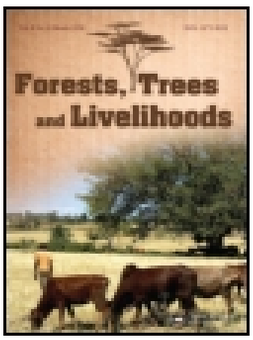

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Exploring local knowledge and preferences for shea (*Vitellaria paradoxa*) ethnovarieties in Southwest Burkina Faso through a gender and ethnic lens

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ABSTRACT

In Africa's 'shea belt', the shea tree (*Vitellaria paradoxa*) plays a central role in rural livelihoods and ecosystems. Yet, it faces many threats. The aim of this study is to examine local people's classification systems and preferences for shea ethnovarieties in Burkina Faso to support domestication efforts that respect local priorities. Work was carried out among the Bobo, Sambla, Mosse and FulBe ethnic groups in two villages in south-west Burkina Faso. Participatory characterization and ranking matrices were used with 10 groups segregated by gender and ethnicity to understand if knowledge and preferences for shea ethnovarieties vary between gender and ethnic groups. Results show a general agreement across groups about top-cited ethnovariety names, characteristics and key criteria defining the classification system. Participants identified a total of 25 shea ethnovarieties according to 11 primary fruit and nut variants. The number of ethnovarieties cited varied slightly across groups, with greater consistency across ethnicities than across gender groups. Each ethnic and gender group identified certain ethnovarieties not cited by their ethnic or gender counterparts. Two ethnovarieties – 'small shea fruit' and 'big shea fruit' – were preferred across groups. The study highlights the value of gender-sensitive participatory research for understanding local botanical knowledge and preferences.

KEYWORDS

Vitellaria paradoxa; gender; ethnobotanical knowledge; ethnovarieties; folk classification; participatory research; Burkina Faso

Introduction

The shea tree, *Vitellaria paradoxa* C.F. Gaertn., is of foremost importance in Africa's Sudano-Sahelian region (Chalfin 2004). The tree yields a high-stearate fat called shea butter that can be extracted from the large seeds (nuts) its fruits contain (Alander 2004) and which represent a key source of fat in the local diet (Boffa et al. 1996). In addition to the species' medicinal and cultural values, shea nuts and butter are important export commodities and play a major role in the local economy in impoverished countries such as Burkina Faso (Masters et al. 2004).

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Yet, the species is afflicted by many socio-economic and environmental threats, including livestock pressure on seedlings, shortened fallow periods, branch removal to feed animals, felling to serve as firewood, diseases and drought, which accelerate its loss (Augusseau et al. 2006). Hence, many efforts have been made to identify and domesticate superior individuals to ensure the species' conservation (Ræbild et al. 2011).

Within these efforts, traditional knowledge and systems of classification have received attention as they provide support to conservation action and breeding. For instance, indigenous knowledge of species traits can serve as a valuable starting point for understanding variations in key phenotypic traits (Vodouhè et al. 2011). Based on these traits, farmers recognize different ethnovarieties; or locally defined taxa or classifications for a given species, based on intra-specific (usually phenotypic) differences as observed and managed by local farmers or other resource users (Rivera et al. 2006). Farmers additionally select and preserve 'superior' (shea and other) individuals on farm (Lovett & Haq 2000a; Assogbadjo et al. 2008). Understanding local knowledge systems and preferences can thus inform the selection, in externally led domestication and development programs, of shea ethnovarieties that hold importance to local people and the potential to improve local incomes and livelihoods.

Folk nomenclature and taxonomies have been described for major crops such as taro (Xu et al. 2001), cassava (Sambatti et al. 2001) and rice (Appa Rao et al. 2002) as well as for less widely cultivated crops such as enset (Olango et al. 2014), leafy vegetables (Adoukonou-Sagbadja et al. 2006) and various tree species (Assogbadjo et al. 2008; De Caluwé et al. 2009). Typically, classification systems provide labels and keys to distinguish morphological differences in plant varieties, and may be based on particular parts or life stages of a species. Yet, these systems may also reflect non-morphological attributes based on plant use for medicinal, spiritual or economic purposes, among others (Jinxiu et al. 2004). Deciphering classification systems is complicated by the fact that farmers may recognize several phenotypes as one ethnovariety, and several ethnovarieties may refer to a single phenotype (Quiros et al. 1990). The names attributed to ethnovarieties are closely linked to the geography, culture and shared experiences of a given group (Mazzocchi 2006). Folk classification systems thus often differ across locations (Gwali et al. 2015).

