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# Caprine milk as a source of income for women instead of a taboo: a comparative analysis of the implication of women in the caprine and bovine value chains in Fatick, Senegal

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## Abstract

Domestic animals, especially small ruminants, are an important source of income for millions of smallholder farmers, particularly women, in Senegal. The aim of this study was to understand the place of the bovine and caprine milk value chains and to identify the role and challenges for women in the Fatick livestock production sector. A survey was conducted among a sample of 50 female producers, including 30 and 20 from the bovine and caprine milk value chains, respectively. Descriptive statistics were performed to compare the caprine and bovine milk value chains in terms of activities, products, and implications for household incomes while showing the place of women at different links of these value chains. The result of the study showed that the bovine milk value chain provided higher income compared to the caprine's, but the latter was found to be more diverse in terms of milk-derived products with increased income opportunities' potential. Remoteness, lack of equipment, and cultural biases were reported to be the main constraints in the caprine value chain, while milk price fluctuations were reported to be the biggest challenge for producers in the bovine milk value chain. Access to land and government subsidy programs and domestic time management were the main and specific challenges affecting women in the bovine and caprine value chains. Therefore, there is a need for the establishment of policies and interventions that consider the needs, opportunities, and complementarity offered by both the caprine and bovine milk value chains across smallholder women settings, while putting gender mainstreaming at the center of the discussions and reforms.

**Keywords:** Women, Smallholder farmers, Milk value chain, Dairy sector, Livestock, Caprine, Bovine

## Introduction

The dairy industry in Senegal is developing and evolving in a context of rapid urbanization, population growth, and increasing consumer demand for dairy products, while being met with changes in the dietary behavior of Senegalese people (Broutin et al. 2007). The consumption of dairy products by Senegalese people has been increasing since the 1960s. Today, it is 4 to 5 times higher than during the post-independence period (Ferrari 2017). Moreover, according to recent census figures, the number of Senegalese people working in agriculture, livestock, and hunting is approximately 883,000; 36.2% of whom are women (ANSD [National Agency of Statistics and Demography] 2017). The dairy livestock, goat, and bovine farming, given their potential and multi-functionality, play a leading role in the fight against poverty and food insecurity. Indeed, dairy farming is a tangible source of income for producers as they can sell both the animals themselves and their products, creating employment opportunities for thousands of people (Peacock 2005). In addition, although goat milk production per capita remains relatively low compared to bovine, goat milk is an important source of nutrients in the communities where it is consumed (Turkmen 2017). These chains (bovine and caprine) therefore act as a critical source of nutritionally rich food, providing protein, vitamins, minerals, and essential fatty acids and helping to meet the dietary needs of millions of Senegalese, particularly children and women of childbearing age. Goat farming is also an important source of meat, especially in rural areas where cattle are not often slaughtered. Despite its nutritional and economic importance, the caprine sector has yet to recover from certain cultural perceptions. A traditional myth (belief) persists in the region of Fatick that goat milk can cause leprosy for women by drinking or handling it (personal information). It was a belief conveyed for generations to preserve the goat's offspring, but if the goat is well nourished, the kid will be able to eat properly, so milking can be done for drinking or processing. Similar observations were also found in the Fulani communities of Mali and Senegal, where it is also believed that boiling milk may cause udders to dry and stop giving milk (Traoré et al. 2018; Fokou et al. 2010). In addition, goat's milk appears to be less preferred than cow's milk because of its taste, cultural bias, and natural dislike of the milk (Idamokoro et al. 2019). The caprine sector was also viewed as less valuable and designed for certain groups of people (more vulnerable groups such as women) not only in Senegal but also across the world (Idamokoro et al. 2019; Phoya et al. 2003; Lebbie 2004). Therefore, in the region of Fatick, the owners and managers of goats are mainly women. Moreover, in Fatick and Senegal in general, goats and sheep have an added social dimension through their association with various social and religious events (e.g., baptisms, marriage ceremonies, and host receptions, Tabaski or sheep festivals; Missohou et al. 2016; Gillerot 2018), contributing to the feminization of this sector (e.g., a goat is given to the bride as a wedding gift).

Over the past two decades, debates on the roles of men and women in economic and social development, and on gender equality, have become increasingly important for policy makers and development professionals in Africa. In particular, they have revealed the extent to which gender determines access to material and economic resources, the relationship to power, and the capacity for initiative and action (Sow 1998). However, while awareness of these issues is perceptible throughout the world, detailed data on work and its perception, as well as on the economic contribution of women in Africa,

are still lacking. In Africa, farm managers are mainly men. In rural areas, 72% of the land is controlled by men compared to 28% by women (Diop 2010), the latter not being considered as full producers. The land allocated to women by customary land tenure or current development policies is smaller in size and quality than that of men. Land is most often allocated to them in the context of collective groups, which means that they do not benefit much individually from it (Sow 1998). Yet, in Africa, and particularly in Senegal, women play an essential role in agriculture; they constitute 60% of the agricultural labor force and are responsible for more than 70% of food production (Thierry et al. 2019), all of the processing of commodities, and 60–90% of marketing (Pala 1976). Traditionally, women are almost universally recognized for their role as key players in poultry, small ruminant, and micro-livestock production (Köhler-Rollefson 2012; Distefano 2012). In the Fatick region, the share of women in agriculture, livestock, and hunting is 34.4% (ANSD 2017). Moreover, goat owners and managers are mainly women, while cows are the property of men, and the women only have rights to the products, i.e., the milk production. Women are generally in charge of milk management in a sector where, even today, there is a real gendered separation of tasks. The men take care of the herd, the reproduction part (selection of breeding stock), and the milking, even if the women can support their husbands in this task, and the younger men have to take care of driving the animals to the pastures (MFFE 2016). Women are autonomous in the processing and marketing of milk, but they are often excluded from collection transport (which brings the milk from the production areas to the processing units). This can be explained by the low mobility capacity of women, particularly in West Africa (de Dianous 2020). Women are assigned the function of milking the animals first for home consumption of dairy products and then for processing and marketing the milk to provide income for the household (Chatellier 2018; Diao Camara 2013) but recent studies have also shown their involvement in the production part of the value chain such as feeding and watering the animals (Yasmin and Ikemoto 2015; Ogdand and Hembade 2014). Men receive most of the family income, even though women play a central role in production (de Dianous 2020). Women also tend to have more access and disposition rights over livestock products such as milk, butter, cheese, ghee, hides, and skins than over the animal itself in both bovine and goat value chains (Idamokoro 2019; Gillerot 2018; Evans 2016). Women sell milk and milk products to traders, restaurant owners, and families in nearby towns. The milk trade provides one of the few available opportunities for small-scale female producers to control their own money (Ridgewell and Flintan 2007). Women's participation at each level of the value chain varies due to a variety of factors, including the type of animals, their skills and abilities, access to capital, and relationship with their husbands. Previous research on livestock value chains (Njuki et al. 2011) indicates that in a livestock value chain, the ratio of men to women in terms of representation and control increases as household wealth increases and the value of milk increases, yet no study to date has taken in-depth look at women's roles amongst these value chains. Although women in Fatick and Senegal are more active in the goat milk value chain than in the bovine milk value chain, they continue to play a key role in the livestock sector for both value chains.

