Sheep herding systems and animal genetic resource management in the Central Plateau region of Burkina Faso

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Summary

As in the entire livestock sector in developing countries, sheep farming in Burkina Faso has been facing an increasing demand in a context of constraining socioeconomic and environmental production. This has resulted in poorly controlled crossbreeding in suburban Ouagadougou, the capital. In order to identify ways to manage these practices so as to make sheep systems sustainable, a survey was conducted with 63 livestock farmers in the Central Plateau region. The main objective was to assess the possibilities of integrated management between rural and suburban breeders, particularly by means of exchange of females. The data were collected through direct interviews using a questionnaire with open and closed questions. The results showed that all farmers had breeding strategies through the selection of breeding males. This selection mainly occurred within their own herd (98% of the interviewees) and sometimes in markets (22%). The main improvement objectives were adult weight and lamb growth, or maintenance of hardiness. The Djallonke ewe of the Mossi variety was the most common breed in the area (present in 97% of herds). Implementing their objectives, the breeders crossed their Mossi ewes with Fulani rams, larger in size, but provisionally to limit the loss of resistance of their flock. The potential link with suburban breeders' production *via* the sale of females appeared to face cultural constraints. The production system described by the breeders had sustainability constraints and did not allow for real integration with the suburban system. Participatory approaches should be implemented locally to develop appropriate solutions to increase production and sustainable management of animal genetic resources.

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■ INTRODUCTION

Urbanization and population growth have spurred a considerable increase in demand for animal products in West Africa (FAOSTAT, 2016). Besides poultry, which is first concerned by this increase, meat of small ruminants appears as a growing sector. Mutton is, indeed, culturally important in the subregion, linked to its role in Islam. In 2011, Burkina Faso had more than eight million sheep with 6.2% of this flock in the Central Plateau region (MRA, 2012). The national flock is divided into three genetic subgroups: Fulani sheep, Mossi Djallonke sheep and West African Dwarf sheep (Traoré et al., 2008). The first two sheep are encountered in the Central Plateau region. Mossi Djallonke sheep is described as small and hardy, i.e. adapted to Sudanese climate and resistant to diseases, whereas the Fulani sheep is heavy but susceptible to diseases and environmental stress (Tindano et al., 2015). Together with Mali and Niger, Burkina Faso constitutes the main provider of ruminants to coastal countries of West Africa (Renard, 2003; Josserand, 2013), with a share of small ruminants of 16% in the total livestock exports (Josserand, 2013). In Burkina Faso, between 2007 and 2011, small ruminant meat consumption increased annually by about 3%, reaching 53,173 tons (FAOSTAT, 2013).

The increase in demand for meat could benefit poor rural farmers if they had better access to markets and training in good management practices. These practices cover health, nutrition and reproduction of

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their herd (Kosgey and Okeyo, 2007). Health and feeding problems are often cited as major constraints to production (Tindano et al., 2015). All animal production is based on the genetic resources used and thus the management of these resources is key to sustainability (Hoffmann, 2011). It suggests improvement based on local breeds in accordance with the new challenges of the livestock sector (FAO, 2007).

Suburban sheep breeding around Ouagadougou appears threatened by the poor management of genetic resources. This management mainly consists in crossbreeding Fulani rams with Mossi ewes without a strict control of the level of Fulani sheep blood. This moves the genetic pool toward higher weights but lesser resistance given the characteristics of Fulani sheep (Tindano et al., 2015). The link between rural and suburban producers could benefit to the overall management of animal genetic resources, the rural areas then appearing as a sustainable source of highly adapted genetic material. The Central Plateau region covers the eastern, northern and western suburban zone of Ouagadougou. Furthermore, it represents the cradle of the Mossi Djallonke sheep. With the prospect of identifying ways for the sustainable and inclusive development of suburban and rural sheep breeding in Burkina Faso, this study aimed at characterizing the present systems involved in sheep production in rural areas of the Central Plateau region. It particularly focused on the status of genetic resources in rural breeding systems, i.e. farmers' objectives on this issue and their management practices in order to assess the possibilities of implementing a genetic improvement program and a connection between the two systems.

■ MATERIALS AND METHODS

Study area

The study area covers two provinces of the Central Plateau region (Oubritenga and Kourweogo). Ziniaré, the administrative center of this region, is located at 12° 35' N and 1° 11' W. The climate is of the North Sudan type. Rainfalls range from 600 to 800 millimeters per year and extend from June to October. Vegetation is of the tree and shrub savanna type with an herbaceous layer, abundant in the rainy season, dominated by species such as *Pennisetum pedicellatum, Cenchrus biflorus, Aristida adscensionis, Brachiaria plantaginea* and a ligneous layer dominated by *Combretum micranthum, Lannea microcarpa, Vitellaria paradoxa* and *Parkia biglobosa*.