Although farmers from different gender and ethnic backgrounds and origins tend to hold distinct and complementary sets of knowledge and preferences with respect to forest resources, the role social attributes play in determining farmer preferences for ethnovarieties has received little attention (Rocheleau et al. 1996; Howard 2003; Diarrassouba et al. 2008). Differentiated preferences can importantly affect tree management practices, however, including the protection of naturally regenerating shea trees on cultivated lands (Lovett & Haq 2000b; Assogbadjo et al. 2008). Moreover, understanding to what extent knowledge and preferences for shea ethnovarieties are shared (or not) across local gender and ethnic groups can improve the equitability of shea tree domestication programmes. Accordingly, the objective of this paper is to better understand the local knowledge of and preferences for shea ethnovarieties in south-west Burkina Faso, and to understand whether or how these vary according to gender and ethnicity.

Methodology

Study sites

The study was carried out in Burkina Faso's south-west province of Houet, located in the administrative region of Haut-Bassin. Field work took place in the villages of Bana Bobo,

situated in the commune of Bobo-Dioulasso, and Bana Lamogoya, part of the commune of Karangasso-Sambla. The two neighbouring villages are separated by a river and are about 30 km away from Bobo-Dioulasso, Burkina Faso's second largest city.

The local climate is dry tropical with a longer dry season from October to May and a rainy season from June to September. Located in the transition zone between the Sudan and the Sahel, the area receives an average annual rainfall of 900 to 1200 mm. Temperatures range from a minimum of 19.5 °C during the cool period from November to February to a maximum of 36.5 °C during the hot period in March and April (MATD 2007). The landscape is characterized by shrubby savanna gallery forests. Dominant tree species are *Vitellaria paradoxa, Khaya senegalensis*, *Afzelia africana*, *Parkia biglobosa*, *Lannea microcarpa, Piliostigma thonningii, Detarium microcarpum*, *Mitragyna inermis* and *Sclerocarya birrea* (MATD 2007).

The local population is highly reliant on these species for subsistence. Among the native Bobo and Sambla peoples as well as the migrant Mosse community, agriculture is a primary livelihood activity with some livestock rearing, petty trade and a high dependency on non-timber forest products (NTFP) such as shea fruit for consumption and sale. In contrast, local FulBe migrants are semi-nomadic herders who rely on animal fat in their diets. Traditionally, they did not collect and process shea nuts for subsistence or sale, but this trend has changed. Due to the villages' proximity to Bobo-Dioulasso, men from both study villages also commute to Bobo-Dioulasso for work on a daily basis during the dry season.

Land management in the area is conditioned by both formal and customary tenure regimes that endow different access rights to natural resources to women and men based on their lineage and status of residence. A land chief traditionally apportions land among households of the village's founding lineage. Migrants are allowed to borrow available land from the founding lineages, yet their rights to these lands are insecure as the lending landowner can reclaim the land at any time without prior notification.[1] This practice of reclaiming land is increasingly common as socio-economic changes in the villages coupled with national land reforms encourage land privatization and the ensuing sale of land cultivated by migrants (Zongo 2010).

Customary rights to use and manage shea trees, which are not planted but rather protected during land clearance, depend on the type of land where the trees grow and vary according to gender, ethnicity, residence status and other social attributes (Boffa et al. 1996; Elias and Carney 2005). Generally, shea trees growing in the bush are open access, while those growing in fallows or on farmland belong to the land owner. Benefits derived from the trees growing on borrowed lands are often shared between the landowner and the tenant farmer (Augusseau et al. 2006).

Tree species studied

The shea tree is long lived. Trees can attain 200–300 years of age and are characterized by a slow growth cycle. They begin producing flowers in their fifteenth year, and attain full fruit production after 45–50 years. They shed their leaves mostly at the beginning of the dry season and flower during their period of leaflessness. Hermaphroditic flowers grow in bunches of 30–40, and produce strongly scented nectar, which entices the tree's pollinators: nectarivorous insects, including bees. Fruiting spans the rainy season months of May to mid-September, depending on the latitude. The ellipsoid fruit, which matures around July or August, grow in groups of six to eight. Each fruit generally carries one, or rarely two, nut(s) (Burkill 2000). The pulp, which is normally sweet, is an important source of nutrients for humans, other mammals, birds and bats.

