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**Strengthening Women's Empowerment, Climate Resilience, and Nutrition
Along the Goat Value Chain in Senegal**
A qualitative study

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ABSTRACT

Goats are an important source of income, nutrition and resilience in Senegal. This study assesses opportunities to strengthen women's agency, increase resilience to climate change, and improve nutrition along the various stages of goat value chains from the acquisition of feed resources and other inputs to processing, marketing and consumption of various goat products. The qualitative study finds that even though goats are more climate resilient than other livestock, climate change impacts on goat production and productivity are increasingly felt, particularly through impacts on feed resources. The study identified opportunities to strengthen women's roles along the goat value chain, particularly in goat production and, to a lesser extent, in processing of goat products. Women and their families also benefit from the consumption of goat milk and women have some degree of control over income from the sale of goat products. Strengthening women's agency in these nutrient-rich and relatively climate-resilient value chains will require improving their access to land resources and better animal feeds, supporting women's groups and building women's capacity for processing and marketing goat products, improving access to electricity for cold storage of goat products, and raising awareness regarding the nutritional benefits of goat products, especially for women and children.

Keywords: women's empowerment, goat value chains, Senegal, qualitative methods, climate change, nutrition.

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AUTHOR CONTRIBUTIONS

Papa Abdoulaye Kane and Mamadou Bobo Barry contributed to the study design, led the data collection effort and drafted the initial report analyzing qualitative results. They also contributed to the literature review and analysis of primary data, led the secondary data analysis, and provided overall coordination for the ISRA-BAME team. Sarah Eissler designed the qualitative analytic framework, led the qualitative analysis, and drafted the manuscript. Thian e Tall contributed to data collection and Simone Fass engaged with the ISRA-BAME team on data collection and study implementation. Astou Diao Camara contributed to the study design and concept and the design of data collection instruments and Moussa Sall contributed to data collection and literature review. Elizabeth Bryan and Claudia Ringler developed the conceptual design of the study, oversaw study implementation and contributed to the final write-up.

ACRONYMS

ARECAP	Association Régionale des Éleveurs de Caprins
BAME	Bureau d'Analyses Macro Economiques
CIMEL	Centre d'Impulsion et de Modernisation de l'Elevage
CRZ	Centre de Recherches Zootechniques
GCAN	Gender, Climate Change and Nutrition Integration Initiative
IFPRI	International Food Policy Research Institute
IRB	Institutional Review Board
ISRA	Institut Sénégalais de Recherches Agricoles
NGO	Non Governmental Organization
PAFC	Projet d'Appui à la Filière Caprine
RFS	Resilience and Food Security
USAID	US Agency for International Development

1 INTRODUCTION

There has been increased global attention to improving goat value chains as a strategic entry point for strengthening women's empowerment, climate resilience, and nutrition security. Goats are particularly resilient ruminants that require minimal maintenance yet yield nutritious milk and meat for consumption (Nair et al. 2021). Women also play important roles in livestock management and often own or jointly own small ruminants, such as goats (Hillesland et al. 2023; Waithanji et al. 2015; Njuki and Mburu 2013). Goat husbandry also serves as an important livelihood source for women in some contexts. However, women often lack control over decisions related to the consumption or sale of goat meat or goat products and women may lose rights to their livestock and control over livestock activities and income when these activities become more profitable (Hillesland et al. 2023; Kristjanson et al. 2014; Njuki and Mburu 2013; Njuki et al. 2011). In general, women prefer to engage in livestock activities, such as the production of specific livestock species and products, when they can control the income from production, have greater security in their ownership of the animals, can access markets, and can meet the labor requirements (Waithanji, Njuki, and Nabintu 2013). Moreover, climate change may increase the drudgery of caring for livestock, a task that often falls on women, and yet women tend to lack access to the resources and services needed to adapt effectively (Najjar and Baruah 2023). Despite these constraints, livestock interventions have the potential to increase climate-resilience, contribute to gender equality, and improve nutrition with greater attention to gender-related constraints and preferences and a focus on nutrition-sensitive strategies (Chanamoto and Hall 2015).

Livestock husbandry is an important livelihood activity throughout the Sahelian Region, providing income and a vehicle for wealth accumulation, and playing an important role in cultural and religious practices (Eilitta 2021). Senegal's total goat population has increased dramatically over the past three decades, from around 2 million head to more than 7 million head in 2021, driven by increasing demand for livestock products and government interventions aimed at increasing goat productivity (CEPSE/DIREL/MEPA 2021; Sow et al. 2021). Women tend to manage goats and other small ruminants, and importantly, control at least some of the income generated from goat-rearing activities (Habanabakize et al. 2022). Goats are particularly resilient animals, as they can withstand climatic shocks, particularly those that are drought-related, and can survive in variable and harsh conditions, requiring minimal maintenance and lower quality feed sources, while still producing nutritious by products (Assan 2021; Diallo et al. 2021). They are also an important source of wealth and are often traded or sold in response to climate or other forms of shocks as a risk management strategy employed by rural households (Sow et al. 2021).