Nevertheless, it is clear that women's work and responsibilities in livestock production remain poorly recognized, under-studied, and undervalued by those who design

and implement livestock policies and plans. As a result, for many years, several gender issues have been central to discussions of agricultural livelihoods. These include access to and control over property, the gender division of labor, and women's roles, responsibilities, and decision-making power (Diao Camara 2013). It is therefore imperative today to consider women's perceptions and issues in the formulation of agricultural development policies. This could be particularly applied to the case of the dairy sector in the Fatick region of Senegal.

For a holistic examination of women's involvement in goat and bovine production activities in the Fatick livestock sector, a value chain analysis approach was adopted for our study. The value chain is the set of activities that add the value necessary to move a product or service through the different phases of production (Webber and Labaste 2010). This value chain analysis approach allowed us to not only understand women's involvement and perceived contributions in each segment of the bovine and goat value chain (production, processing, transportation, marketing, etc.), but also to understand where opportunities for improvement exist.

Previous studies have accurately identified a gap in knowledge regarding the roles of women throughout livestock value chains in Africa and Senegal in particular. The goal of this paper was therefore to provide an in-depth look at the role of women throughout the bovine and caprine value chains amongst rural farmers in the region of Fatick, Senegal. More specifically, the study aims to map the supply chains of both caprine and bovine milk in order to first establish the major stages, then addressed the specific roles of women, as well as women's perceptions of their places within the overall chain. Finally, we identified the major challenges facing by both men and women, with an emphasis on those specific to women.

## Methodology

### Brief description of the study area

The Fatick region corresponds to a part of the former kingdom of Sine whose capital was Diakhao. It is located in the western center of the country between 13°35 and 14°00 N latitude and 16°00 and 17°00 W longitudes (Ndiaye 2006). The region has three departments (Fatick, Foundiougne, and Gossas), 10 districts, and 35 rural communities. Fatick is an integral part of the agro-ecological zone of the groundnut basin, bounded to the east by the Kaolack region, to the west by the Atlantic Ocean, to the northwest by the Thies region and to the south by the Saloum arm of the sea that bathes Foundiougne. Fatick covers an area of 6685 km<sup>2</sup> and has a population of 761,713 inhabitants, with an equal proportion of women (50.4%) compared to men (49.6%; ANSD 2018). The climate of the Sahelo-Sudanese region is tropical and characterized by two seasons: a rainy season from mid-June to October (rainfall ranging from 400 to 600 mm per year) and a dry season starting from mid-October to mid-June with a cool period from November to January (ANSD 2018). The agriculture industry employs more than 90% of the working population, with 70% practicing livestock activities, and is the mainstay of regional economic activity (ANSD 2018). Production systems are mostly dominated by the traditional systems (such as pastoralism, or agro-pastoralism) that have long been associated with agriculture and livestock. According to the latest National Agency of Statistics and Demography (ANSD 2018) report, the Fatick region remains among the poorest in the

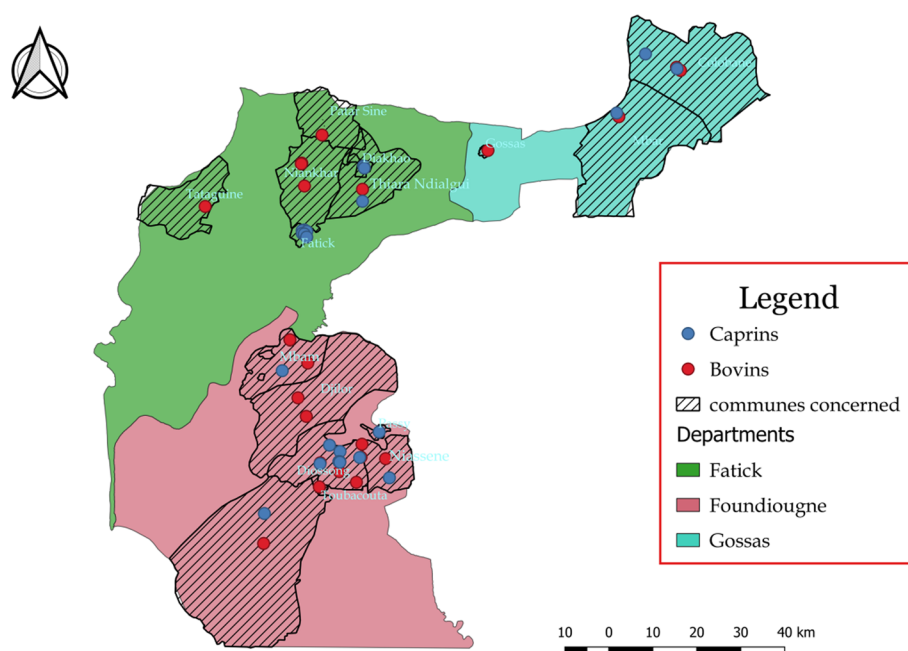
country with a poverty index of 67.8%, compared to 46.7% nationally. Difficult access to fodder resources, water, and the reduction in pastoral areas, due to salinization and encroachment, remain some of the main challenges for livestock smallholders in the Fatick region (Zougmore et al. 2016).