Vitellaria paradoxa has two non-overlapping subspecies: a western subsp. *paradoxa* (Kotschy) found from Senegal to the Central African Republic, and an eastern subsp. *nilotica* (Kotschy) found in Ethiopia, southern Sudan, Democratic Republic of Congo and northern/eastern Uganda (Hall et al. 1996). Each subspecies exhibits various forms with distinct characteristics. Early studies have recognized three shea tree types based on fruit and leaf characteristics: *mangifolium*, *poissoni* and *nilotica*, (Lovett & Haq 2000b).[2] Yet, the genetic factors with which particular traits are associated remain poorly understood (Okullo et al. 2004; Diarrassouba et al. 2007, 2009). Shea trees are allogamous, and cross pollination between trees can result in large phenotypic differences that are accentuated by environmental factors (Gwali et al. 2012). Differences in shea nut weight can be linked to soil fertility and variations in climate, particularly rainfall (Lovett & Haq 2000b; Maranz & Wiesman 2003; Sanou et al. 2006). Furthermore, the various traits examined have different patterns of variation (Sanou et al. 2006).

Possible domestication events – sometimes targeting different traits – linked to the species' long-term integration in traditional agrosilvicultural systems may have led to the high phenotypic diversity found today (Maranz & Wiesman 2003; Leakey et al. 2004). For instance, the high fat content found in shea populations located on Burkina Faso's Mossi Plateau, where there is a history of continuous and dense habitation, suggests the anthropogenic selection of trees with fatty nuts in the area (Maranz et al. 2004a, 2004b). In addition, thinner and taller trees that provide lower yields and smaller fruit grow in places with less human intervention like bush lands or fallows as opposed to farmlands (Lamien et al. 2004). These differences are due to the negative effects of bush fires and grazing in the bush and to the benefits of fertilizer application, reduced competition and selection for desirable trees in cultivated fields.

Data collection and analysis

Data were collected between October 2013 and February 2014 in Bana-Bobo and Bana-Lamogoya. Informal conversational interviews were conducted with five key local female and male resource persons to help facilitators gain basic understanding of local classification systems and improve their ability to facilitate group discussions on the topic. Ten group sessions were conducted with men and women from the Bobo, Sambla, Mosse and FulBe ethnic groups. Groups were segregated by gender and ethnicity to promote the fuller participation of women and migrants who may not otherwise feel comfortable speaking in mixed groups and to allow for an analysis of gendered and inter-ethnic differences in knowledge of and preferences for ethnovarieties. Each group comprised participants of a mix of ages between 19 and 65 years old, but the influence of age on knowledge of and preferences for ethnovarieties was not specifically studied. Participants were selected randomly from a list of all identified households stratified according to ethnicity. Each group was then composed of approximately 10 active participants, with the exception of the Mosse and FulBe men's groups in Bana-Bobo and the Sambla men's group in Bana-Lamogoya, which counted only four to seven participants as most adult men were working in Bobo-Dioulasso during the day, when the data collection activities took place.

Dioula, which was common to all participants across the two villages, was used as working language. Yet, the names and characteristics of the ethnovarieties were also discussed in each group's primary language, namely Bobo for the Bobo, Fulfuldé for the FulBe, Mooré for

the Mosse, and Sambla for the Sambla. In each village, after working in separate groups, participants from the different gender and ethnic groups came together to present their work and discuss.

Two participatory tools were used sequentially. First, an identification and characterization matrix was used to identify the names and acquire a general description of locally recognized shea ethnovarieties. For each ethnovariety, information was gathered on five key traits identified during exploratory informal conversational interviews with key informants: morphological characteristics of the fruit, nut, and leaves, pulp taste and presence or absence of butter during nut processing. Although women are the ones to process shea nuts into butter, men also commented on their perceptions of butter content for different ethnovarieties. Participants then ranked the ethnovarieties, from their most to least preferred, in a second matrix. Large sheets of paper and markers were used to keep each group's responses visible to its participants throughout the activity.

Based on the ethnovariety names and characteristics provided by participants using the identification and characterization matrix, the total number of ethnovarieties recognized in the two villages was assessed. Local names in Dioula and other languages used during the field work were translated verbatim into English and matches among the ethnovarieties named in the different languages were established based on the English translations and the ethnovariety characteristics. The main traits (criteria) structuring the local classification system were identified.

Overall preference rankings across groups were determined according to the number of times an ethnovariety was cited in the top five in relation to the total number of times it was cited, and to the highest rank it received. The median preference rank was calculated from the rankings that a given ethnovariety received from all participant groups to identify trends in preferences according to gender and ethnicity. The type of data collected (ranking values generated through free listing by groups) did not lend themselves to the application of standard statistical tests but allowed a descriptive summary of the main patterns. Comparisons were made among ethnovarieties identified by men and women within and across ethnic groups.

