RESEARCH PROGRAM ON Climate Change, Agriculture and Food Security

CGIAR CCAFS

Info Note

Candidate fodder species for goat production in Northern Ghana

Findings from a participatory evaluation exercise within the climate-smart villages of Ghana

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Key messages

- With increasing climate variability and drought frequencies, dry season feeding from fodder of drought tolerant tree/shrub species are becoming popular among pastoralists.
- Top 20 tree/shrub fodder species were identified by farmers as the most locally available and palatable fodder with multipurpose uses.
- Selected top five species (*Annona senegalensis*, *Afzelia africana*, *Pericopsis laxiflora, Pterocarpus erinaceus* and *Ficus gnaphalocarpa*) were found to be of an acceptable nutritional quality for goats. However, *P. laxiflora* and *P. erinaceus* recorded significantly low dry matter intake (< 3% of animal body live weight) when fed to goats suggesting the two species may not be adequate as sole feeds.

Introduction

Livestock production employs over 60% of rural households in the three northern regions of Ghana, making investment in this industry critical for alleviating poverty and enhancing food security. Among other factors, the Ministry of Food and Agriculture reports access to sustainable feed supply as one of the livestock industry's key constraints. As most livestock are kept on a free-range system, forage of fair nutritive value is normally scarce in the dry season due to recurrent droughts, continuous over-grazing and lack of range improvement interventions. Often, palatable and productive perennial grasses, legumes and herbs become replaced with unpalatable, low quality annual species, with a concomitant loss of soil fertility. The nutritive value of available pasture species is therefore often poor with low levels of crude protein. The predominant small scale, subsistence livestock producers are also challenged with the financial resources to afford a continuous supplementation of concentrate feeds to their animals. Recent research has been directed to using tree leaves as fodder for livestock due to many advantages such as supply of good quality green fodder even in the dry season as well as high crude protein and minerals contents.

In the Lawra and Jirapa Districts of the Upper West Region of Ghana, the CGIAR Research Program on Climate Change and Agriculture (CCAFS) established a Climate-Smart Village (CSV), an agriculture research for development site where various agricultural innovations are tested on their potential to deliver on any of the 3 pillars (productivity, adaptation and mitigation) of climate-smart agriculture (CSA). Among many CSA options at the CSV, the integration of multipurpose trees on farmlands is promoted as a CSA practice for improving fodder availability, increasing overall farm productivity, improving ecological resilience and providing farmers with important safety net opportunities against climate-related risks. In this study, we used a participatory approach to document and characterize fodder trees and shrubs that are prioritized by farmers for livestock production.

Documentation of fodder species was based on questionnaire interviews, focus group discussions and desktop reviews. Top fodder species selected by farmers were characterized for the nutritional composition and intake by farmer preferred livestock.

Existing livestock production systems

- Major livestock in the study areas were goat, sheep and cattle, mainly raised for subsistence. Almost all the respondents (97%) had goats with about half of them having sheep and 17% owning cattle.
- Goat was the most preferred and gender-sensitive livestock in the study area. Women farmers were found to be most responsive to goat production due to: (1) their comparatively cheaper cost of acquisition; (2) market demands and economic return; and (3) their prolific nature.
- Integrated crop-livestock systems were practiced by all respondents. Crops found to be most suitable with livestock production included: groundnut, maize,

cowpea, bambara groundnuts, sorghum, millet, rice and yam in descending order.

- In the dry season, goats were left on free range irrespective of community. The common practice in the wet season was tethering of sheep and goats on the communal grazing land to graze silage with or without feed supplementation (Figure 1).