In this study, we explore the potential for strengthening goat value chains in Senegal to foster women's empowerment, increase climate resilience, and improve nutritional outcomes. In particular, we examine climate-related risks and opportunities to strengthen resilience along the goat value chain as well as gender-related bottlenecks and potential solutions to support women's empowerment. Identifying the risks to goat value chains posed by climate change is increasingly important as bottlenecks are increasingly climate-related (CIAT, BFS/USAID 2016; Fanzo et al. 2018). For example, roads used to transport goats and goat products to market can be destroyed by extreme rains, while goat feed availability is directly linked to precipitation, increasing climate-variability and climate-change induced changes in goat prices. Although goats are a relatively

more climate-resilient ruminant than other small livestock species, evidence does suggest that climate change and climate extremes can affect goat productivity. For example, Pragna et al. (2018) find that increased temperatures can influence goat digestion, which can have a negative impact on their productivity. Additionally, the impacts of climate hazards on goat value chains have implications for nutrition quality and access to goat products. And finally, while research suggests that women play a key role in goat activities, it is important to identify opportunities for women to enhance nutritional outcomes linked to goat value chains, given that they play an important role in securing food for their households and in household dietary decision making, particularly for children. As such, there is a need to better understand the actual and potential role of women in the production, processing and marketing of goats and goat products (including milk and meat) and the opportunities and barriers for women to participate in and benefit from their participation in goat activities along the value chain.

1.1 Study Rationale

This study aims to understand the opportunities and challenges related to women's empowerment, climate resilience and nutrition along the goat value chain in Senegal, with two overarching objectives: (1) to understand the potential for goat production to support women's empowerment, climate resilience and improved nutrition relative to other animal source foods; and (2) to identify relevant actions to further strengthen these results along the value chain while minimizing environmental, health and social tradeoffs. Specifically, the following research questions guided the design and implementation of this study:

- What is the role of goats and the goat value chain for climate resilience, women's empowerment and improved nutrition in Senegal?
- What risks does climate change pose to the goat value chain compared to other comparable key animal source food value chains? What advantages or disadvantages does goat farming have in terms of climate resilience and other environmental trade-offs compared to other types of farming?
- How does the consumption of goat products contribute to the diets of rural and urban communities compared to other foods of animal origin?
- What are the main interventions to strengthen women's empowerment, climate resilience and nutrition along the goat value chain in Senegal? Could this include organizational changes of actors, changes in technologies and practices and changes in policies, investments, institutions, and governance.

1.2 Nexus of Climate Change, Gender, Nutrition, and the Goat Value Chain

Strengthening opportunities across goat value chains has become of increasing interest to the global development community as a means to improve women's empowerment, climate change resilience, and nutrition in poorer communities. A GatesNotes blog in 2019 focused on the potential of goats for empowering women, citing goat value chains as a key entry point for development programming to have real impacts for empowering women and gender equality.

Goats are an important livelihood source for many poor, rural households. Goat producers can sell goat milk, meat, manure, wool, and skin, while keeping portions of each for home consumption (Thorton 2010). It is common for most agricultural households to own at least one goat, whether for production purposes or to give as a gift to a neighbor or family member (Sow et al. 2021). They are also used as an insurance mechanism, as households can sell or trade a goat and other livestock for quick cash in response to a shock, thus owning goats can increase household resilience to climatic or economic shocks and stressors (Banda and Tanganyika 2021; Herrero et al. 2013). Diversifying household livestock portfolios to include small ruminants and poultry can also improve household welfare under climate change, specifically by increasing household income and food expenditure, particularly for lower income households (Ngigi et al. 2021).

Goats also provide an important source of nutrition security, particularly considering the anticipated effects climate change will have on agriculture and food systems, and subsequently human diets and human nutrition (Fanzo et al. 2018). Often, goat milk is consumed by young children and its meat is consumed as part of many religious ceremonies (Traoré et al. 2018). Goats do not require high quality feed sources (and can consume anything from cacti to cardboard) while still producing milk and meat for consumption and sale (Assan 2021).