The study of livestock development is particularly interesting because of the new dynamic in the sector brought by the installation of Kirene dairy (which will subsequently be referred to as a dairy processor in this study) and a milk collection center in Fatick (Habanabakize et al. 2022). The area presents a new format for livestock development (mostly bovine milk) with specialization and intensification of milk production. Indeed, the dairy processor and the collection center offer a package of extensive services and a consistent market opportunity for rural and urban livestock producers. It has also provided an alternative to a pastoral production economy, as many producers have started to produce milk for both household consumption and as a source of new income. In addition, farmers organizations such as “Association Régionale des Éleveurs Caprins de Fatick” (ARECAP [Regional Association of Caprine Breeders]) or the “Programme d’Amélioration de la Filière Caprine” (PAFC [Improvement Program for the Caprine Sector]), are helping to build and strengthen the capacity of women involved in the different activities of the goat milk value.

#### Data collection and handling

In order to meet the objectives of this study, the first census of dairy farmers in the Fatick region was attempted, but there is no exhaustive database of these farmers. Due to a lack of resources and time, the surveys were limited to a sample of 50 women farmers from the Regional Livestock Department database, including 30 and 20 from the caprine and bovine milk value chains, respectively, in the Fatick region. More specifically, 10 women from the bovine and 9 from the caprine value chain were from the Fatick department, 5 and 15 from Foundiougne, and 5 and 6 from Gossas (Fig. 1). The sample was pseudo-randomly selected to include women who are only involved in caprine or in bovine value chain, respectively.

The extension of the sampling locations to all the three departments of the region allowed for capturing the context of the entire studied area, in addition to reaching the locations covered by both the dairy processor and the farmers’ organizations programs. A semi-structured qualitative research method was adopted, in which individual interviews by a single person were conducted. The questionnaire and methodology for this study were previously tested (field testing), reviewed, and approved by the McGill University Research Ethics Board committee (Ethics approval number: # 484-0519), in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Participants and the Tri-Council Policy Statement. It was also approved by the “Commission de Protection des Données Personnelles” (CDP [Commission of Protection of Personal Data of Senegal]) of Senegal. (Ref.no: 00000520 CDP). Interviewees responded to questions covering aspects of milk production, processing and marketing in both value chains (Table 1) in order to understand the level of implication and challenges faced by women while exploring the place of women in each of these value chains. The questionnaire consisted of both multiple-choice (e.g., “In which parts of the milk value chain are you involved?” possible answers: “1. Production,



**Fig. 1** Geographic location of women interviewees (caprine and bovine value chain) from the Fatick region of Senegal (Departments: Fatick, Foundiougne, Gossas)

2. Processing, 3. Marketing”), and open-ended questions (e.g., “How many goats do you own as a woman?”).

One- to two-hour open-ended interviews with key informants working with the PAFC program were also conducted to obtain key information on the mapping of each value chain.

### Data analysis

In order to characterize and compare both value chains and to understand the role, the level of implication, and the challenges faced by women in the bovine and caprine milk value chains in the study area, Sphinx software (Brandl 2021) was used to record and transform the information from the survey questionnaire and interviews into a database containing both categorical and numerical values. Descriptive statistics methods were used to perform data analysis and processing, and as such, averages, standard deviations as well as the percentages were calculated. QGIS software (QGIS 2019) was used to produce the maps.