Sampling and data collection

The survey involved 63 producers in six zones of technical livestock support (ZATE). Ten farmers were randomly selected per zone in a list including owners, as provided by livestock technicians. Given the objective of studying the present trend of the local management of genetic resources, owners keeping a minimum of 10 animals were selected for the survey. One of the areas, being particularly large, motivated the selection of 13 farmers. Data was collected through direct interviews from April 3 to May 11, 2013. Closed and open-ended questions addressed the following topics: i) socioeconomic characteristics of sheep farms, ii) sheep genetic resources and their management, iii) husbandry practices, iv) objectives and constraints, and v) market integration (inputs, products and breeding).

Statistical analysis

All statistical analyses were performed with R (version 3.1.0). Descriptive statistics, multiple correspondence analysis (MCA) and hierarchical classification analysis (HCA) were performed to establish a typology (package FactoMineR, function MCA and HCPC) (Agro Campus Ouest, Rennes, France). The variables used for MCA and HCA are described in Table I. Chi-square or Fisher's exact tests were conducted to evaluate the dependence between clusters and categorical variables, as well as among categorical variables.

Table I

Meaning of codes used in the multiple correspondence analysis and hierarchical classification analysis of breeders' characteristics in the Central Plateau of Burkina Faso

Variables	Codes	Modalities	% Breeders
Non-agricultural economic activity	econoact	econ_yes: yes	34.9
		econ_no: no	65.1
Sheep feeding method	feeding	nat.past: natural pasture exclusively	22.2
		combin: combination of pasture and complementation	77.8
Sheep guarding system	shepherd	shep_yes: sheep guarded by shepherd all year	31.7
		shep_no: sheep in scavenging in the dry season	69.8
Systematic deworming	deworm	dewor_yes: yes	42.9
		dewor_no: no	57.1
Number of sheep	effective	effect1: number of sheep < 30	60.3
		effect2: number of sheep between 30 and 50	22.2
		effect3: number of sheep > 50	17.5
Ethnicity of breeder	ethnic	mossi: Mossi herder	71.4
		fulani: Fulani herder	28.6
Crossing experiment	crossing	cross_yes: has conducted crossing experiments with sheep	58.7
		cross_no: never conducted crossing experiments with sheep	41.3
Education	education	no.educat: no education	39.7
		alphab: secondary, primary or literate in local language	39.7
		koran: Koranic school	20.6
Breeding sheep	breeds	djalon: only Djallonke breed	69.8
		dja_fula: Djallonke and Fulani breeds	30.2
Livestock rank in the household economy	rank	princip: livestock as the main economic activity	39.7
		second: livestock as the secondary or tertiary economic activity	60.3

■ RESULTS

Socioeconomic characteristics

Interviewees' socioeconomic characteristics are presented in Table II.

Table II

Breeders' socioeconomic characteristics in the Central Plateau of Burkina Faso

Characteristics	%
Sex	
Men	96.8
Women	03.2
Ethnic group	
Mossi	71.4
Fulani	28.6
Instruction level	
No instruction	39.7
Koranic school	20.6
Literate in the local language	27.0
Primary	11.1
Secondary	01.6
Marital status	
Co-wife	01.6
Single	01.6
Widow	01.6
Monogamous married	49.2
Polygamous married	46.0
Origin of initial flock	
Inheritance	65.1
Purchased	34.9
Rank of livestock	
Principal activity	39.7
Secondary activity	58.7
Tertiary activity	01.6
Livestock system	
Sedentary	96.8
Seasonal transhumance	03.2
Other species	
Poultry	100
Cattle	90.5
Goat	93.5
Crop production	
Home consumption	100
Cash crops	76.2
Market gardening	36.5
Non agricultural activity	
Trade	17.5
Handicraft	14.3
Paid jobs	03.2
Rank of sheep in livestock	
Principal	30.2
Secondary	69.8

Flock structure and general husbandry are presented in Table III. The flock mean size was 32.5 sheep and the median number of sheep 26 (range: 10–117). The average male-to-female ratio was 1:4 and the number of lambs per adult female 0.6 ± 0.3.