Results

Identification and characterization of shea ethnovarieties

Overall, farmers identified a total of 25 shea ethnovarieties based on 11 primary fruit and nut variants (Table 1). Eleven ethnovarieties were identified primarily according to the characteristics of their pulp (taste, colour, texture and quality) and eight additional ethnovarieties were identified based on their fruit characteristics (size, shape and fruiting behaviour). Six ethnovarieties were identified based on shea nut traits (size, number of seeds, colour and quality). Although participants reported that tree morphology, shape and size of the leaves as well as butter quantity differ between the ethnovarieties, these were not used as primary criteria for classifying ethnovarieties.

Based on an analysis of the names of the ethnovarieties and their characteristics across groups, only one ('small shea fruit') of the 25 ethnovarieties was cited by all 10 participant groups while two of them ('big shea fruit' and 'late shea fruit') were cited by 9 of 10 participant groups (Table 2). Six more were identified by six or seven out of 10 groups and 13 in total

Table 1. Ethnovarieties identified and characterized by different participant groups, both villages. Legend: Bobo (B), Dioula (D), Fulfulde (F), Moore (M), Sambla (S).

			Characteristics			
English name	Name in local language	Variant	Taste	Fruit	Nut	Leaves
Sweet shea fruit	D: Si timi-timi M: Taam noogo F: Karèdjè ne weli	Pulp taste	Sweet	Big or small, fleshy, tough pulp, circular	Big, black, yellow or reddish	Large, smooth, reddish
Potashed shea fruit	D: Sighni sii, M: Taam zème S: Man gnogodjo		Bitter	Small, white	Whitish or reddish	Large, well formed
Tasteless shea fruit	D: Sii goman M: Taam fado F: Karèdjè na wela		Tasteless	Big or small, black, circular	Big or small	Small
Yellow shea fruit	D: Sii nèrèmougoulama B: Ma cloognifougnayi M: Taam rongo S: Man nenfanon	Pulp colour	Sweet	Big, yellow, circular	Big or small, black	Large
Black shea fruit	D: Sii finman S: Man tié		Sweet	Big, black, circular	Reddish or black, clear	Large or small
White shea fruit	D: Sii gnaa guèman M: Taam pele la ya noogo S: Man kan		Sweet or tasteless	Big, white	Big or small, white	Large or small, damaged
Red shea fruit	D: Sii wilema M: Taam miuda F: Karèdjè bôdèdjè		Sweet	Big or small, elongated, red skin	Big or small, elongated or circular	Small, elongated, reddish
Tough shea fruit	D: Sii djani B: Ma kon kuiré M: Taam koemsé S: Man go	Pulp texture	Sweet or tasteless	Tough pulp, white, damaged	Big or small, white	Small
Soft shea fruit	D: Sii magamani		Sweet	Elongated	Elongated	Large, elongated
Hairy shea fruit	M: Taam wougoudou		Sweet	Big, hairy, itch	Big, black	Large
Permanently rotten shea fruit	M: Taam poonsa	Pulp quality	Not edible	Big or small	Big, black or reddish	Large or small, elongated
Small shea fruit	B: Man maminyin D: Sii missin M: Taam banogo F: Karèdjè na séwi S: Man minguenkan	Fruit size	Sweet or neutral	Small, circular	Black, white or reddish	Small
Big shea fruit	D: Sii boulama M: Taam bèda S: Man denblé		Sweet	Big, fleshy pulp, elongated	Big, black or clear	Large, green colour

Long shea fruit	D: Sii noundjan, sii dadjan, sii papayelama, sii baraman M: Taam wogodo, taam toalma F: Karèdjè djouté	Fruit shape	Sweet	Big or small, yellow, elongated and oval	Big or small, black or reddish	Large or small, elongated, dense foliage
Circular shea fruit	D: Sii lemouroulama, sii densourou, sii nounsourou M: Taam gilsi, taam koyesin S: Man bishioo		Sweet or neutral	Big, circular	Big, khaki, circular	Large or small
Precocious shea fruit	M: Taam dahinga S: Man soya	Fruiting behaviour	Sweet or tasteless	Big or small	White or black	Large or small, black
Late shea fruit	S: Taam yaogo folo sii, kofè sii S: Tinin man		Sweet	Small, circular-	White or black	Large or small
Permanent immature shea fruit	D: Sii mi ti mon M: Taam goussé		Not edible	Big or small, elongated or circular	Black or white	Large, elongated
Male shea tree	D: Sii tchèman M: Taam raogo, taam daogo		N/A	N/A	N/A	Large or small, yellow
Small nut shea	D: Sii kolo kolo M: Taam popora S: Man boutan	Nut size	Sweet or tasteless	Big, fleshy pulp, elongated or circular	Very small oval nut or inexistent nut	Large, damaged
Big nut shea	S: Sii koloba diman, sii koloba goman		Sweet or tasteless	Big, green, circular	Big, black, circular	Small
Several nuts shea	D: Flani sii M: Taam zoun yiibou S: Man flani	Number of seeds	Sweet	Big, circular	Several nuts, black colour	Large or small, elongated
White nut shea	M: Taam zounpèla	Nut colour	Tasteless	Big or small, white	White	Large
Small soft shea nut	D: Sii missin kolo magni	Nut quality	Tasteless or sweet	Small	Permanently immature	Very small or inexistent
Broken nut shea	S: Sii kolopèrèni, sii pèrèni, desoumapien ma		Tasteless	Circular	Circular	Small