## Results

### Mapping of the actors involved in the bovine and caprine milk value chains in Fatick

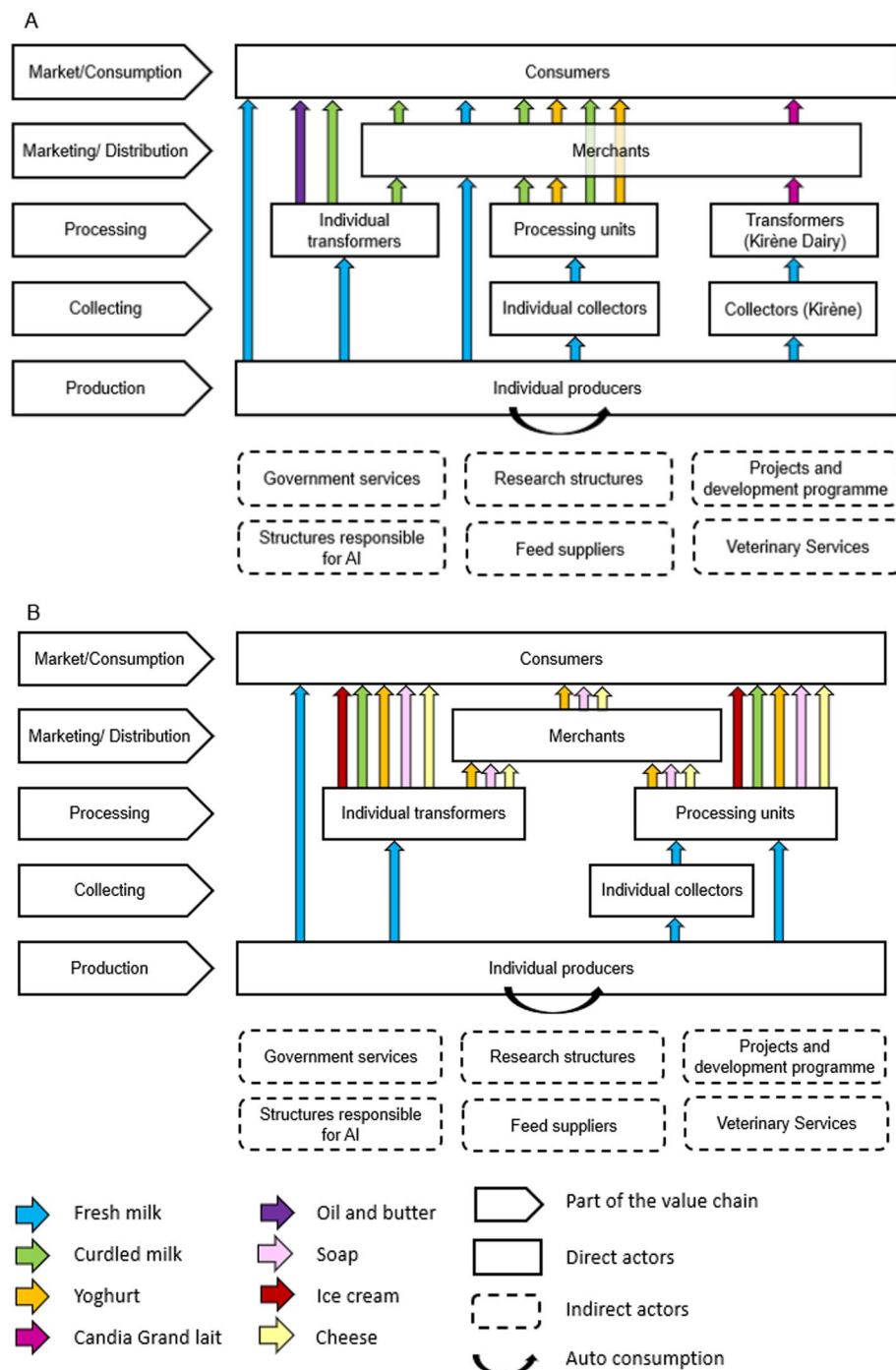
The analyses showed that the caprine and bovine milk value chains in the Fatick region are made up of direct actors including the milk producer (farmer), collector, processor, merchant, and consumer; and indirect actors such as the government, input distributors, farmers’ organizations and projects and programs such as PAFC and “Programme de Développement Intégré de Fatick” (PDIF [Integrated Development



**Table 1** Target categories and topics of the survey questionnaires and variables used for descriptive statistics

Categories	Topics	Variables
Socio-demographic characteristics	Respondent's location	Department, Municipality, Village
	Respondent characteristics	Age, Marital status, Instruction level, Education level
	Village organization	Type of organization, number of people (male, female), areas of activity of the organization
Herd characteristics		Species, Number of each animal (owned by the household and by women)
Women's contribution to livestock activities	Value chain	Type of links in which women are involved, Type of activity in which women are involved
	Feeding and watering	Type of feed, Water sources
	Reproduction	Method of reproduction
	Milking and milk production	Milking: milking method; responsibility for milking; frequency of milking per day; type of container; Production: time of year of maximum production, lactation time, average amount of milk produced per day during the dry season and during the rainy season, fate of milk, percentage of milk consumed, milk sold raw, and milk processed during the dry season and the rainy season
	Milk processing	Presence of technical training, Products resulting from processing, Method of processing carried out, Processing activity involving women, Conservation of products, Destination of processed milk, Difficulties encountered in the conservation of milk
	Marketing	Type of activities carried out by women, Sale of milk: where, price; Sale of processed products: where; Transport of products (distance), Lack of milk sales: when, what happens to the raw milk after the sale
Incomes		Presence of other sources of income, Destination of income from sales, Type of improvement in living conditions through sales, Share of income from milk sales in total household income, Share of income from milk sales in family expenses
Constraints		Type of constraints in animal husbandry, milk processing, marketing, Type of constraints specific to women in animal husbandry, Solutions envisaged

Program of Fatick]), among other actors (Fig. 2A and B). Direct actors are involved in the actual production activities of the value chain including (i) production (animal feeding, watering, reproduction, animal health, and milking); (ii) milk and delivered products collection; (iii) processing, (iv) market/distribution, and (v) marketing/consumption. The indirect actors are usually stakeholders at different levels of the value chain who work toward promoting the livestock activities in these two value chains.



**Fig. 2** Mapping the bovine (A) and caprine (B) milk value chain actors in the Fatik region

### Socio-demographic characteristics of women involved in bovine and caprine milk value chains in Fatik

The socio-demographic characteristics of the women interviewed in this study are presented in Table 2. Women in the bovine milk value chain were, on average, older than those in the goat milk value chain, with 60% of women in the bovine value chain being



**Table 2** Socio-demographic characteristics of women involved in bovine and caprine milk value chains in Fatick, expressed as percentage of interviewed women

		<b>Bovine</b> <i>n</i> = 20 interviewees	<b>Caprine</b> <i>n</i> = 30 interviewees
Age	Average age ( $\pm$ SD, years)	50 ( $\pm$ 13.1)	45 ( $\pm$ 12.6)
Marital status (% of women)	Single	5	3
	Married	65	80
	Widow	30	17
Instruction (% of women)	Parallel education system <sup>1</sup>	30	37
	Classical education system <sup>2</sup>	25	53
	None	45	10
Education level <sup>3</sup> (% of women)	Primary	100	50
	Secondary	0	50
Village organization (% of women)	GIE <sup>4</sup>	5	93
	Associations	5	0
	Cooperatives	25	0
	None	65	7

<sup>1</sup> Koranic classes and literacy rooms (in local language, French or Arabic)

<sup>2</sup> French and/or Arabic school

<sup>3</sup> Only for women who have received instruction in French

<sup>4</sup> "Groupement d'Intérêt Economique" (GIE [Economic Interest Group])

