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Livestock Keepers' Attitudes: Keystone of Effective Community-Based Breeding Programs

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Abstract: Livestock keepers in southwestern Burkina Faso hold the local Lobi taurine breed, local Zebu cattle, and their crosses. Some communities in the region have begun to implement community-based cattle breeding programs (CBBPs), which involve animal tagging and recording and, potentially, also bull sharing. Based on the hypothesis that the participation of livestock keepers in CBBPs depends on their attitudes towards these programs, we used questionnaires to survey the attitudes of 125 farmers towards cattle breeding strategies and tools. Results were analyzed using principal component analysis. Farmers showed a highly positive attitude towards maintaining the features of their preferred cattle breed, but their attitudes varied substantially towards crossbreeding for breed improvement. Farmers generally agreed that performance was more important than animal appearance, and most of them were willing to cooperate with breeders' associations but were skeptical about sharing their bulls with other farmers. The majority was reluctant to record performance data, which may be due to a capacity deficit and their confidence in being able to select the best animals based purely on phenotype. Our analysis suggests that breeders' associations, as a key component of CBBPs, should lay down clear rules and obligations for their members from the outset. Timely consideration of farmers' attitudes towards different breeding tools may improve their uptake and guarantee the sustainability of CBBPs.

Keywords: breeding strategies; farmer attitudes; Burkina Faso

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1. Introduction

Local breeds are particularly relevant in developing countries, where they contribute to farmers' livelihoods and have socio-cultural functions [1]. These breeds have the advantage of adaptability to scarce and low-quality feed resources, adverse climatic conditions, and

resistance to parasites and endemic diseases. However, their productivity is low [1,2]. In an effort to increase farm production, farmers are increasingly crossbreeding local breeds with more productive international breeds or even replacing the local breeds entirely [3,4]. This trend threatens the conservation and use of local breeds [5–7].

In developing countries, genetic improvement of local breeds is one of the avenues to conserve them sustainably while supporting smallholder farmers [1,8]. Conventional breeding programs can be quite difficult to implement in communities of smallholder farmers in developing countries [9], which has led to the promotion of community-based breeding programs (CBBPs) [9–11]. CBBPs focus on indigenous stocks and strive to take into account the needs, views, decisions, and active participation of farmers [9–12]. Despite this goal, several CBBPs have failed because they did not adequately integrate the views of farmers, which resulted in low participation [9,13]. Thus, CBBP success depends on active participation by livestock keepers as well as consideration of local knowledge and the institutional setting [14–17]. The attitudes of livestock keepers towards the breeding strategy and tools proposed in CBBPs (or conventional breeding programs) can influence their willingness to participate [18]. However, few studies have systematically examined these attitudes or how they may be linked to CBBP outcomes. Instead, the literature has focused more on technical aspects of program design and implementation [19–21] and their possible economic impact on farmers' livelihoods [22,23].

In fact, farmers' knowledge, perception, and attitude towards a given technology help determine its success [24]. Farmers' attitudes are affected, in turn, by many personal factors (e.g., gender, age, marital status), socioeconomic factors (e.g., income, assets, education), and personality factors (e.g., self-confidence, readiness for innovation) as well as familiarity with the technology. Its adoption can also be determined by the agro–ecological environment, surrounding culture, political conditions, user-friendliness of the proposed technology, as well as the costs and benefits for farmers [24].

Better understanding of the livestock keepers' attitudes towards different breeding tools will help design more effective CBBPs as well as improve farmer participation and support from extension services. Taking into account local attitudes is all the more important because of how much production, management, and socioeconomic factors can vary within and across geographic areas [25,26]. In addition, farmers can vary in their attitudes towards breeding approaches and tools [18] as well as disease risk management, conservation, and animal welfare [27–29]. This heterogeneity is particularly evident in developing countries, where farming remains less intensified and homogenized than in developed countries.

The present study assessed the attitudes of farmers in southwestern Burkina Faso towards breeding strategies and explored attitudinal differences among different farmer communities. The study also examined the implications of such attitudes for the design and implementation of CBBPs in the area.

2. Materials and Methods

2.1. Study Site

The research was conducted in the mountainous South-Sudanian ecological zone in southwestern Burkina Faso (Figure 1). The area is inhabited by approximately 850,000 people comprising the "local" ethnic groups Lobi, Dagara, Birifo, Djan, and Pogouli, as well as the "immigrant" groups Mossi, Fulani, and Bobo [30]. Their primary economic activities are cattle and crop production [31]. The breeds in this area include the two most common cattle breeds in Burkina Faso, namely the indigenous Lobi taurine (named after the Lobi ethnic group) and the Zebu, as well as crosses between these two breeds.