They are considered a climate resilient ruminant, especially when compared to other small and larger livestock animals and contribute to both adaptation and mitigation strategies (Darcan and Silanikove 2018). Goats are tolerant in harsh weather conditions, can more readily adapt to climatic, feed and water stresses, can rely on more inferior quality of feed sources and still produce milk and meat, and have a short gestation period that contributes to higher growth potential (Hedge 2020; Dubeuf et al. 2023). Goats are particularly resilient in drier conditions and in areas prone to drought (Diallo et al. 2021). For example, during periods of water scarcity, goats can travel further distances to search for water and forage and can rely on poor forage and less amounts of water for their survival compared to other small ruminants (Assan 2021). As such, they are a less risky investment for households to choose for livestock production while still reaping economic and nutritional benefits (Assan 2021). They also emit less methane than other comparable ruminants, which is an advantage in promoting goat value chains as a climate change mitigation strategy (Darcan and Silanikove 2018).

Goat management is often women's responsibility in rural households across different contexts (Assan 2021), from India (3ie 2020) to Kenya (Ogolla et al. 2022) and Senegal (Sow et al. 2021). As goats are a particularly low maintenance ruminant and relatively tolerant of harsh environmental conditions, they are preferred by women who are more time constrained and often have limited resources to invest in livestock care or other forms of productive activities such as crop production (Njuki and Mburu 2013). Household dynamics related to goat management and control over income generated from goats can vary across contexts. For example, Gates (2019) cites programming examples from India, where women were mostly in charge of goat management, including decisions over productive inputs as well as income generated from goat sales, whereas other studies, such as Hillesland et al. (2023) and Ogolla et al. (2022), find that while women are considered joint owners of goats and sheep and provide the bulk of management labor, their husbands effectively assume decision-making power over their management and the income generated. In the latter example, men were able to sell a goat for quick cash but did not need to consult their wives (i.e., the joint owner) before doing so, while the reverse was not

acceptable; women needed to consult their husbands prior to selling a jointly-owned goat. This dynamic highlights important normative barriers women, in particular, may face over their equal benefit from goat production, in addition to other structural barriers that may limit their equal benefit.

Gates (2019) highlights opportunities to strengthen goat production by reducing barriers women often face to maintain healthy goats and optimize benefits. For example, he writes,

There is huge potential for goats to help boost women’s empowerment. But that potential has not been fully realized. Because of a lack of access to veterinary services in India, mortality rates for goats are as high as 40 percent. And ill or low-weight goats fetch lower prices in the marketplace (Gates 2019).

As such, opportunities to strengthen women’s engagement and benefit from goat production must address both normative and structural barriers. A recent Aga Khan Foundation program in India, Project Mesha, trained more than 200 women to provide necessary veterinary services for goats managed by women, ultimately promoting best goat care in their communities and directly reaching women who manage goats (3ie 2020). A recent United Nations Development Programme (UNDP)-funded project aimed to use targeted technical assistance and capacity building to improve goat breeding and production practices as a means to strengthen women’s economic empowerment and climate resilience in Niger. The project, in addition to other interventions, provides technical training on goat diseases and improving awareness and practice of vaccination for women goat herders in communities vulnerable to impacts of climate change (UNDP n.d.).

1.3 Overview of the Livestock Sector and Goats in Senegal

Livestock remains an important economic resource in Senegal. Of important livestock species, goats have continued to be an important ruminant for household well-being. A study characterizing the Senegalese goat herder by Sow et al. (2021) finds that women are predominately involved in goat management and production, and that study participants kept goats for three main reasons in descending order of importance: (1) cash income, milk/meat consumption, and milk production; (2) cash income and meat consumption; and (3) milk production for income or home consumption.

In this section, we present high-level national statistics to demonstrate the growth of the livestock sector and specific species in Senegal since 2010, highlighting where goats are an important livestock species. Since 2010, the national stock of goats has increased from 4,755,000 to 7,003,000 head in Senegal (CEPSE/DIREL/MEPA, 2021). Compared to other Sahelian countries, Senegal’s livestock population is considerably smaller (Eilitta 2021). While the number of goats in the country remains lower than the human population (16.9 million people in 2021), the growth in the goat population is increasing at a faster pace—an annual increase of 7.9 percent for goats compared to 2.7 percent for people in 2021.

Table 1 presents an overview of the total number of livestock (in thousands) between 2010 and 2021. Poultry – both familial and industrial – represent the highest numbers of stock, whereas goats are just behind sheep for total numbers. The rate of growth in herd stock from 2010 is the highest for goats (47 percent) and sheep (46 percent), behind industrial poultry (337 percent).