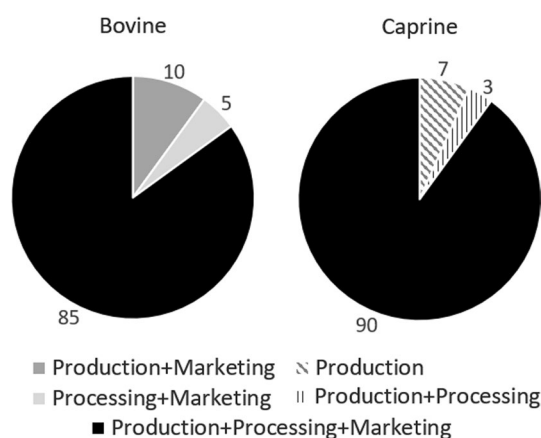
over 50 years old compared to 40% of women in the goat value chain. There were more married women in the goat milk value chain (80% of the women interviewed) than in the bovine milk value chain (65%), but more widowed women in the bovine milk value chain than in the goat milk value chain (30% vs. 17%, respectively). The level of education was also different among women in the two milk value chains. Only 55% of women who rear bovines had at least one type of education, compared to 90% of women who rear goats. Moreover, of the women in the bovine milk value chain who have learned French, 100% had only primary education, while 50% of the women in the goat milk value chain had also gone to secondary school. It should also be noted that only 35% of women in the bovine milk value chain belonged to a village organization, compared to 93% of women in the goat milk value chain.

#### **Implication of women across caprine and bovine value chains activities**

The result of this study revealed that women were overwhelmingly involved in all three types of activity: production, processing, and marketing, whether in the goat or bovine milk value chain (Fig. 3). 15% and 3% of women in the bovine and goat milk value chain, respectively, were involved in only two types of activities while 7% of women in the goat milk value chain were involved in production only.

#### ***Women's implication in the production, processing, and marketing activities for both the caprine and bovine milk value chains***

**Production activities** In the goat milk value chain, women were involved in all production activities, whereas in the bovine milk value chain, 25% of the women indicated to have hired workers to ensure production activities (Table 3). A higher percentage of women were involved in the different production activities for the goat milk value chain



**Fig. 3** Percentage of women involved in each of the two value chains' activities

than for the bovine milk value chain, except for the breeding activity where only 3% of the women rearing goats said they were involved in this activity while 35% of the women interviewed in the bovine milk value chain were involved in breeding. For both value chains, women's involvement was more important for the maintenance of facilities, feeding, and animal health. Only 55% and 77% of the women interviewed in bovine and goat milk value, respectively, said they were involved in milking.

**Processing activities** All the women interviewed in the bovine milk value chain produced curdled milk but there were few women who processed milk into other products in the study area (Table 3). Less than 15% of women reported processing cow's milk into derived products such as cheese, yoghurt, ice cream, oil, and butter or soap. In contrast to the bovine milk value chain, the results of this study indicated that there was a wide variety of milk processing activities in the goat milk value chain. More than 50% of the women surveyed processed goat milk into soap or yoghurt, while 27% and 17% of the women processed it into cheese and ice cream, respectively.

**Marketing activities** Women ensured the marketing of cow and goat milk products either directly by selling to the consumers or indirectly by selling to an intermediary (merchants, individuals; Fig. 2A and B).

Curdled milk and fresh milk were the most sold products in the bovine milk value chain with more than 80% of the women interviewed selling each of these two products (Table 3). Between 5 and 15% of women reported selling cow's milk in each of the other forms of derived products. For the goat milk value chain, the most sold products, with more than 70% of the women interviewed selling them, were curdled milk and cheese. Goat's milk soap was also an important derived product that was sold by 50% of the women. Fresh goat's milk was the least sold product with only 40% of women reporting to sell it.

#### Income distribution for the caprine and bovine value chains at household level

For 40% of the women interviewed in the bovine milk value chain, the share of income from the sale of milk and milk products was reported to represent more than 75% of the

**Table 3** Characteristics (in percentage) of women interviewees involved in different activities of bovine and caprine value chains

		<b>Bovine n = 20 interviewees</b>	<b>Caprine n = 30 interviewees</b>
Production <sup>1</sup> (% of women involved in each activity)	Maintenance of facilities	70	93
	Feeding	65	93
	Health	60	90
	Milking	55	77
	Reproduction	35	3
	Hiring of Worker	25	0
Processing <sup>1</sup> (% of women producing each type of product)	Curdled milk	100	77
	Soap	5	83
	Yoghurt	10	50
	Cheese	15	27
	Ice cream	10	17
	Oil and butter	10	0
Marketing <sup>1</sup> (% of women selling each type of product)	Fresh milk	80	40
	Curdled milk	95	70
	Soap	5	83
	Yoghurt	15	27
	Cheese	5	50
	Ice cream	10	17
Share of income from sales	Oil and butter	10	0
	Less than 25%	35	38
	25%	10	17
	Between 25 and 50%	10	3
	50%	5	21
	Between 50 and 75%	0	7
Other incomes <sup>1</sup> (% of women involved in other activities)	More than 75%	40	14
	No other source of income	35	3
	Agriculture + Fattening	8	14
	Agriculture + Fattening + Marketing	46	64
	Marketing	31	7
	Agriculture + Marketing	8	7
	Fattening + Marketing	8	7

**Table 3** (continued)

			<b>Bovine n = 20 interviewees</b>	<b>Caprine n = 30 interviewees</b>
Constraints noted by women <sup>1</sup> (% of women)	Production	Lack of land (fodder crops)	80	67
		Inequality between men and women (state subsidy)	60	23
		Difficulty of the work	60	53
		Time management	40	60
		Difficulty in combining livestock and agriculture	40	43
		Lack of pens	30	63
	Processing	Lack of equipment	5	90
		Lack of infrastructure	5	67
		Lack of mastery of techniques	0	50
		Insufficiency/Quality of milk	15	40
		Lack of training on innovations	25	30
		Lack of electricity	0	10
		Conservation	55	0
	Marketing	Means of transport	30	63
		Lack of road track	20	60
		Lack of market in the village	25	53
		Isolation of the village	20	40
		Price of raw milk (Kirène)	45	0

<sup>1</sup> The categories are not exclusive: women respondents could indicate several answers

total household income, while this was the case for only 14% of the women interviewed in the goat milk value chain (Table 3). Thus, the bovine milk value chain was reported to be more significant for household income than the goat milk value chain. However, in both the bovine and goat milk value chains, around 35% of women indicated that the share of income from the sale of milk was less than 25% of total household income.