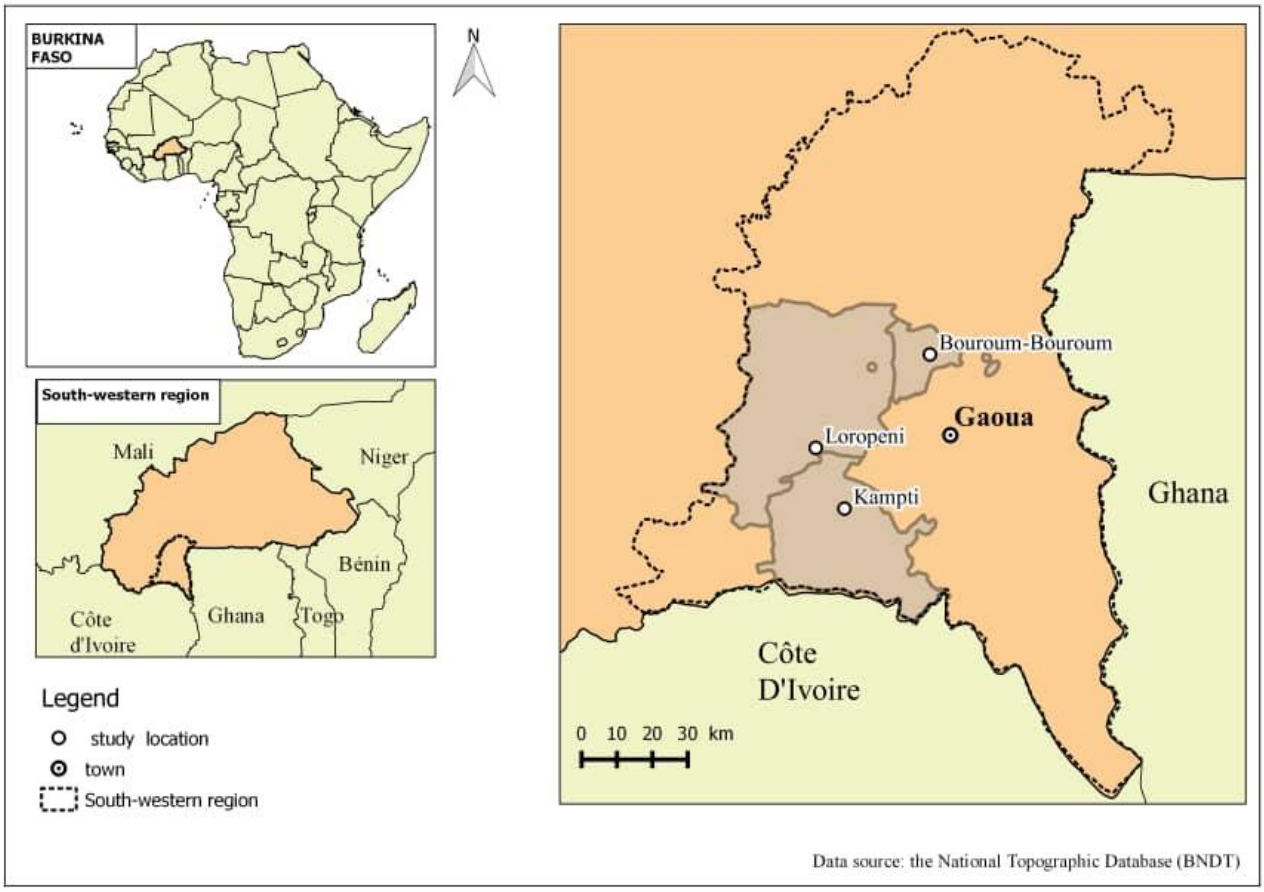

Figure 1. Location of study sites.

Rainfall patterns have recently become more erratic than in the past, and livestock production is constrained by parasite and disease pressures [32]. To improve productivity, farmers have begun crossing the local Lobi taurine breed, reducing the pure local populations [33–35]. To help conserve and improve Lobi cattle, local authorities and livestock researchers have recommended CBBPs similar to those that have proven successful in other developing countries [10]. Two universities and one research institute in Burkina Faso, in collaboration with two universities in Austria, have launched the project "Localbreed—Local Cattle Breed—Burkina Faso" to implement CBBPs aimed at conserving and improving pure Lobi cattle as well as Zebu *x* Lobi crossbreds [36].

2.2. Sampling

In a 2018 study in the same area, we developed a typology of cattle production systems based on a sample of 169 households [32]. Four cattle production systems were identified: (1) sedentary Lobi farms, (2) sedentary crossbreed farms, (3) semi-transhumant Fulani Zebu farms, and (4) transhumant Fulani Zebu farms. Our intention was to include these same households in the present study to investigate the attitudes of farmers toward breeding instruments. However, some households moved away after the previous study, so in the present work, we were only able to include 125 of the original 169 households.

2.3. Farmer Survey and Attitudinal Statements

We evaluated farmers' attitudes using a set of attitudinal statements towards which farmers stated their agreement using a six-level Likert scale: totally disagree, disagree, somewhat disagree, somewhat agree, agree, and totally agree. Such a scale avoids the central tendency bias. We also included the option: "I do not know/I do not have an opinion on this". The list of attitudinal statements was defined based on a study of sheep

and beef farmer attitudes in Australia, New Zealand, and Spain [18]. The statements were adapted to local conditions by taking into account local breeding practices and the current state of breeding programs. For example, statements related to the use of genomic information were removed, and two statements related to farmers' collaboration and bull sharing were added. The final list consisted of 10 statements, 8 of which were common to the attitudinal scale in the previous work [18] (Table 1). The list of statements that made up the core of a longer questionnaire also included questions about the farming system, farmer profile, farmer breeding strategies, and breeding tools.