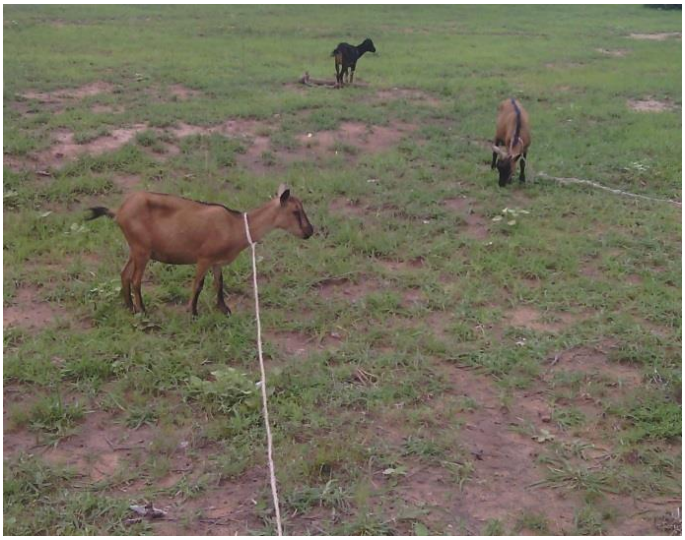


Figure 1: Tethered goats on grazing land at Bompari

Prioritized fodder species selected by farmers

- Many fodder species were identified by farmers. In Table 1, we report the top 20 fodder species based participatory ranking with the communities. Generally, the species are scattered on farmlands or among fallow vegetation. Apart from fodder, fuelwood and medicines were the most prevalent use for top 20 identified species.

- The choice of the species were based on their multipurpose nature, local availability and palatability of their leaf fodder.

Table 1: Top 20 fodder tree/shrub species at the study site

Fodder species	Other uses apart from fodder
1. *Faidherbia albida*	• Soil conservation • Fuelwood • Shade • Windbreak
2. *Ficus gnaphalocarpa*	• Soil conservation • Fuelwood • Shade • Medicine
3. *Annona senegalensis*	• Medicine
4. *Pterocarpus erinaceus*	• Soil conservation • Fuelwood • Shade
5. *Mangifera indica*	• Food • Shade • Income generation
6. *Blighia sapida*	• Food • Shade
7. *Vitex doniana*	• Soil improvement • Food • Medicine
8. *Afzelia africana*	• Soil improvement • Medicine • Fuelwood
9. *Khaya senegalensis*	• Fuelwood • Medicine
10. *Anogeissus leiocarpus*	• Fuelwood • Medicine
11. *Diospyros mespiliformis*	• Fuelwood • Medicine
12. *Adansonia digitata*	• Food • Fuelwood • Medicine
13. *Bombax costatum*	• Soil improvement • Shade • Medicine • Boundary planting
14. *Vitellaria paradoxa*	• Fuelwood • Lipid • Latex • Apiculture
15. *Azadirachta indica*	• Fuelwood • Lipid • Medicine • Insecticide
16. *Strychnos spinosa*	• Fuelwood • Medicine
17. *Pericopsis laxiflora*	• Medicine • Fuelwood
18. *Lannea acida*	• Medicine
19. *Parkia biglobosa*	• Food • Fuelwood • Medicine
20. *Dichrostachys glomerata*	• Fuelwood • Soil conservation • Medicine

Fodder quality test

- The fodder quality of the top five farmer-selected species (*Annona senegalensis*, *Afzelia africana*, *Pericopsis laxiflora, Pterocarpus erinaceus* and *Ficus gnaphalocarpa*) was tested in comparison with the haulms of *Arachis hypogaea* with participation of farmers. Fodder quality was related to their nutritional composition and intake by West African Dwarf goats.

Figure 2: Goats in metabolic cages during trials

Figure 3: Farmers on visit during trials

- Generally, the crude protein contents of the experimental feeds were higher than the minimum range of 60-80 g kg^{-1} required for sustenance of microbial growth. The dry matter content of the browse plants was in the range of 280.0 to 450.2 g kg^{-1} with *P. laxiflora* having the highest and *A. hypogaea* having the least (Table 2). Similarly, *P. laxiflora* also recorded the highest neutral detergent fibre content while *A. hypogaea* recorded the lowest. Calcium (Ca) and acid detergent lignin contents did not differ significantly among the browse plants.

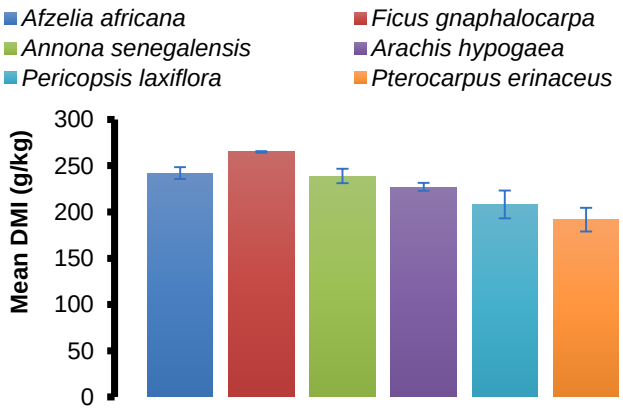
Table 2: Nutritional composition of selected fodder species