Notes: The nuts of all but four ethnovarieties were reported to yield butter. The four ethnovarieties with no butter content are: 'male shea tree', 'small nut shea', 'small soft shea nut' and 'broken nut shea'.

Table 2. Preference ranking of the 25 identified shea ethnovarieties by different participant groups. Legend: Bobo (B), FulBe (F), Mosse (M), Sambla (S).

	Rank										Descriptive statistics					
	Women					Men										
	Bana Bobo			Bana Lamagoya		Bana Bobo			Bana Lamogoya							
	B	M	F	S	M	B	M	F	S	M	No. times cited among top 5	Total no. times cited (out of 10 groups)	Highest rank given	Lowest rank given	Median	Interquar-tile range
1. Small shea fruit	1	4	5	1	3	5	5	5	6	1	9	10	1	6	4.5	3.5
2. Big shea fruit	4		4	3	2	3	8	2	5	2	8	9	2	8	3	2
3. Long shea fruit			6			2	2	4	3	3	5	6	2	6	3	1.5
4. Precocious shea fruit		1		4	1	1		8		7	4	6	1	8	2.5	5.25
5. Red shea fruit	5		2		7			1	1		4	5	1	7	2	4
6. Several nuts shea		3		6	5	6	9	3			3	6	3	9	5.5	2.5
7. Yellow shea fruit	2			2			1			6	3	4	1	6	2	1.25
8. Sweet shea fruit		2	1		4	7					3	4	1	7	3	3
9. Black shea fruit			3	5			3				3	3	3	5	3	1
10. Late shea fruit	11	6		10	10	4	7	6	4	8	2	9	4	11	7	4
11. Circular shea fruit	9								2	5	2	3	2	9	5	3.5
12. White shea fruit	3		8	9	13		4			10	2	6	3	13	8.5	4.75
13. Tasteless shea fruit	7	5	7					9	7		1	5	5	9	7	0
14. Big nut shea							10	7		4	1	3	4	10	7	3
15. White nut shea	8	11			12						0	3	8	12	11	2
16. Small nut shea	14	10	10	11	11	10				11	0	7	10	14	11	1
17. Male shea tree		12	12		14	11		10		13	0	6	10	14	12	1.5
18. Tough shea fruit	10			7	8		6			9	0	5	6	10	8	2
19. Permanently immature shea fruit		7		12	6	9	11				0	5	6	12	9	4
20. Permanently rotten shea fruit	13	9	9		9						0	4	9	13	9	1
21. Broken nut shea	12					8	12			12	0	4	8	12	12	1
22. Hairy shea fruit		8									0	1	8	8	8	0
23. Soft shea fruit	6										0	1	6	6	6	0
24. Potashed shea fruit				8							0	1	8	8	8	0
25. Small soft shea nut			11								0	1	11	11	11	0

were identified by at least half of the groups. Four were cited by only one participant group. There was consistency across the gender and ethnic groups in the traits related to pulp taste and the fruit, nut and leaf characteristics associated with specific ethnovarieties. 'Small shea fruit', for instance, was characterized across groups as having a sweet or neutral taste, small and circular fruit, white, reddish or black nuts and small leaves (Table 1). The five women's groups provided similar appraisals of butter yields, whereas only two of the five men's groups could comment on this aspect.

The number of shea ethnovarieties reported varied only slightly between gender groups (Table 3). In total, women and men identified 24 and 19 ethnovarieties, respectively, 18 of which they named in common (Table 2). Nine out of 10 participant groups named between 10 and 14 ethnovarieties; one group (Sambla men in Bana Lamogoya) named only seven (Table 3). One ethnovariety ('big nut shea') was only reported by three men's groups and no women's group, whereas 'white nut shea', 'permanently rotten shea fruit' as well as the four least frequently named ethnovarieties were named by only women's groups (Table 2).