Table 1. Attitudinal items on the survey.

Attitudinal Item	Variable
* It is very important to maintain the breed features of bulls/cows.	MaintainBreedFeatures
* Crossing animals of different breeds should be avoided when improving beef cattle performance.	AvoidCrossing
* The appearance of a bull/cow ("beauty of animals") is sufficient for telling its performance.	AppearanceIndicatePerform
* I do not need a person to come and record performance data on a bull/cow in order to know how good the animal is.	RecordingNotImportant
* The appearance of a bull/cow ("beauty of animals") is more important than its performance.	AppearanceMoreImpPerform
* The appearance of progeny ("beauty of animals") completely indicates how good the bull/cow is.	AppearanceProgenyImportant
*,# Artificial insemination does not help improve the performance of a cattle herd.	AI_NotHelpPerformance
+ Sharing or exchanging bulls between farmers is important for improving the performance of a cattle herd.	BullShareImportance
* In order to improve the performance of my herd, collaboration with other farmers to compare animals is crucial.	FarmerCollabCrucial
+ Being a member of a cattle breeders' association helps me to improve my herd.	BreederAssocHelps

* Items taken from the survey [20]. + Items that were added to adapt the survey to local conditions. # Removed from the analysis due to the low number of responses.

2.4. Data Collection

We contacted the heads of household and carried out face-to-face interviews from July to September 2019. We used local materials, such as pebbles or shea nuts, to explain the 7-point scaling system for responding to survey items [37], where 0 meant "I do not know/I do not have an opinion on this"; 1, totally disagree; 2, disagree; 3, somewhat disagree; 4, somewhat agree; 5, agree; and 6, totally agree. The respondents decided where and when to conduct the survey/interview session and in which language (Dioula, Mooré, or French). Before an interview, farmers were individually asked to consent to the recording of the sessions and for the results to be used for scientific work.

2.5. Data Analysis

2.5.1. Dataset Preparation

We first carried out quality control of the dataset. Households for which the interview contained more than three responses of "I do not know/I do not have an opinion on this" were removed, which was the case for one household. This response was given by 37–70% of respondents, depending on the production system, with reference to the statement on artificial insemination, so this statement was removed from the analysis. Therefore, we analyzed nine attitudinal statements in the end. Values were imputed for observation with three or fewer missing values (n = 33) not to miss the remaining statements' information. We used the expected maximization algorithm in the "Amelia" package of R (version 3.6.1) [18].

2.5.2. Statistical Analyses

Analysis of Responses about Production Systems

Among variables describing farmers' profile, farming system, and breeding management, the mean and the standard deviation were calculated for continuous variables, while the percentage was calculated for categorical variables. Before data analysis, we carried out the Shapiro test and Q-Q normality plots to examine the distribution of data. As data did not follow a normal distribution, we carried out nonparametric tests. Differences between production systems were assessed for significance using the χ^2 test (categorical variables) or using the nonparametric Kruskal–Wallis test followed by Wilcoxon-test with Bonferroni–Holm correction (continuous variables). Differences were considered significant at $p < 0.05$.

Analysis of Responses to Attitudinal Statements

Principal component analysis (PCA) was used to investigate relationships among farmers' attitudes towards different breeding aspects and explore the variability of these attitudes across the entire farmer sample. In particular, we aimed to identify for which attitudinal statements there was concurrence of agreement or disagreement and those for which there was strong heterogeneity. PCA was carried out using the FactoMinerR package, and results were plotted using the FactoExtra package, both in R (version 3.6.1). Principal components (PCs) with an eigenvalue of at least one were retained (Kaiser's criterion) [38,39]. We analyzed variation in farmers' attitudes across the four production systems, which were plotted around the mean values for each farming system, and then confidence ellipses were drawn on the PCA plots. Finally, to help interpret the PCA results, we calculated the average agreement for each original attitudinal statement in each production systems

The lengths of the vectors (i.e., arrows) indicate how strongly the associated variable influences the PC. Therefore, they are directly proportional to the variation of that variable in the sample. For example, a very short arrow indicates that the two PCs contain nearly no information about the variable in question. The angle between any two arrows represents the correlation between the associated variables. When the angle between two variable vectors is 90 degrees, the two variables are deemed to be orthogonal and uncorrelated. Smaller angles indicate positive correlation; larger angles, negative correlation. Finally, the location of the dots (i.e., observations) in the plot is related to the score for each variable according to the direction of the arrows.

3. Results

The main characteristics of the four production systems (Table 2) were consistent with those of the 2018 study conducted in the same area [32]. For all production systems, farmers had an average age of 50 years, and most had no formal education. They had all inherited their farms and were working full-time as farmers. Most farmers relied on hired herders; in contrast, farmers who kept Lobi taurine cattle in sedentary systems were more likely to rely on family labor. All farmers had more than one breeding bull, and they preferred those breeding bulls to ones from outside their herd.