Parameter	Species						SEM	P value
	A. senegalensis	*F. gnaphalocarpa*	*P. laxiflora*	*P. erinaceus*	*A. africana*	*A. hypogaea*		
DM	380.5^{c}	363.5^{e}	450.2^{a}	376.7^{d}	406.9^{b}	280.0^{f}	2.35	0.05
CP	81.2^{d}	115.9^{b}	102.4^{bc}	105.3^{bc}	136.7 ^{a}	90.4^{cd}	7.04	0.05
Ash	68.6^{e}	241.4^{a}	115.5^{c}	86.5^{d}	106.6^{c}	185.2^{b}	3.58	0.05
NDF	604.1^{ab}	669.3^{a}	675.8^{a}	617.1^{ab}	645.0^{ab}	578.7^{b}	19.1	0.05
ADF	545.5^{ab}	506.0^{ab}	575.5^{a}	348.9^{b}	400.5^{ab}	510.0^{ab}	49.4	0.05
ADL	173.1	146.0	102.8	85.7	129.2	86.8	25.4	0.14
Ca	15.3	12.4	13.0	12.3	12.1	16.3	2.71	0.18
P	0.22^{d}	3.19^{a}	0.84^{c}	1.35^{b}	1.00^{bc}	1.01^{bc}	0.21	0.05

Values are the means of 4 replicates. Values in a row with the same alphabet as superscript are not significantly different at 5% probability level. SEM = standard error of means. DM = dry matter, CP = crude protein, NDF = Neutral detergent fibre, ADL = acid detergent lignin and ADF = acid detergent fibre.

- Total dry matter intake (DMI) was within the expected 3% of animal live body weight in the case of *A. senegalensis, F. gnaphalocarpa, A. africana* and *A. hypogaea* but low for *P. laxiflora* and *P. erinaceus* suggesting that these two species may not be adequate as sole feeds for goats. On the contrary, *P. erinaceus* is a popular fodder plant in northern Ghana, and it is the most common fodder sold in the regional capital of the Upper West Region.

Figure 4: Mean dry matter intake of browse species by goats



Conclusions and way forward

- Top 20 tree/shrub fodder species were identified by farmers as the most locally available and palatable fodder with multipurpose uses.
- Tested top five species (*Annona senegalensis*, *Afzelia africana*, *Pericopsis laxiflora, Pterocarpus erinaceus* and *Ficus gnaphalocarpa*) were found to be of an acceptable nutritional quality for goats. However, *P. laxiflora* and *P. erinaceus* recorded significantly low dry matter intake (< 3% of animal body live weight) when fed to goats suggesting the two species may not be adequate as sole feeds.
- A multispecies fodder bank will be established with farmer-prioritized species to demonstrate their efficacy for livestock production and potential for local adoption.

Further Reading

- Partey, Samuel T., Zougmoré, Robert B., Ouédraogo, Mathieu, Campbell, Bruce M. 2018. Developing climate-smart agriculture to face climate variability in West Africa: challenges and lessons learnt, Journal of cleaner Production, 187: 285-295.
- Zougmoré R, Partey S, Ouédraogo M, Omitoyin B, Thomas T, Ayantunde A, Ericksen P, Said M, Jalloh A. 2016. Toward Climate smart-agriculture in West Africa: a review of climate change impacts, adaptation strategies and policy developments for the livestock, fishery and crop production sectors. Agriculture & Food Security 5:26.
- Ouédraogo-Koné, S., Kaboré-Zoungrana, C.Y., Ledin, I., (2008b). Intake and digestibility in sheep and chemical composition during different seasons of some West African browse species. Trop. Anim. Health Prod. 40, 155–164.

Research led by

This Info Note summarizes the results of a portfolio of exploratory studies carried out at the CCAFS climate-smart village in Ghana as an entry point to developing integrated tree-crop-livestock production systems that helps farmers build resilient livelihoods and adaptive capacity to climate change and variability.

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CCAFS and Info Notes

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is a strategic partnership of CGIAR and Future Earth, led by the International Center for Tropical Agriculture (CIAT). CCAFS brings together some of the world's best researchers in agricultural science, development research, climate science and Earth System science, to identify and address the most important interactions, synergies and tradeoffs between climate change, agriculture and food security.

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