In terms of the types of ethnovarieties named, women and men of a given ethnic group and village identified only three to eight ethnovarieties in common (Table 3). Hence, aside from Mosse men and women in Bana Lamagoya, over half of the ethnovarieties cited by a gender group in a given village was not identified by its gender counterpart.

Within a given gender group, there were both overlaps and singularities in the ethnovarieties named by different ethnic groups in each study village (Tables 3 and 4). Paired analyses across ethnic groups in Bana Lamogoya showed that three quarters of the ethnovarieties

Table 3. Correspondence between shea tree ethnovarieties (EVs) identified by different gender groups, both villages.

		Number of identified ethnovarieties			
Village	Ethnicity	Women	Men	No. EVs common to women and men	Tot no. cited EVs
Bana Bobo	Bobo	14	11	5	20
	Mosse	12	12	4	20
	FulBe	12	10	6	16
Bana Lamogoya	Sambla	12	7	3	16
	Mosse	14	13	8	19

Table 4. Correspondence between shea tree ethnovarieties (EVs) identified by different ethnic groups, both villages.

	Women			Men		
Village	Ethnic groups, with no. of EVs identified by each in parentheses	No. EVs common to both ethnic groups	Total no. EVs cited across both ethnic groups	Ethnic groups with no. of EVs identified by each in parentheses	No. EVs common to both ethnic groups	Total no. EVs cited across both ethnic groups
Bana Bobo	Bobo (14) & Mosse (12)	6	20	Bobo (11) & Mosse (12)	7	16
	Bobo (14) & FulBe (12)	7	19	Bobo (11) & FulBe (10)	7	14
	Mosse (12) & FulBe (12)	6	18	Mosse (12) & FulBe (10)	6	16
Bana Lamogoya	Sambla (12) & Mosse (14)	9	17	Sambla (7) & Mosse (13)	5	15

cited by Sambla women were also cited by Mosse women (Table 4). In Bana Bobo, approximately half of the ethnovarieties cited by women of a particular ethnic group were also cited by the other ethnic groups. Men's responses showed a higher correspondence across ethnic groups, although each group also named ethnovarieties not recognized by other ethnic groups (Table 4). For a given village, there was a higher correspondence in the ethnovarieties identified across ethnic groups for a given gender than across gender groups of the same ethnicity. The number of ethnovarieties cited was similar across the two villages (Table 4). Nearly all (21) ethnovarieties were recognized in both villages (Table 2); with the only ethnovarieties not cited in both villages being those named by a single participant group.

Preferences for shea ethnovarieties

Table 2 shows the preference rankings for ethnovarieties provided by the different groups. Two of the 25 ethnovarieties – 'small shea fruit' and 'big shea fruit' – stand out for being preferred by nearly all the groups (nine and eight out of ten groups, respectively) (Table 2). In total, 14 ethnovarieties were cited among the top five by at least one participant group.

During the group discussions, women from all ethnic groups explained that their preferences hinged on the ethnovariety's usefulness for butter production, with ethnovarieties perceived to be rich in quality butter being the most desirable. Ethnovarieties that were perceived to have a low or no butter content, such as 'small nut shea', 'male shea tree', 'broken nut shea' and 'small soft shea nut' (Table 1), were among the least desired (Table 2).

There was general agreement between men and women that desirable traits also relate to shea fruit. Men from four of five groups stated in the group sessions that their preferences were most tightly linked to fruit yield and taste. For example, ethnovarieties such as 'small shea fruit', 'big shea fruit', and 'long shea fruit', which have sweet pulp, were among those preferred by the men's groups.

From a gender perspective, the preferred ethnovarieties for men were 'small', 'big' and 'long' shea fruit, whereas women most often preferred 'small' and 'big' shea fruit, followed by 'precocious shea fruit' and 'sweet shea fruit' (Table 2). Interestingly, 'long shea fruit' was ranked within the top five by all of the men's groups but by no women's group, although one women's group recognized the ethnovariety. 'Sweet shea fruit' was preferred by three women's groups and no men's group; and only one men's group recognized the ethnovariety. Overall, there was a great deal of variation in preferences both across and within gender and ethnic groups, and no clear pattern could be attributed to ethnicity, residence status or village.

Discussion

Shea folk classification systems

The sophistication of folk classification systems for shea has already been demonstrated by studies carried out in other regions of the species' range. For instance, in Uganda, Gwali et al. (2011) describe the local classification of shea into 44 ethnovarieties based on variations in fruit yield, tree form, and pulp taste, among other factors. The larger number of ethnovarieties identified in their study may owe to the fact that three Ugandan farming systems

were visited – which could have resulted in a greater number of shea phenotypes – while only one was visited in Burkina Faso. In Southern Chad, Djekota et al. (2014) confirm that there is a high variation in morphological characters in *V. paradoxa* populations, noting, however, that the four main morphotypes they identified were not congruent with the local folk classification system that recognized six morphotypes in the same area (Mbaiguinam et al. 2007).