PCA identified six PCs with eigenvalues of at least one that together described 90.0% of the total variance (Table 3). The first component explained 25.4% of the variance (Figure 2), and the four primary and positively correlated items were attitudes towards crossbreeding, collaboration between farmers, membership in a breeders' association, and bull sharing. This first PC correlated negatively with performance recording.

Table 2. Main characteristics of the four production systems.

Variable	Production System			
	I Sedentary Lobi taurine *n* = 61	II Sedentary crossbreed *n* = 19	III Semi-transhumant Fulani Zebu *n* = 33	IV Transhumant Fulani Zebu *n* = 11
Household attributes				
Age of household head, yrs (mean ± SD)	55.5 ± 11.1 [a]	55.1 ± 12.7 [a]	48.6 ± 12.8 [b]	52.6 ± 8.9 [a]
Education of household head (%)				
None	95.1 [a]	73.7 [b]	97.0 [ab]	90.9 [ab]
Basic	3.3 [a]	15.8 [a]	3.0 [a]	0.0 [a]
Secondary	1.6 [a]	10.5 [a]	0.0 [a]	9.1 [a]
Technical training	0.0	0.0	0.0	0.0
Time spent on the farm (%)				
Full-time	100 [a]	100 [a]	100 [a]	100 [a]
Part-time	0	0	0	0
Use of hired labor (%)				
Yes	21.3 [a]	63.2 [b]	51.5 [b]	81.8 [b]
No	78.7 [a]	36.8 [b]	48.5 [b]	18.2 [b]
Farm inherited by household head (%)				
Yes	100 [a]	100 [a]	100 [a]	100 [a]
No	0	0	0	0
Livestock ownership and management				
No. of animals (mean ± SD)				
Lobi breed				
Cows	9.2 ± 6.0 [a]	4.5 ± 3.8 [b]	0.9 ± 3.0 [c]	0.0 ± 0.0 [c]
Bulls	3.1 ± 2.1 [a]	1.3 ± 1.5 [b]	0.1 ± 0.4 [c]	0.4 ± 1.2 [c]
Crossbreeds				
Cows	0.7 ± 2.0 [a]	14.9 ± 13.5 [b]	11.6 ± 14.2 [b]	11.6 ± 16.2 [b]
Bulls	0.5 ± 0.9 [a]	2.7 ± 2.7 [b]	1.5 ± 1.4 [b]	3.2 ± 4.5 [b]
Zebu breed				
Cows	1.5 ± 3.9 [a]	5.5 ± 11.6 [b]	32.2 ± 30.1 [c]	106.0 ± 57.6 [d]
Bulls	1.6 ± 2.3 [a]	1.3 ± 1.1 [a]	3.3 ± 2.6 [b]	6.6 ± 3.8 [c]
Origin of bulls (%)				
(a) Directly from breeders or other farmers	42.6 [a]	36.8 [a]	6.1 [b]	18.2 [ab]
(b) Livestock sale/markets	1.6 [a]	0.0 [a]	3.0 [a]	9.1 [a]
Both (a) and (b)	1.7 [a]	5.3 [a]	0.0 [a]	0.0 [a]
From own herd	54.1 [a]	57.9 [a]	90.9 [b]	72.7 [ab]

[a,b,c] Means within a row with different superscripts are significantly different at $p < 0.05$ based on the chi-squared test (categorical variables) or the Kruskal–Wallis test (continuous variables).

Table 3. Correlation of initial variables with principal components.

Variable	Principal Component					
	1	2	3	4	5	6
MaintainBreedFeatures	0.2	0.3 **	0.1	−0.2	−0.1	−0.1
AvoidCrossing	0.8 ***	−0.5 ***	0.3 **	0.1	0.1	0.1
AppearanceIndicatePerform	0.1	0.5 ***	0.7 ***	0.4 ***	0.1	−0.2 **
RecordingNotImportant	−0.5 ***	−0.2 *	0.4 ***	−0.1	0.7 ***	−0.1
AppearanceMoreImpPerform	0.1	−0.1	−0.4 ***	0.9 ***	0.2	0.1
AppearanceProgenyImportant	0.2 *	0.6 ***	0.2	−0.1	0.2	0.7 ***
FarmersCollabCrucial	0.4 ***	0.3 ***	−0.1	−0.3 ***	0.3 **	−0.5 ***
BreederAssocHelps	0.3 **	0.2 **	−0.1	−0.2 *	−0.1	0.2 *
BullShareImportance	0.6 ***	0.5 ***	−0.4 ***	−0.1	0.4 ***	−0.2
Eigenvalue	3.9	2.7	2.4	2.1	1.6	1.4
Percentage of variance explained	25.4	17.2	15.1	13.6	9.9	8.8
Cumulative variance explained		42.6	57.7	71.3	81.2	90.0

*, **, *** indicate significance at $p < 0.05$, $p < 0.01$, or $p < 0.001$, respectively.