It was also found that 65% and 97% of bovine and goat farmers, respectively, had other sources of household income (Table 3). Agriculture combined with fattening and marketing were activities carried out by 46% and 64% of bovine and goat interviewees, respectively. Women in the bovine milk value chain were more involved in these marketing activities than their counterparts in the goat milk value chain (31% vs. 7%).

#### **Challenges identified by the women in caprine and bovine milk value chain in Fatick**

For production activities, access to land and other natural resources was said to be the key problem for interviewees, as more than 65% of the women interviewed in the bovine and goat milk value chains reported not having access to land for their production activities (Table 3). The results of this study also revealed that half of the women in goats and bovine rearing had difficulties in devoting time to production activities due to other domestic

responsibilities solely dedicated to women (domestic time management), but also difficulties related to the nature of the work itself.

Comparing the two value chains, the lack of holding pens is a more important issue for women in the goat value chain than those in the bovine value chain (63% vs. 30%). In addition, 60% of the women in bovine milk value chain versus around 20% of the women in goats milk value chain raised the issue of gender inequality in terms of government subsidies (e.g., government animal feed support programs which only benefit men).

For processing activities, women in the goat value chain indicated more challenges than those in the bovine value chain. Indeed, the main constraints for women raising cattle were problems related to the conservation of milk and derived products, lack of training on innovations, and the milk quality. However, more than 50% of women in the caprine value chain identified constraints related to the lack of equipment, infrastructures, and technical skills. Inadequate and poor-quality milk, and lack of training on innovations, concerned only 40% and 30% of women of the caprine value chain, respectively. Finally, the last constraint raised by women raising goats concerned the lack of electricity on their farms.

For marketing activities, more than half of the women raising goats revealed that the means of transport, the absence of roads, and markets accessibility were major constraints in their work. Forty percent of them also mentioned the isolation of their village as a problem for their trade. For women in the bovine value chain, the price of milk set by the dairy processor represented a constraint for nearly half of them.

## **Discussion**

### **Actors**

This study has allowed the characterization of both actors and links in the caprine and bovine value chains. It was found that milk collection is not well developed in the Fatick area for both value chains. For the cattle value chain, women sell both on the local market and at the dairy processor. However, only women producers in the Fatick department can deliver to the dairy, as women in Foundiounge and Gossas are too far away from the collection center. Women in the goat milk value chain do not sell a lot of fresh milk directly to traders partly due to the low productivity of local breeds. Thus, sales are essentially made of products derived from goat's milk. In the studied region, the farmers expect to be supported by the local government services (such as departmental livestock services), the private sector, various projects and programs (PDIF [Integrated Development Program of Fatick], PAFC [Improvement Program for the Caprine Sector], dairy processors, etc.), to intervene at different levels of the bovine and caprine value chain to ensure their access to alimentation, animal health, insemination services, access to production and transformation equipment, and markets. However, farmers still lack access to most of these services. There is a need of cooperation and collaboration between government services, the private sector, and other programs in the region, for information sharing, avoiding duplication of efforts, and resource use efficiency.

### **Socio-demographic characteristics of women involved in caprine and bovine milk value chains**

The results of this study showed differences among women involved in caprine and bovine milk value chains in terms of their education/instruction level and their

involvement in village groups. Similarly to our results, another study in this region of Senegal found that almost half of the surveyed women involved in the bovine milk value chain had no known type of education versus only 10% in the caprine milk value chain (Dieng et al. 2014). Other studies have noted the negative impact of low levels of education of individuals on the appropriation of technical innovations and, consequently, on the modernization of the dairy sector (Duteurtre 2006; Broutin 2004). Moreover, women in the bovine sector were found to be less engaged in village organizations than women in the caprine sector. This can be explained by the installation of the PAFC project and PDIF, which help women involved in the caprine sector to organize themselves and generally support village's organizations. However, the "National Agency of Statistics and Demography" (NASD)'s work in 2018 highlighted that the creation of the "Groupement d'Intérêt Economique" (GIE [Economic Interest Group]) and the village associations supported by NGOs are increasingly promoting livestock farming development in the Fatick region. Indeed, women in the study who belonged to village groups and organizations (mostly in the caprine sector) reported having had the chance to be trained at least once in their lives in different aspects such as food security, entrepreneurship, income diversification, nutrition or production, which stimulated the diversification of their means of livelihood including milk production and processing. These observations were also confirmed by different studies in Sub-Saharan Africa rural communities (Bernard et al. 2008; Ferguson and Kepe 2011; Mhembwe and Dube 2017) which showed the positive correlation between belonging to village groups or cooperatives, and increased awareness, understanding, and access to information and training compared to producers who were not involved in village group activities. Participation in village associations thus seems to be an important point for the development of value chains. This paper is thus identifying a gap between successful strategies and women's access to them. More women need access to these associations which have been found to be beneficial in many ways. Moreover, the fact that more educated women were found in the goat value chain than the cattle's one may be due to increased access to information that allowed for open-mindedness toward traditional social perceptions and beliefs (i.e., beliefs concerning the goat milk). It is therefore possible that increased access to education allows women to overcome these taboos surrounding the use of certain animals and thus develop profitable livestock income activities that were previously unexplored (or underdeveloped) by other individuals in their communities.