The average percentage of head sold annually was 25.4% of the flock at the time of survey (range 0–40%). The sales mainly involved adult males, often to cover social expenses or to buy new cattle and cattle feed. Culling was not based on age or performance.

Most of the animals were usually sold in local markets to collectors, who transported them to Ouagadougou market or sold them to exporters. During festive periods (Muslim feast of sacrifice, Christmas and New Year), however, some producers reported directly selling their fattened rams in Ouagadougou. Most times, this was carried out by settling down along the main roads of the city to offer their animals directly to consumers. These animals were almost all destined for slaughter and thus there was almost no exchange of animals for

Table III

Flock structure and breeders' management characteristics in the Central Plateau of Burkina Faso

Variables	%
Flock structure	
Adult males	14.2 ± 8.1
Adult females	55.6 ± 13.1
Lambs	30.2 ± 11.2
Feeding system	
Exclusively natural pasture	22.2
Complementation	77.8
Guarding system in dry season	
Freely grazing	69.8
Herdsman	30.2
Dry season drinking water	
Drill-holes	79.4
Wells	39.7
Water impoundments	07.9
Vaccination	
Regularly	39.7
Not regularly	60.3
Deworming	
Regularly	42.9
Not regularly	57.1
Breeds present in flocks	
Mossi sheep	96.8
Fulani sheep	30.2
Origin of breeding stock	
Own flock	98.4
Marketplace	22.2
Other breeders	12.7
Selection criteria	
Size and weight	77.8
Coat	38.1
Conformation	22.2
Growth	09.5
Horn size	09.5
Hardiness	06.3

breeding between producers of this region and those of the suburban area of Ouagadougou.

According to interviewees, the major expenditures for flock management were animal feed and veterinary costs, which were therefore presented as the major constraints.

Husbandry practices

Sheep feeding in all surveyed farms was based on natural pastures. It combined crop residues (sorghum stalk, groundnut hay), conserved fodder collected on natural pastures, and concentrates (cotton-oil cake, maize or sorghum bran) during the dry season (Table III). During the rainy season, all the flocks were watched over to prevent damages to crops. During the dry season, however, 69.84% of interviewees let their flocks graze freely in natural pastures.

According to most breeders, livestock services did not provide a solution to health problems. Some breeders vaccinated their sheep against pasteurellosis and dewormed them regularly (Table III). In case of disease, half of the farmers (32) declared buying the products on the market or from a technician, but without prior diagnosis. Traditional veterinary treatments were used by 30.2% of interviewees. Breeders explained their low use of veterinary services by the high cost of technicians and the little reassurance with regard result quality. Half of producers were more than six kilometers away from the health center. The main sheep diseases cited were diarrhea (68.5%), respiratory diseases (55.6%), nervous disorders (22.2%), bloating (18.5%), and sudden death (18.5%).

Animal genetic resource management

Reproduction

All interviewees declared making a deliberate choice of breeding males but also females when available numbers were sufficient. Thus, females that had functional or morphological defects were eliminated. Females with improper coat color were also excluded based on traditional beliefs. The breeding stock was selected within their own flock (98.4%), sometimes on the market place (22.2%) or directly from other breeders (12.7%). Rejected males and females were sold for slaughter. However, they could remain in the flock for a long period, waiting for a favorable price or specific financial needs. Castration of males was not practiced in sheep but commonly in goats. When sheep were left to graze, different flocks met with no specific mating control. Some farmers kept their male(s) tethered to prevent theft risks. Most breeders did not perceive inbreeding as a problem; only 4.8% of them mentioned possible disadvantages, e.g. poor growth.

Genetic improvement

Breeders described three sheep types: the Mossi Djallonke sheep, also called savanna Djallonke, the Fulani sheep, and their crossbreeds. Stated breeding objectives were to improve adult weight (84.1%) and lamb growth (79.4%). Other important objectives were to maintain hardiness (73%) and coat color (19%).

At the time of our visit, 27% of farmers had been testing crossbreeding. However, 31.7% had already practiced crossbreeding and stopped to limit the level of Fulani sheep blood in the herd. The crossbreeding strategy considered here was the temporary introduction of a Fulani ram in the Djallonke flock. After the birth of the first crossbred lambs, the Fulani purebred ram was eliminated. A large majority of breeders (84.1%) was willing to invest financially in the acquisition of 'improved breeding males', i.e. producing heavy lambs while maintaining disease resistance. The herders interviewed nevertheless believed that one individual could not carry both traits at the same time. Most breeders (82.5%) sporadically sold breeding stock to other breeders. Among them, 36.5% sold only rams and 63.5% sold rams and females. When selling to other farmers, 51.9% said that prices were higher than those on the market and 36.5% reported lower prices. The remaining farmers believed that there was no difference. The perception of these prices was significantly related to the ethnic group ($p < 0.001$), with Mossi farmers expecting lower prices. Many breeders (76.2%) said they would agree to sell regularly young females to other breeders if they received direct requests. These breeders estimated the number of young females that may be sold annually at 3.3 ± 1.7.