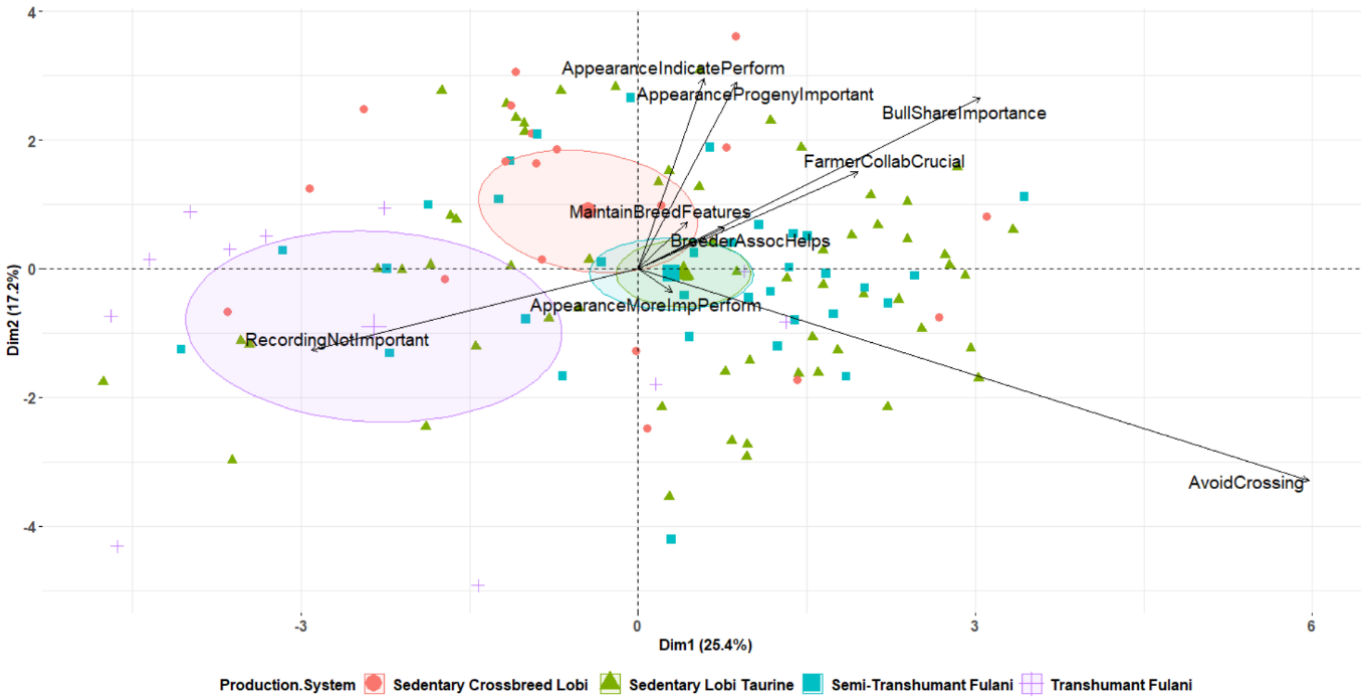

Figure 2. Principal component analysis (PCA) plot of farmers' attitudes in different production systems towards the variables of PC1 and PC2.

The second component accounted for 17.2% of the variance and was explained by the following five variables: importance of the appearance of the progeny, animal appearance as a performance indicator, the importance of bull sharing, avoiding crossing, and collaboration among farmers. The biplot of PC1 and PC2 suggested a clear attitudinal difference between respondents from the "Sedentary Crossbreed Lobi" or "Transhumant Fulani" production systems. In the plot, the ellipse representing "Sedentary Crossbreed Lobi" lay opposite the variable "AvoidCrossing", indicating a positive attitude towards crossbreeding (Figure 2 and Figure 4). "Transhumant Fulani" respondents showed an attitude towards bull sharing opposite to that of all the other groups and were critical of farmers' collaboration as a tool to improve breed features.

Among attitudes that correlated strongly with PC 1 and 2, clear differences were not observed between respondents from "Sedentary Lobi Taurine" or "Semi-Transhumant Fulani" production systems (Figure 2). The confidence ellipses of these two systems lay in the center of the PC plot and covered the entire PC space, indicating high heterogeneity of attitudes. Attitudes varied the most among "Transhumant Fulani" farmers, reflected in the greater spread of the confidence ellipse.

The biplot of PC3 and PC4 revealed that "Sedentary Lobi Taurine" farmers had a strongly positive attitude towards bull sharing, while "Semi-Transhumant Fulani" farmers had a strongly positive attitude towards animal appearance as a good performance indicator (Figure 3). This biplot revealed substantial heterogeneity within both production systems.

Farmers from all four production systems strongly supported maintaining breed features, relying on appearance as a performance indicator, being a member of a breeder's association, and valuing animal performance more than appearance (Figure 4). "Transhumant Fulani" farmers were more critical towards performance recording, collaboration with other farmers, and sharing their bulls to improve herd performance.