#### **Involvement of women in the dairy value chains of bovine and goats**

The results of this study indicate that, for both value chains, women could be actors in several parts of their respective value chain at the same time: in the production, processing, and marketing of milk and its derived products. In the studied zone, caprine are often owned by women, which makes their involvement in all activities related to the caprine sector from production to commercialization, unsurprising. This idea is supported by Gillerot (2018) in her study about goat breeding and the goat milk sector in Fatick, which indicated that men are not interested in goat farming and thus the production and management of goats are taken over by women. This also explains the reason why women are the sole beneficiary of the goat development initiatives led by Caprine Farmers' association in the Fatick region. For the bovine value chain, these results are



congruent with findings of studies in other Senegalese regions (Kaolack, by Ndiaye 2017) and in West Africa (Chatellier 2018), who worked on similar aspects and found that even if there is less involvement of women in the actual milk production activities, women are strongly involved in the processing and marketing of cow's milk. Nonetheless, it was found that female producers in the bovine sector were more active in fresh milk production and less active in transformation activities compared to the women in the caprine sector. This is likely due to the presence of the dairy processor in the region which buys large quantities of fresh cattle milk from producers in the vicinity of the dairy milk plant, while the rest of the milk is sold to individual consumers as well as in the parallel markets of the departmental town (Fatick city). The impact of the dairy processors, such as Kirène, in boosting the local cattle milk industry has also been established by researchers in Fatick (Habanabakize et al. 2022; Tournaire 2019) and in other regions across Senegal (Corniaux et al. 2014; Napoléone et al. 2015). Furthermore, fresh goat milk is less consumed, and its market value is still very low due to cultural biases, personal preferences, and other traditional beliefs, both in the studied region and in different parts of the globe, despite its nutritional benefits (Idamokoro et al. 2019; Phoya et al. 2003).

Soap was found to be the most processed product from goat milk followed by curdled milk. This may be explained by the fact that most of the women's groups transforming the goat milk are located in remote areas where electricity and other conservation means are not available, and therefore soap, which is easily made and has an extended shelf life, is preferred and is a well-sold product by these women compared to cheese, yoghurt, and ice cream. The current results were different to the findings of Diouf (2004) who observed that producers in Niayes regions of Senegal were mostly processing cheese from goat milk, where there are small-scale transformation units in different towns of the region. Thus, there is a large body of evidence that shows that the choices of the primary products of processed goat milk differ in different regions depending on the availability of markets and equipment, as well as cultural aspects.

### Income

This study has shown that the revenues generated from milk selling activities constitute an important share of the total perceived household income of the women interviewed. The study has also indicated that the bovine milk value chain provides more income to the household than the caprine milk value chain in the studied area. The money from both value chains comes directly from the processing and marketing of livestock products (milk, cheese, butter, manure, and meat) or from the direct sale of live animals (cattle, goats). Factors associated with the differences in income distribution and adoption of the bovine and caprine milk value chains include the availability of markets, individual preferences, and cultural differences (Guney and Ocak 2013; Idamokoro et al. 2019; Utami 2014). In addition to these factors, it is worth mentioning that for years women have exploited cow's milk while the goat dairy sector is still evolving in the studied region.

Our findings indicate that the income generated from the sales of milk and its products is managed by women and the money is spent for daily household expenses. This is consistent with findings from multiple studies that have found that while the sale of animals (mostly small ruminants, but sometimes also cattle) provides an emergency source

of cash for medical expenses or school fees, the sale of milk and its products provide a regular flow of income essential to a family's well-being. It is also often used to purchase food, clothes, and other household items (Gillerot 2018; Schneider 2012; Ditefano 2012).

Farmers have also reported other sources of income at the household level in addition to the milk revenues. This study showed that women farmers of both value chains in Fatick get extra income from agriculture, fattening and small commerce in addition to the milk production activities. In the context of smallholder rural farmers, even if livestock and agricultural activities top the list of other household income-generating activities, these sectors are prone to numerous challenges including effects of climate change, low access to inputs, liquidity issues, and market fragmentations (Asravor 2018). It is therefore very common across rural smallholder settings, especially for women, to look for alternative ways of generating income to overcome challenges and to respond to opportunities that improve their livelihoods (Ng'ong'ola et al. 2017; Ellis 2010; Minot 2006).

### Challenges

In echo to the constraints faced by Senegalese livestock producers in general, such as extreme weather events, feed and water resource scarcity for example, the women in this study reported multiple constraints that farmers face. Women in the caprine milk value chain noted the lack of equipment as the biggest challenge for production activities. Indeed, while most of the women in the caprine sector are involved in milk transformation activities, they do not have access to the proper conservation and transformation equipment needed to properly carry out these tasks. The inaccessibility of electricity, roads, and market infrastructures are also big obstacles to their production activities due to their remote locations in rural areas. In most cases, smallholder producers are located in rural areas, and different studies in Senegal (Bernard et al. 2008; Van den Broeck et al. 2017), and in the West African region (Sarr et al. 2015; Bernard et al. 2008), have reported remoteness to have a negative impact on production and transformation activities. The lack of basic resources and infrastructure, such as conservation equipment, may also contribute to why these groups of women are mainly producing soap. This differs from producers in different regions (such as Canada vs. Jordan, Lebanon, Saudi Arabia, or France; Hosri and Khoury 2004; ANICAP 2016; Alqudah 2016), who have access to resources to conserve derived products for relatively longer periods of time and produce a wide range of products from goat and cow's milk.

Women involved in cattle and goat farming have also pointed out the lack of training and innovation/modernization as a problem. For example, 25–30% of the women surveyed from both value chains had never received training in raw milk processing. Thus, milk processing is generally done in a traditional manner, mostly without pasteurization. Insufficient and poor-quality milk also remains a problem for the processing of both bovine and caprine milk, though more seriously for the goat sector. Indeed, some products, such as cheese, require a large quantity of milk during processing, while local goats have relatively low productivity. The lack of quality faced by both sectors could be due to some malpractice, such as adding excess water into raw milk, as indicated by some of the interviewees. Finally, milk price fluctuations

were reported to be amongst the largest challenges faced by interviewees in the bovine milk value chain. Even if the dairy processor, along with the collection center, offers a package of extension services and a consistent market opportunity for rural and urban livestock producers, interviewees reported price dissatisfaction that the dairy's buying price was half of the parallel markets price (\$350 vs. \$600, CFA).