Typology

Multiple correspondence analysis

For the MCA, the first three dimensions were selected, accounting for 51.35% of the total variability. An analysis of variance allowed determining the variables that significantly contributed to the definition of the first three axes (Table IV).

Axis 1 appears in Figure 1 as a livestock system axis opposing modalities describing pastoral livestock (with positive coefficients) to those describing agropastoral livestock (with negative coefficients). These modalities are those that have thus contributed most to the construction of axis 1.

Axis 2 in Figure 1 describes animal genetic resource management, opposing crossbreeding (with positive coefficients) to purebred farming (with negative coefficients).

Table IV

Variables of breeders' characteristics (Central Plateau, Burkina Faso) used in the multiple correspondence analysis and hierarchical classification analysis, and their degrees of link with the cluster (as variable) and the first three axes

Variables	Codes	Axis 1	Axis 2	Axis 3	Cluster
Non-agricultural economic activity	econoact	*	–	***	*
Sheep feeding method	feeding	***	–	–	***
Sheep guarding system	shepherd	***	–	–	*
Systematic deworming	deworm	*	*	*	*
Number of sheep	effective	***	–	***	**
Ethnicity of breeder	ethnic	***	–	–	***
Crossing experiment	crossing	–	***	–	***
Education	education	–	*	***	–
Breeding sheep	breeds	–	***	**	***
Livestock rank in the household economy	rank	***	–	–	***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; – : not significant

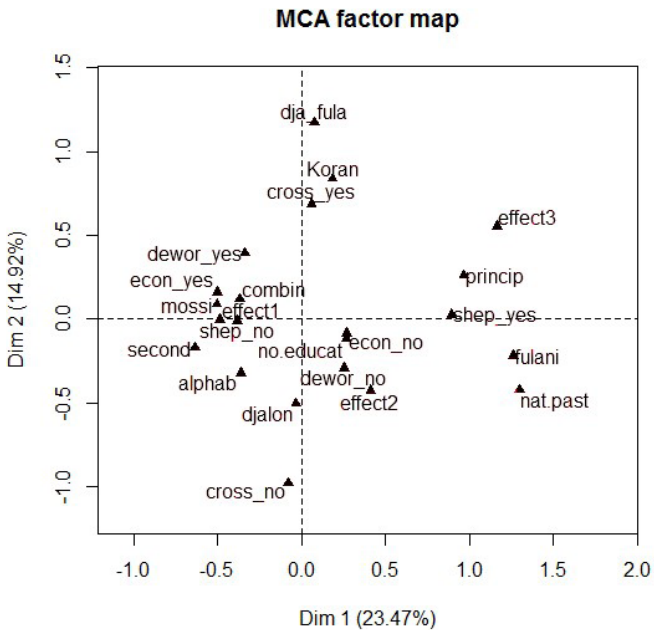

Figure 1: *Breeders' characteristics (Central Plateau, Burkina Faso). Modality coordinates on the first two axes. econ_yes: non-agricultural economic activity; econ_no: no non-agricultural economic activity; nat.past: use of natural pasture exclusively; combin: combination of pasture and complementation; shep_yes: sheep guarded by shepherd all year; shep_no: sheep scavenging in the dry season; dewor_yes: systematic deworming; dewor_no: no systematic deworming; effect1: num. of sheep < 30; effect2: num. of sheep between 30 and 50; effect3: num. of sheep > 50; mossi: Mossi herder; fulani: Fulani herder; cross_yes: has conducted crossbreeding experiments with sheep; cross_no: never conducted crossbreeding experiments with sheep; no.educat: noeducation; alphab: secondary, primary or literate in local language; koran: Koranic school; djalon: only Djallonke breed; dja_fula: Djallonke and Fulani breeds; princip: livestock as the main economic activity; second: livestock as the secondary or tertiary economic activity.*