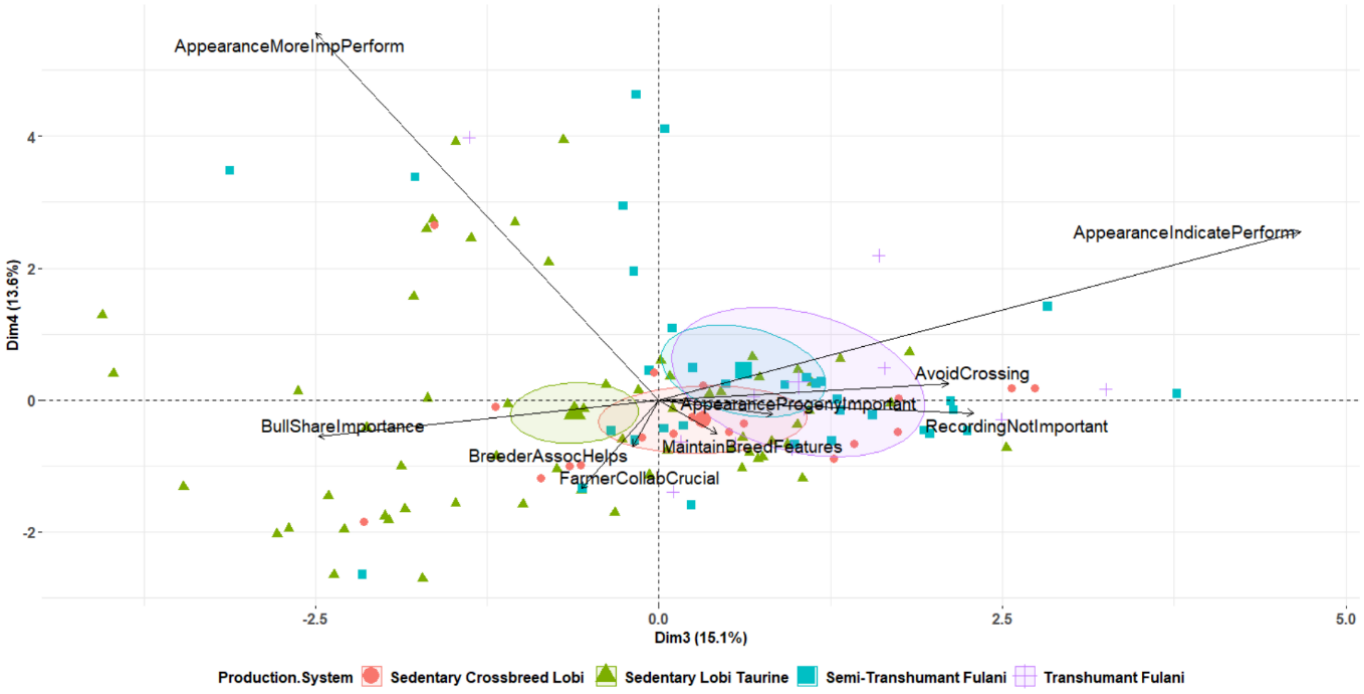

Figure 3. PCA plot of farmers' attitudes in different production systems towards the variables of PC3 and PC4.

