and diseases, and compatibility with other crops. In addition, farmers' preferences and cultural practices also need to be considered when species are screened for their appropriateness.

This study at the same time confirms the findings of Bayer, 1990 and Thapa et al., 1997

that farmers in some parts of the World had some practical knowledge about the quality of fodder trees. Therefore, including them in any research of this nature would be consistent enough to form a basis for selecting the most useful fodder species (Roothaert, 2000). According to Warren *et al.* (1995), traditional Ecological Knowledge is the basis for local-level decision-making in areas of contemporary life, including natural resource management, nutrition, food preparation, health, education, and community and social organization.

Table 3: Livestock Silvopastoral Management system based on the Season of the year

Management system	Dry season		Raining season	
	Frequency	Percentage	Frequency	Percentage
Tethering (Subsistence) system	34	10.5	122	37.5
Free range (Extensive) system	174	53.5	27	8.3
Cut-and carry (Intensive) system	59	18.2	123	37.8
Semi-intensive system	58	17.8	53	16.3
Total	160	100	160	100
Fodder trees/shrubs utilization				
Yes	77	48.1	147	91.9
No	83	51.9	13	8.1
Total	160	100	160	100
Percentage of Fodder trees/shrubs fed to animals				
100	34	21.3	31	19.4
70	23	14.4	53	33.1
50	57	35.6	49	30.6
25	32	20	21	13.1
10	14	8.8	6	3.8
Total	160	100	160	100

Source: Field Survey (2014)

Table 4: Farmer's most preferred top eight Fodder trees/shrubs

Fodder Species	No. of Respondents(a)	Scores(b)	Ranking
<i>Ficus thonningii</i>	10	94	1
<i>Vitellaria paradoxa</i>	10	85	2
<i>Anogeissus leiocarpus</i>	9	60	3
<i>Prosopis africana</i>	8	49	4
<i>Khaya senegalensis</i>	8	36	5
<i>Entada africana</i>	6	30	6
<i>Piliostigma thonningii</i>	6	21	7
<i>Annona senegalensis</i>	5	19	8

Source: Field Survey (2014) Note: ^a Number of respondents who included the species in the top eight
 Table 5: Farmer's criteria for assessing the most preferred fodder trees/shrubs

Items	Criteria	Mean	Std. Deviation
Animal-related			
1	Satisfies hunger of animals	4.97	0.10
2	Improves health of animals	4.95	0.22
3	Palatability/liked by animals	4.84	0.42
4	Improves milk production	4.68	0.78
5	Improves meat production	4.82	0.39
Tree-related			
6	Drought resistance	4.79	0.41
7	Its abundance	4.84	0.36
8	Ease of lopping	4.89	0.31
9	High biomass production	4.87	0.34
10	Resistance to continuous lopping	4.83	0.38
11	Taste(bitter and sweet	4.81	0.48
12	Thickness of leaves (thick and thin)	4.84	0.36
13	Size of leaves (big or broad or small or narrow)	4.86	0.34
14	Lustre of leaves (green or yellow or light green)	4.89	0.31
15	Texture (rough or smooth)	4.84	0.42
16	Smell (good or bad)	4.38	1.08
17	Improves soil fertility	4.96	0.28

Source: Field Survey (2014)

Conclusion

The study has provided important information from farmers for setting priorities of indigenous fodder trees/shrubs for research and development. The indigenous knowledge on fodder trees explored from this Savanna region may be an important tool to plan the livestock management with respect to nutrition, especially setting priorities in time of feed scarcity (January-April). The policy maker, livestock professionals and foresters may use this knowledge to develop the livestock resources in

Savanna regions. The present findings shows that indigenous knowledge on fodder trees may be important part for the development of fodder status through the proper combination of researcher's scientific knowledge with the farmer's indigenous knowledge. More research is also needed on chemical composition, nutritive & anti-nutritive factors of the fodder trees and shrubs available in the study area. The relationship between farmer's assessments of fodder trees and laboratory nutritive analysis is required.



Plate 1: Herders lopping fodder trees branches for their animals during dry season

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