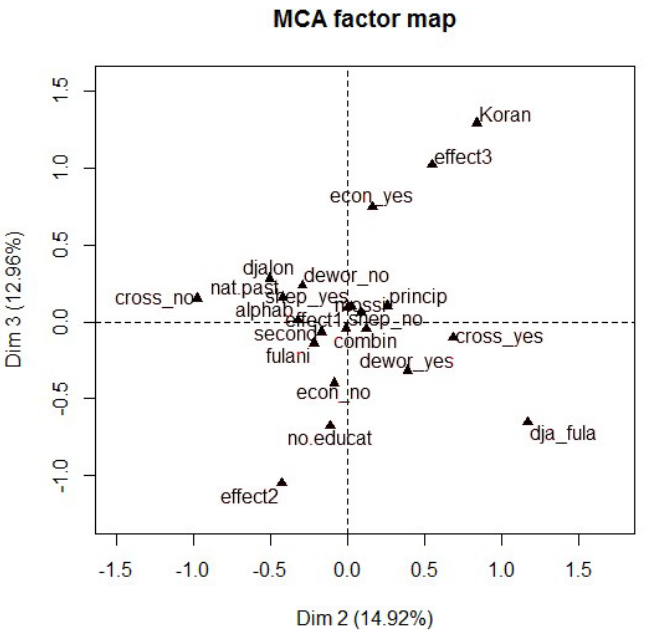

Figure 2: *Breeders' characteristics (Central Plateau, Burkina Faso). Modality coordinates on axes 2 and 3. econ_yes: non-agricultural economic activity; econ_no: no non-agricultural economic activity; nat.past: use of natural pasture exclusively; combin: combination of pasture and complementation; shep_yes: sheep guarded by shepherd all year; shep_no: sheep scavenging in the dry season; dewor_yes: systematic deworming; dewor_no: no systematic deworming; effect1: num. of sheep < 30; effect2: num. of sheep between 30 and 50; effect3: num. of sheep > 50; mossi: Mossi herder; fulani: Fulani herder; cross_yes: has conducted crossbreeding experiments with sheep; cross_no: never conducted crossbreeding experiments with sheep; no.educat: noeducation; alphab: secondary, primary or literate in local language; koran: Koranic school; djalon: only Djallonke breed; dja_fula: Djallonke and Fulani breeds; princip: livestock as the main economic activity; second: livestock as the secondary or tertiary economic activity.*

Axis 3 in Figure 2 discriminates economic levels of households, opposing the modalities such as 'large flock', 'non-agricultural economic activities', and 'Koranic education' (positive coefficients) to 'midsize flock', 'lack of non-agricultural economic activity', and 'lack of formal education' (negative coefficients).

Hierarchical classification and description of clusters

HCA was performed on all 12 observed variables. Apart from 'education level', all variables were significantly related to the cluster variable (Table IV).

The clusters were characterized (Table V) through the numbers of breeders in these clusters per modality. Cluster1 mainly refers to the first group of modalities described in Figure 1 (positive values on axis 1). Therefore, this is the group of pastoral livestock keepers. Cluster2 mainly refers to the group of modalities with negative values on axis 1: this is the group of agropastoral livestock keepers. Cluster3 is characterized by crossbreeding practice and the absence of formal education. Like cluster2, individuals in cluster3 combine the use of pastures and supplementary feeding and belong to the Mossi ethnic group.

■ DISCUSSION

Socioeconomic characteristics

The survey aimed at interviewing the persons in charge of sheep management within the households with more than ten sheep. This may partly explain the predominance of men in the sample, due to their status of family head in the study area. Thus, studies focusing on women are needed to characterize better their involvement, objectives, constraints and practices. A similar predominance was found in sheep farmers in Ethiopia (Edea et al., 2012).

The recent installation of several farmers (purchase of initial flock) shows the dynamism of this population and that sheep farming is an attractive activity in this rural area. Also 40% of interviewees kept livestock as a primary economic activity and 30% identified themselves as 'traditional livestock keepers' (Fulani). Therefore, specialized livestock keepers are not only those maintaining a secular activity but also the result of an active decision to invest in the sector. This dynamism can also be explained by the need to cope with climate variability by the integration of livestock to crop production. Similar observations have been made in Kenya where the dichotomy between pastoralists and crop producer tends to make way for integration (Kosgey et al., 2008). The typology shows a group (cluster3) that goes beyond this integration. This group is identified in the sample by a more frequent practice of crossbreeding. The livestock keepers of this cluster were essentially agropastoralists. In this group, livestock activities were thus directed toward the generation of monetary income, by the sale of animals for slaughter. Crossbreeding was practiced through the temporary inclusion of a Fulani ram in the herd. Therefore, the replacement females with a hardier phenotype were produced by the alternate use of rams of the