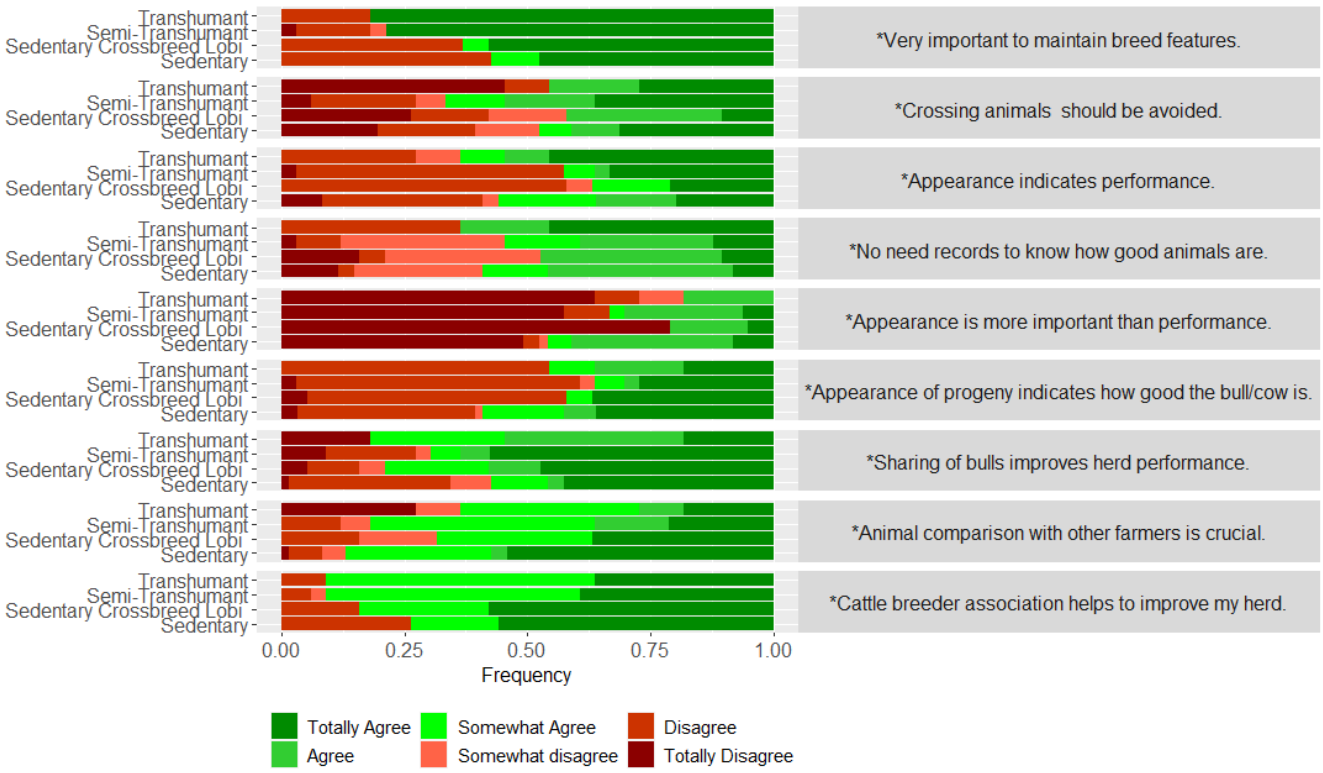

Figure 4. Farmers' attitudes of four production systems towards breeding tools. Legend for Figure 4. Transhumant: Transhumant Fulani. Semi-Transhumant: Semi-Transhumant Fulani. Sedentary Crossbreed Lobi: Sedentary Crossbreed Lobi. Sedentary: Sedentary Lobi Taurine. * The full sentences can be found in the same order in Table 1.

4. Discussion

This study investigated farmers' attitudes towards aspects of breeding relevant to the successful implementation of CBBPs. We focused on how attitudes varied within and across four production systems related to two ethnic groups (Lobi and Fulani), two livestock breeds (Taurine and Zebu), and three farming styles (Sedentary, Semi-Transhumant, and Transhumant), which we established in previous work [32]. Our analysis identified three issues about CBBPs that may need to be addressed during their design and implementation: whether to prioritize pure breeding or crossbreeding, how to promote cooperation and bull sharing among farmers, and how to promote performance recording and animal tagging. Each of these issues is explored in greater detail below. Ensuring that these issues are resolved in alignment with the attitudes of participating farmers may help ensure that CBBPs are successful and sustainable.

4.1. Prioritizing Pure Breeding or Crossbreeding and "Beauty" or Performance

Across all four production systems, farmers showed a highly positive attitude towards maintaining the features of their preferred cattle breed. Lobi Taurine and Fulani Zebu are traditionally kept by different ethnic groups and play essential roles in their cultural practices, contributing to their respective cultural identities [40–42]. This attachment of farmers to a particular breed will likely help conservation and breeding efforts as farmers should be more inclined to participate in breeding programs that are aimed at improving what they value, instead of switching cattle breeds as a response to changes in production systems, environmental factors, or market forces. In Uganda, the Ankole Cow Conservation Association has used this strategy of linking farmer identity to a breeding program to conserve Ankole cattle [2]. However, connections between ethnic groups and cattle breeds can change over time [43].

In our study, farmers from all production systems overwhelmingly supported the need to maintain breed features, yet they kept both pure and crossbred animals, especially the "Sedentary Crossbreed" farmers. Their visual appraisal of animals as pure or crossbred may not always be accurate. For example, Lobi animals that have been mixed with Zebu based on genomic analysis are frequently misclassified as pure by farmers [44]. Indeed, many farmers in developing countries consider crossbreeding an attractive option for increasing their income [8,45–48]. "Sedentary Crossbreed" farmers in our study area consider crossbreeding two local breeds to be a way to improve herd productivity [32].

However, researchers and international agencies have warned that farmers' interest in crossbreeding can lead to the loss of purebred cattle in Burkina Faso [33,34] and elsewhere [1,45]. Our study shows that although farmers are clearly interested in crossbred animals, most of them are also concerned about retaining pure breed features. Nevertheless, CBBPs usually do not implement or promote well-designed crossbreeding strategies that minimize the risk of losing purebred cattle. This means that farmers are often left on their own when selecting bulls or making other breeding decisions, especially deciding which bulls to mate with crossbred females. We argue that both pure breeding and crossbreeding can and should be practiced in the same area and that farmers are aware of the benefits and risks of both approaches. Effective and sustainable parallel implementation requires institutionalization and possibly guidance from technical staff.

As part of the issue over pure breeding or crossbreeding, the farmers in our study generally agreed that animals' performance is more important than their appearance, which is in line with the study of Ankole cattle farmers in Uganda [16]. In many developing countries, farmers consider the well-being indicator "animal body condition score" as more important than any other attribute [49]. A possible explanation is that cattle income makes an essential contribution to the household livelihood and that farmers prefer animals that quickly reach market weight, while buyers prefer animals with good body condition. Indeed, animal body condition strongly influences farm gate price in Benin, Kenya, and Ethiopia [50–55], and good body condition is a prerequisite for adequate traction power for plowing. These considerations help explain why most breeding programs in devel-

oping countries aim to improve performance [56]. Consensus-building between farmers, researchers, and extension services may help make breeding goals more aligned with farmer attitudes and, therefore, more likely to succeed.