In addition to these challenges faced by both men and women, there are also challenges specific to women. Whether in the bovine or goat value chain, the lack of access to land is a major problem noted by the women interviewed. Women in Senegal have been known to have weaker land rights as the land is mostly controlled by men and thus, some women do not have access to land at all while others tend to farm more marginal and smaller fields, with less healthy soils that poorly support production activities (Diop 2010; Evans 2016; Tine and Sy 2003). The lack of holding pens, i.e., pens to confined animals for calving or for livestock generally, more precisely the lack of access to the holding pens because they are managed by and for men, remains a constraint for both sectors, but especially for goat farming. In fact, even if women are involved in the production, processing, and marketing of milk, the cattle are generally owned by men. As a result, the lack of holding pens is not often mentioned as a problem for bovine farming.

The management of domestic time was also reported to be a challenge faced by many women. In most cases, taking care of children, cooking, collecting fuel wood and water for domestic use, etc., are the women's responsibilities. Hence, household chores take up most of their time, to the detriment of the care of animals and the development of their production, processing, and marketing activities. The same challenge was also reported by other studies conducted in Senegal (Marshall 2017; Lindsey 2015) and in other sub-Saharan African countries (Mupawaenda et al. 2009) which found that women would not have enough time to efficiently invest their efforts in production activities because of time conflict with other primary household activities.

The women interviewed also revealed that they experience discrimination between men and women, for example in terms of government subsidies. Small ruminant breeders, who are mainly women, are not concerned by state subsidies directed toward heads of households. Even if recent years have seen an increase in advocacy and policy reforms for gender equity, the exclusion of women in intervention and policy design across value chains, still remains a global problem (Armbruster et al. 2019; Colverson et al. 2020; Njuki and Sanginga 2013; Ogunlela and Mukhtar 2009).

Our study has shown the important role that women have in the bovine and goat value chains in Fatick, as well as the role of milk in households. Milk allows women to improve their living conditions by enabling them to contribute to family expenses and to the security and well-being of the family. Nevertheless, women face many constraints that can limit their income. This study therefore highlights the importance of considering women and their perceptions so that they can also benefit from goat and cattle value chain improvement projects and policies.

### Concluding remarks

This study has investigated the place of the caprine and bovine milk value chains in Fatick's livestock sector. It has also discussed the perceived role and responsibility of women across the two value chains. It was found that both value chains are important in the development of the region for the role they play in securing the household food security and as additional sources of income. The results of the study showed that the bovine milk value chain provided more income than the caprine's for women in Fatick, due to the constant market opportunity offered by the dairy processor and Fatick milk collection center for fresh cow's milk. Nevertheless, there were more milk products derived from goat milk than from cattle, and thus, the income from the caprine milk value chain was mostly from transformed products such as soap, cheese, and yogurt, instead of fresh milk. It was also found that women are more active in the caprine than the bovine milk value chain, because for most women, access to livestock is by virtue of their relationships with men (husbands, fathers, and sons) who control livestock, and yet the men are usually not interested in goats and small ruminants in general. However, milk processing and marketing of the derived products remain the responsibility of women in both value chains. Indeed, trading milk and derived products provides smallholder women producers with one of the few available opportunities to control their own money and have the chance to be financially involved in household activities.

While there are common challenges to both value chains in the region such as extreme weather events, feed and water resources scarcity, price fluctuations, and remoteness; we identified specific challenges to each value chain. The caprine value chain is yet to recover from the traditional beliefs that stunt its development. In fact, fresh goat's milk is less consumed, and its market is still low, partially because of cultural differences, personal preferences, and other traditional beliefs that go with drinking goat's milk in the studied region. In the same vein, it was also found that women involved in livestock production activities lack access to land resources, have problems managing domestic and production time, and are not considered in most policy programming that supports producers, as opposed to their male counterparts. In order to advance the livestock sector as a whole in the region, there is a need for holistic management policies that fully recognize the role of every key actor, and specifically women in the value chain, as well as the diversity of value chains and their complementarity. To achieve this, it will require the establishment of policies and interventions that intentionally consider the needs and opportunities offered by both the caprine and bovine value chains, while putting gender mainstreaming at the center of the discussion and reforms.

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### Author contributions

EH coordinated the project, designed the survey (investigation), developed the methodology, wrote, reviewed, and edited the original draft and all the versions of the manuscript. MAD participated in drafting the initial study, the survey, and methodology and data analysis. EV conceptualized the project, provided funding acquisition, administered the project, provided supervision, was involved in the survey design, paper design, and reviewed and edited the manuscript. PC contributed to the conceptualization of the project, funding acquisition, co-administrated the project, and reviewed the manuscript. KB contributed to the survey design (investigation), data collection, maps elaboration, and manuscript revisions. CC contributed to the conceptualization of the project, funding acquisition, survey design (investigation), and review of the manuscript. ADC participated in revisions of all the versions of the manuscript. MC edited and revised all the versions of the manuscript. KT revised all the versions of the manuscript. IW revised all the versions of the manuscript. All authors read and approved the final manuscript.

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## Declarations

### Ethics approval and consent to participate

The questionnaire and methodology for this study were reviewed and approved by the McGill University Research Ethics Board committee (REB) (Ethics approval number: # 484-0519) in accordance with the requirements of the McGill University Policy on the Ethical Conduct of Research Involving Human Participants and the Tri-Council Policy Statement. It was also assessed and approved by the “Commission de Protection des Données Personnelles” (CDP) of Senegal (Ref. no: 00000520 CDP). Informed consent was obtained from all individual participants included in the study.

### Competing interests

The authors declare that they have no competing interests.

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