Table V

Distribution (number) of breeders' characteristics (Central Plateau, Burkina Faso) in clusters by modalities of each variable

Variables	Codes	Cluster1	Cluster2	Cluster3	Total
Non-agricultural economic activity	econ_no	13	16	12	41
	econ_yes	2	15	5	22
Sheep feeding method	combin	4	29	16	49
	nat.past	11	2	1	14
Sheep guarding system	shep_no	5	26	13	44
	shep_yes	10	5	4	19
Systematic deworming	dewor_no	14	16	6	36
	dewor_yes	1	15	11	27
Number of sheep	effect1	4	23	11	38
	effect2	3	6	5	14
	effect3	8	2	1	11
Ethnicity of breeder	fulani	13	3	2	18
	mossi	2	28	15	45
Crossing experiment	cross_no	6	20	0	26
	cross_yes	9	11	17	37
Education	alphab	4	15	6	25
	Koran	5	6	2	13
	no.educat	6	10	9	25
Breeding sheep	dja_fula	3	0	16	19
	djalon	12	31	1	44
Livestock rank in the household economy	princip	15	2	8	25
	second	0	29	9	38

Mossi type. This practice, however, led us to reconsider the notion of pure breed in this area. Crossbreeding was less frequently practiced in the pastoralist group (cluster1). This group, using less veterinary products and complementation, was aware of the need for more hardiness.

The literacy level appeared lower than that reported in sheep farmers in Nigeria (Anyanwu et al., 2010). This can be a handicap for awareness actions or training and therefore innovation. In addition, data recording by farmers, as needed for overall improvement of management and selective breeding, might be difficult to implement (Kosgey and Okeyo, 2007; Mirkena et al., 2012).

Husbandry

The predominance of small flocks, with more than half of them comprising less than thirty sheep, could result in high levels of inbreeding. Uncontrolled mating can also contribute to this inbreeding in that it leaves the possibility of mating between very close individuals. Meetings of stray animals could, however, help mitigate this inbreeding (Kosgey et al., 2008). The male-to-female ratio showed the presence of several rams in the flocks. The farm inclination toward savings may explain this; the sales of males depend on events requiring liquidity.

The feeding system combining natural pasture and crop residues as well as animals straying in the dry season has also been observed in Ethiopia (Gizaw et al., 2009; Edea et al., 2012). The latter practice is incompatible with mating control and selective breeding. This feeding system must be well handled before any breeding program can be implemented. The typology shows that this practice is one of clusters 2 and 3. These breeders practice crop production as a traditional activity and livestock as a secondary one. They only perceive animal keeping as a way to protect crops in the rainy season, unlike cluster1 breeders who have livestock as their main activity and use shepherds all year long. Thus, mating control could be more easily implemented in the latter group.

The problem of low veterinary coverage, as well as self-medication, was related, in the opinion of the producers, to the high cost of services and products. The lack of trust in the effectiveness of interventions also emerged from the interviews. This may be understood in relation with the lack of observability of the quality of veterinary services: difficulty in distinguishing counterfeit products and in estimating the actual qualification of technicians (Van den Bossche et al., 2004). Facing the absence of animal health care in the zone, actions aimed at building capacities in veterinary services and building trust between them and farmers might much improve livestock production and farmers' livelihoods. Community-based animal health workers could as such play an important role (Peeling and Holden, 2004).

Reproduction and animal genetic resources

The choice of breeding stock to improve the future flock was a viewpoint widely shared in the study. Nevertheless, because of the small size of the herds and of choosing the breeding stock mainly in farmers' own herds, the risk of inbreeding was high, the more so as breeders did not perceive this inbreeding as a problem. Raising awareness about the effects of inbreeding seemed necessary in order to gradually direct the breeders toward exchanges of breeding males. As also reported in sheep breeding in Ethiopia (Gizaw et al., 2009), there was no strict mating control since animals were left free to graze in the dry season and unselected males were not castrated. The absence of castration can be explained by the low price of castrated males on markets, as they are not allowed for the Muslim sheep sacrifice. This particularity should be addressed if a breeding program is implemented, in order to allow only selected males to mate. Facing theft risk, some farmers chose to keep their rams tethered, which in fact allowed other rams to mate with females of the flock. Hence, in order to be an opportunity for mating control, this practice should be generalized to all breeders of a same locality. However, maintenance of males for their use in controlled breeding requires additional spending on feed, which could slow the adoption of this practice.