In the present study, most of the 25 ethnovarieties cited were identified primarily according to the visible characteristics of their fruit, such as its colour, size and shape. This corresponds with Mazzocchi's (2006) observation that a plant's visible physical features are generally the primary criteria used by farmers in folk classification systems; and with observations that qualitative characters such as the shape of the shea fruit and the colours of the immature fruit and leaves are highly discriminative (Diarrassouba et al. 2009). Other ethnovarieties were primarily characterized by their fruiting period ('precocious shea fruit' (early fruiting) and 'late shea fruit' (late fruiting)) and the presence or absence of fruit ('male shea fruit' for trees that fail to fruit). Similarly, in a study on farmer classifications of baobab (*Adansonia digitata*) in West Africa, fruiting patterns were among the most commonly used criteria for classifying baobab ethnovarieties (Assogbadjo et al. 2008). As in the shea case, farmers recognized 'male' and 'female' baobab trees based on this characteristic, even though the baobab actually has hermaphroditic flowers.

Despite its value, shea butter was not considered a criterion for classifying ethnovarieties. This corresponds with previous findings that farmers in Uganda have a general sense of the quantity and quality of butter provided by different shea ethnovarieties, but do not establish ethnovarieties based on these characteristics (Gwali et al. 2011). In this study, Bobo women explained that nuts from different shea ethnovarieties are mixed together at the time of butter processing, making it difficult to assign clear shea butter traits to individual trees or ethnovarieties. A similar observation has been made by Sanou et al. (2006). Nonetheless, Bobo and Mosse women in Bana-Bobo and Bana-Lamogoya, respectively, claimed to have gained observational knowledge of the fat content of nuts from different ethnovarieties.

Contrary to what has been reported in Uganda (Gwali et al. 2011), this study has shown some consistency in the folk classification systems for shea across ethnic groups in southwest Burkina Faso. There was agreement across groups about key variables defining the classification system, and different ethnic groups within a given village and gender group cited 50 per cent or more of the same ethnovarieties. This may be due to the fact that the spatial integration of activities across ethnic groups through years of co-habitation has favoured an exchange of knowledge about their landscape and the trees it harbours (Howorth & O'Keefe 1999). Nonetheless, within a given gender, each ethnic group named some ethnovarieties not also named by other groups.

When focusing on a given ethnic group, however, greater inter-gender differences in the ethnovarieties named were perceptible. What is more, during discussions women and men displayed different depths of knowledge about particular aspects of the species that fall within their domains of expertise. For instance, women come to intimately know the shea tree through shea nut collection and processing, which fall within the female sphere of activities. These differences illustrate the importance of engaging both gender groups in ethnobotanical research. In the shea case, the key role the species plays in the lives of both women and men – who use the tree for multiple purposes and consume its fruit – as well as knowledge sharing within the household have also allowed women and men to acquire

some shared knowledge of the species (Elias 2015). This account for the overlaps observed in the ethnovarieties cited. Still greater overlaps were reported in Uganda, where women's and men's classification knowledge of *V. paradoxa* (subspecies *nilotica*) ethnovarieties strongly matched (Gwali et al. 2011).

Preferences for shea ethnovarieties

Two ethnovarieties stood out for being prioritized by nearly all (9 and 8 of 10) groups: 'small shea fruit' and 'big shea fruit'. These shared preferences across groups point to clear priorities to investigate from a domestication perspective. In this pursuit, it will be required to determine to what extent phenotypic traits of interest result from long-term adaptation processes versus environmental influences, and whether they can be selected for in domestication instances (Simons & Leakey 2004). Gwali et al. (2012, 2014) find that local classification systems for shea in Uganda capture variations in fruit and nut traits, but that the distinct shea types recognized by farmers reflect different phenotypic expressions of actually similar genotypes. Other studies of tropical and temperate trees corroborate that phenotypic traits are not necessarily correlated to genetic variation, but rather constitute a plastic response to different environmental conditions and climatic changes (Kramer 1995; Heaton et al. 1999; Assogbadjo et al. 2009). Whether or not this is the case for 'small shea fruit' and 'big shea fruit' should be explored.