4.2. Promoting Cooperation among Farmers

Our study showed that farmers agreed with the importance of breeders' associations and inter-farmer collaboration to allow them, for example, to benchmark their herds against others. On the other hand, farmers did not always show positive attitudes towards bull sharing. While farmers appear to perceive the potential benefits of joining breeders' associations, such as greater income [57] or greater sustainability of breeding programs [58,59], they seem less willing to accept the implications of such participation, which includes bull sharing. In one study, farmers in Burkina Faso who were members of an association or cooperation showed a more positive attitude towards the conservation of Lobi cattle than farmers who were not members [34].

Based on our findings and the literature, we recommend the establishment of formally registered and recognized breeders' associations for Lobi cattle. These organizations should build on existing social structures to increase acceptance among farmers [15]. Membership should entail clear rules, rights, and obligations for each member [59]. During member discussions, the benefits of bull sharing to the participating farmers and the wider community can be emphasized to counteract the negative attitudes.

Considering the diverse attitudes towards bull sharing and farmer collaboration that we observed in our sample, particularly among "Transhumant Fulani" farmers, we recommend continuous dialog among stakeholders to jointly explore options for preserving and improving cattle breeds. A successful community-based breeding intervention needs to build on the commitment of livestock keepers, and the choice of certain farmers to opt-out must be respected.

4.3. Promoting Data Recording and Animal Tagging

Lack of performance data in smallholder farms is repeatedly cited as a major obstacle for breeding program success [17,60]. Farmers in our study seemed confident that the appearance of animals or that of their progeny are good performance indicators, which implies that they do not see the need to record animal performance. Indeed, farmers may derive a sense of achievement from being able to select the best animals for breeding based only on their external features [43]. Our results reflect the dominance of traditional farming practices in the study area, where the head of household generally exercises absolute power over cattle management [31,32,34]. In addition, all the farmers in our study inherited their farms from their parents, and most of them place value on conforming to their parents' practices [43]. Our analysis leads us to recommend demonstrating to farmers how performance and pedigree data can be used to preserve and improve the external traits they are familiar with, such as breed purity and bull performance.

Encouraging the recording of performance data will require overcoming several obstacles. These include lack of formal education and technical training among farmers, their advanced age, and their lack of workers with the time to routinely and accurately collect animal performance and pedigree data. For example, farmers from the "Sedentary Lobi Taurine" production system rely mostly on family members, who are often overwhelmed with other farm and domestic activities. Another obstacle is the lack of relevant skills and user-friendly infrastructure in information and communications technology, including robust and interactive databases.

Performance recording requires systematic tagging of animals [12,61], yet many farmers in Ethiopia are reluctant to tag their animals because they believe it may cause infection and even death [58]. We suggest that CBBPs implement animal tagging and identification in a way that creates transparency and trust among stakeholders. One possibility is to implement a data-management responsibility chain [10] in which someone (e.g., an agricul-

tural advisor) records data on the farm while external services analyze the data, the results of which are used to rank the animals.

If "outsiders", such as extension services, record and manage performance data, they should regularly provide feedback to farmers about the data to ensure trust and transparency and thereby improve farmer participation. This feedback is especially essential at the beginning of a breeding program so that farmers can familiarize themselves with data interpretation and grow in self-confidence. Indeed, continuous exchange with farmers is a critical element of CBBP viability [15,23,60]. Allowing farmers to participate actively in the improvement and fine-tuning of breeding programs can increase their sense of ownership and turn program tools into "public goods" [62].

Our present findings showing heterogeneity of livestock keepers' attitudes within and across different production systems echo results from our previous study in the same area [32]. These findings suggest that the traditional view of the Fulani ethnic group as pure cattle keepers and the Lobi ethnic group as crop farmers who are less interested in cattle [34] is no longer valid. Both groups seem to have diversified their interests. In addition, the present study demonstrates how quantitative survey methods to investigate attitudes of respondents in rural communities can yield valuable data in contrast to what some have suggested [63–66]. Careful adaptation of the research instruments to local conditions is essential [35].

5. Conclusions

This investigation of livestock keepers' attitudes towards breeding strategies and tools in Burkina Faso showed that farmers' attitudes towards crossbreeding of two local cattle types varied greatly, but they agreed that cattle performance was more important than their appearance. Farmers agreed on the importance of belonging to an association and collaborating with other members but did not necessarily agree on bull sharing. They were reluctant to record data on animal performance, which may reflect a lack of capacity and their own confidence in selecting breeding bulls. Our work shows the potential of attitudinal studies for informing the design and implementation of CBBPs. Conversations on attitudes provide a detailed picture of participating farmers' values and challenges, thus enabling stakeholders to collaborate more fruitfully. Expanding these conversations about attitudes to other stakeholders, such as extension services and research institutions, may be particularly beneficial. To be successful and sustainable, CBBPs should clearly define the obligations and roles of participating farmers, and they should provide systems for animal identification and performance recording to build trust and encourage stakeholders to continue systematic breeding activities.

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