The main selection criteria were body size, adult weight and coat color. The same results were observed in different areas in Ethiopia (Gizaw et al., 2010; Melaku et al., 2012). The objectives behind these selection criteria were primarily to improve weight and growth. Maintaining hardiness was also explicitly stated as a breeding goal as it appeared as a desired quality of 'improved sires', explaining the use of the Mossi Djallonke sheep as the main breed. These results were

similar to those observed at Simien in Ethiopia where the objectives were mainly income improvement and security against risk (Melaku et al., 2012). They highlight the future role of resilient local breeds in future animal genetic resource management. Indeed, whereas crossbreeding was practiced in this study with an objective of rapid weight improvement, the loss of hardiness was limited by controlling the part of Fulani blood in the Djallonke flock through temporary use of Fulani rams. This showed a good perception of genetic management by farmers in these rural areas, which had no equivalent in the suburban systems.

Crossbreeding is practiced in order to take advantage of the best prices granted by large-framed sheep in the region (Tindano et al., 2017). This practice supports the observation made through DNA analysis that the Mossi Djallonke sheep population comes from continuous introgression of Fulani sheep blood in the Djallonke (West African Dwarf sheep) (Traore et al., 2008). Similar practices have been observed in India, where Raikas pastoralists keep two sheep breeds for their respective qualities of production and hardiness, and constitute yearly their crossbred flock, favoring one type over the other according to their expectations about the climatic conditions of the year (Anderson and Centonze, 2007). However, in our study the lack of mating control induced a relative threat of this crossbreeding on the local genetic resources. The control of introgression was here only partial and mating with other males could often occur. Illustrating the free-rider problem, some farmers benefitted from these unplanned crossings as a positive externality. However, if the breeder wished at that moment to turn his flock toward greater hardiness, these externalities were found to be negative. Therefore, this practice should be organized and coordinated.

The rational practice of crossbreeding, in particular terminal crossbreeding, represents a conservation pattern of hardy breeds. The parental purebreds, indeed, have to be conserved to make the most of the heterosis effects and complementarity in the continuous production and slaughter of first generation crossbreds (F1). This strategy would involve specialization of different groups as producers of purebreds and producers of F1 crossbreds for fattening. The suburban producers, closer to the market, with better access to information and veterinary services, might fit into the organization as producers of fattened F1 crossbreds, buying hardy breeding females from pastoralists. Nevertheless, continuous introgression establishes closeness between the two populations, which can reduce heterosis.

In addition, the breeders' disposition to fit into this scheme, investigated through this survey, was not straightforward. Although the principle of the sale of females to other farmers for breeding was accepted by more than two thirds of the sample, the number of females that a breeder was ready to provide per year was very low because of his own renewal needs and of the savings role played by livestock. Moreover, some farmers who would agree to such a scheme only considered doing it with breeders they knew and in the prospect of subsequent reciprocity. Mossi breeders have more particularly defended this vision of females' exchange as a way to tie social bonds rather than to generate incomes. The considered transaction is thus a form of security based on reciprocity, similar to that described by Faye (2003) among pastoralists in Africa. The Mossi's anticipation of a lower price for these breeding females than the market price is also linked to the social value of the sale. On the other hand, Fulani breeders tend to highlight the quality of the animal for sale and anticipate a high price.

This finding is in line with the typology, which shows that the three classes are related to ethnic groups: Fulani, traditional livestock keepers in group 1, and Mossi, traditional crop producers in groups 2 and 3. Therefore, although the trend has shown in recent years harmonization of practices between pastoralists growing crops and farmers raising animals, the ethnic group characterization proves still significantly related to animal production practices.

■ CONCLUSION

Sheep farming in the study area has often been considered as extensive because of the recourse to pastures and the low use of feed and veterinary inputs. However, it can be acknowledged that these systems are labor-intensive and that this fits with the endowment in resources of the households. Genetic resources encountered in the area show a dominance of Djallonke sheep. Crossbreeding between Djallonke and Fulani sheep to improve the weight while maintaining hardiness shows a good perception of the genetic value of animals by breeders, as well as the emergence of a productivity-led system. These crosses, however, would benefit from being organized to ensure their sustainability. The health and feed problems were the major constraints to production. Some practices such as inbreeding and lack of mating control were an obstacle to the evolution toward higher productivity. Participatory approaches, integrating the objectives, capacities and motivations of breeders, should be implemented locally to develop appropriate solutions for increased production and sustainable management of animal genetic resources. These approaches have to consider the possibilities of industrial crossbreeding for improved management of animal genetic resources. To this end, adapted technical and institutional arrangements are to be sought through such participatory approaches.