Although butter traits were not named as variables used to characterize ethnovarieties, women from the different ethnic groups groups expressed that their preferences for shea ethnovarieties were linked first and foremost to the ethnovariety's butter characteristics. In contrast, Bobo men stated that their preferences were related first and foremost to the fruit's characteristics because men consume the fruit but do not process its nuts. Similarly, Maranz et al. (2004b) found that men prioritized fruit with high yields and sweet pulp whereas women cited butter yields as key additional shea tree characteristics. Men's preferences for shea trees with large, juicy fruit and high yields, have already been shown by Sanou et al. (2006). Other characteristics such as health, growth rate and resistance to misletoes, are additionally known to influence the selective protection of shea trees in cultivated fields at the time of land clearance (Lovett & Haq 2000b; Elias 2015). In this study, Bobo men and women further observed and appreciated that the 'small shea fruit' ethnovariety is the most resistant to changes in the climate, particularly rainfall, and the most abundant in their landscape. This perceived abundance contributed to preferences for this ethnovariety.

The top-preferred ethnovariety among Mosse women in both villages was 'precocious shea fruit', which yields fruits earlier in the season than other ethnovarieties. Since native landowners have not yet begun farming their fields at the time of collection of nuts from this ethnovariety, Mosse women, who are migrants, can collect fruit in their fields and fallows without being seen and refused entry into these lands. Tenure regimes that limit the access migrants have to certain types of lands and the valuable trees they carry thus explain their preferences for this ethnovariety. In addition, although Mosse participants report that the yield from this ethnovariety is inferior to other ethnovarieties, they explain that its ability to provide butter for consumption and income earlier than other ethnovarieties, at a critical time during the lean season, is particularly valuable. From a food security perspective, this is another critical factor to consider in future domestication initiatives.

Value of the methodological approach

This study reaffirms that using participatory methods can be effective for understanding folk classification systems (Jinxiu et al. 2004; Olango et al. 2014; Sieber et al. 2014; Silva et al. 2014). Participatory and gender-sensitive approaches such as the one adopted can also shed light on local motivations for plant management, potential conflicts of interest in local priorities, and the contributions of this process to *in situ* conservation of genetic resources (Vodouhè et al. 2011). Working with groups divided by gender and ethnicity, and being inclusive of participants of different ages, helped reveal the range of knowledge and preferences held within the villages. The approach further illuminated the unique ethnobotanical knowledge different groups hold and how preferences may be socially differentiated by sex and ethnic group. Other factors such as education levels and socio-economic status can also affect local knowledge and preferences and should be considered when designing such a study. Programmes aiming to promote specific ethnovarieties must consider the knowledge and interests of local resource users and managers from these differentiated groups or they may generate negative impacts for the very groups they seek to support.

Conclusion

This study has shown overlaps and differences in local knowledge and preferences for shea ethnovarieties among gender and ethnic groups in southwest Burkina Faso. In Bana-Bobo and Bana-Lamogoya, two ethnovarieties were preferred by nearly all groups: 'small shea fruit' and 'big shea fruit' because of the desirable characteristics of their pulp and butter and their abundance (for 'small shea fruit') in the landscape. To promote these ethnovarieties through management or domestication, further research on their morphological traits and genetic makeup is required. By drawing attention to the range of local preferences, this study can support local people, researchers and shea propagation interventions in promoting ethnovarieties that will yield benefits to different segments of the population, including women and Mosse migrants who are highly dependent on the species.

Future research should examine how consistent traits are within the same ethnovariety. If some traits show a continuous gradient across ethnovarieties, attention to the 'boundaries' between ethnovarieties is needed to determine how this variation can be exploited for breeding. It will also be useful to explore if some ethnovarieties carry additional desirable traits – such as drought tolerance or pest resistance – associated to those used to define the ethnovariety; and if some of the traits observed actually result from environmental factors or even diseases (e.g. in the case of 'permanently rotten shea fruit') rather than genetics. Finally, a better understanding of how the propagation of preferred ethnovarieties can influence the species' diversity is required to ensure that the intra-specific diversity of shea is conserved while promoting the presence of locally desirable traits. Attention to these issues can support the sustainable management of this highly valued species.

Notes

1. A similar tenure system is described by Howorth and O'Keefe (1999) in southern Burkina Faso.
2. Chevalier (1943) originally identified eight types, which he later reduced to three. The original categories were: *mangifolium*, *parvifolia*, *cuneata*, *serotina*, *poissoni*, *ferruginea*, *floccosa* and *nilotica*. Trees from the three categories presently accepted are located in the following

areas: *mangifolium* var. is found in the North Sudanian zone, in Mali, Ivory Coast and Burkina Faso; *poissoni* var. is located in Benin and Ghana; and *niloticum* var. is situated in East Africa (Purseglove 1968; Diarrassouba et al. 2009).

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