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Résumé

Tindano K., Moula N., Traoré A., Leroy P., Antoine-Moussiaux N.
Systèmes d'élevage ovin et gestion des ressources génétiques animales dans la région du Plateau Central du Burkina Faso

A l'image de l'ensemble de la filière de l'élevage dans les pays en développement, l'élevage ovin au Burkina Faso fait face à une demande croissante, dans un contexte de production socio-économique et environnemental contraignant. Cela a donné lieu à des croisements peu maîtrisés dans la zone périurbaine de la capitale, Ouagadougou. Afin d'identifier les moyens d'encadrer ces pratiques pour rendre durables les systèmes ovins, une enquête a été conduite auprès de 63 éleveurs évoluant dans le milieu rural de la région du Plateau Central. L'objectif principal était d'évaluer les possibilités d'une gestion intégrée entre les éleveurs ruraux et les éleveurs périurbains à travers notamment des échanges de femelles. Les données ont été collectées à travers des entretiens directs à l'aide d'un questionnaire comportant des questions ouvertes et fermées. Les résultats ont montré que l'ensemble des éleveurs avaient des stratégies de sélection à travers le choix des mâles reproducteurs. Ce choix se faisait essentiellement dans leur propre troupeau (98 % des interviewés) et quelquefois dans les marchés (22 %). Les objectifs principaux d'amélioration concernaient le poids adulte et la croissance des jeunes, ou le maintien de la rusticité. La brebis Djallonké, variété Mossi, était la race la plus rencontrée dans la zone (présente dans 97% des troupeaux). Mettant en œuvre leurs objectifs les éleveurs croisaient leurs brebis Mossi avec des béliers Peuhls, d'un plus grand gabarit, mais de manière temporaire afin de limiter la perte de résistance de leur troupeau. Le lien potentiel avec la production des éleveurs périurbains par la vente de femelles semblait faire face à des contraintes culturelles. Le système de production décrit par les éleveurs présentait des contraintes de durabilité et ne permettait pas de véritable intégration avec le système périurbain. Des approches participatives devraient être mises en œuvre localement afin d'élaborer des solutions appropriées pour accroître la production et la gestion durable des ressources zoogénétiques.

Mots-clés : ovin, brebis Djallonké Mossi, ressource génétique, milieu rural, typologie, Burkina Faso

Resumen

Tindano K., Moula N., Traoré A., Leroy P., Antoine-Moussiaux N.
Sistemas de cría de ovejas y manejo de los recursos genéticos animales en la zona de la Meseta Central de Burkina Faso

Al igual que todo el sector ganadero en los países en desarrollo, la cría de ovejas en Burkina Faso ha afrontado una demanda creciente en un contexto restrictivo de producción socioeconómica y ambiental. El resultado han sido cruces mal controlados en la zona suburbana de Ouagadougou, la capital. Con el fin de identificar maneras de gestionar estas prácticas para sostenibilidad de los sistemas ovinos, se llevó a cabo una encuesta en 63 fincas ganaderas de la región de la Meseta Central. El principal objetivo fue el de asesorar las posibilidades de un manejo integrado entre los criadores suburbanos y rurales, particularmente mediante el intercambio de hembras. Los datos se colectaron a través de entrevistas directas, usando un cuestionario con preguntas abiertas y cerradas. Los resultados muestran que todos los finqueros tenían estrategias de cría a través de la selección de machos. Esta selección ocurrió principalmente dentro del propio hato (98% de los entrevistados) y algunas veces en mercados (22%). Los principales objetivos de mejoramiento fueron el peso adulto y el crecimiento del cordero o mantenimiento de la robustez. La oveja Djallonke de la variedad Mossi fue la raza más común en el área (presente en 97% de los hatos). Implementando sus objetivos, los criadores cruzaron las ovejas Mossi con carneros Peul, de mayor tamaño, pero provisionalmente para limitar la pérdida de resistencia del hato. La relación potencial con criadores suburbanos mediante la venta de hembras parece enfrentarse a obstáculos culturales. El sistema de producción descrito por los productores presentó obstáculos de sostenibilidad y no permitió una integración real con el sistema suburbano. Deben implementarse enfoques participativos localmente para desarrollar soluciones apropiadas para aumentar la producción y el manejo sostenible de los recursos genéticos animales.

Palabras clave: ovino, oveja Djallonke Mossi, recurso genético, zona rural, typología, Burkina Faso