Table 1 Growth of national livestock numbers by species between 2010 and 2021

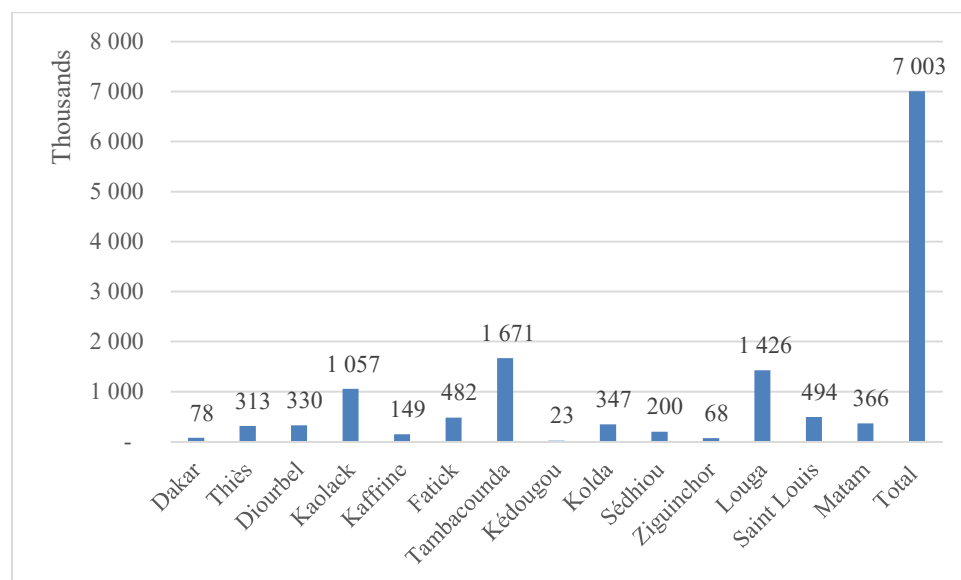
Year	Cattle	Sheep	Goats	Pigs	Camel	Family poultry	Industrial poultry
2010	3,313	5,571	4,755	354	5	22,971	17,478
2011	3,346	5,716	4,887	364	5	23,255	20,916
2012	3,379	5,887	5,038	375	5	23,929	20,998
2013	3,430	6,081	5,199	386	5	24,647	27,281
2014	3,464	6,264	5,355	397	5	25,362	29,931
2015	3,499	6,464	5,527	408	5	26,097	40,298
2016	3,541	6,678	5,704	423	5	27,011	45,299
2017	3,587	6,911	5,886	437	5	27,956	48,577
2018	3,628	7,132	6,051	451	5	28,376	53,043
2019	3,606	7,275	6,013	444	5	27,883	51,365
2020	3,658	7,700	6,490	457	5	28,859	56,214
2021	3,712	8,150	7,003	472	5	29,869	59,025

Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented by thousand head.

Figure 1 presents the breakdown in herd goat by region in Senegal in 2021. The regions with the highest goat populations are Tambacounda, Louga, Kaolack, Saint Louis and Fatick.

Figure 1 The national goat herd in 2021 by region



Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented in thousands.

Table 2 presents the total number of livestock slaughtered by species between 2010 and 2020, representing the number of livestock heads slaughtered for meat or other by products each year.

There was a decline in goat slaughters in 2020, attributable to the COVID-19 pandemic that had restricted trade movements.

Table 2 Number of total heads of livestock slaughters by species between 2010 and 2021

Year	Cattle	Sheep	Goats	Pigs	Camel	Family poultry	Industrial poultry
2010	408	1,615	1,380	258	0.07	21,856	16,313
2011	431	1,839	1,664	269	0.07	22,575	19,125
2012	435	1,886	1,710	273	0.07	22,906	19,464
2013	439	1,884	1,562	281	0.07	23,570	24,484
2014	412	1,885	1,586	288	0.07	24 154	29,931
2015	416	1,879	1,607	294	0.07	24,855	34,744
2016	472	2,262	1,934	306	0.07	25,706	36,924
2017	442	2,197	1,875	316	0.07	26,244	45,605
2018	466	2,343	1,994	327	0.07	27,083	48,599
2019	472	2,354	2,118	325	0.08	27,950	52,772
2020	476	2,552	1,624	329	0.08	27,047	53,404

Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented by thousand head.

National meat production has steadily increased between 2010 and 2020, rising at a growth rate of 69 percent (Table 3) (CEPSE/DIREL/MEPA, 2021). Meat is mainly produced from industrial poultry, followed by cattle, sheep, pigs, and then goats. Following the 2005 ban on uncooked poultry imports, the industrial poultry sector in Senegal drastically increased in both production and sale (Boimah and Weible, 2021).

Table 3 Growth of national meat production by species between 2010 and 2020

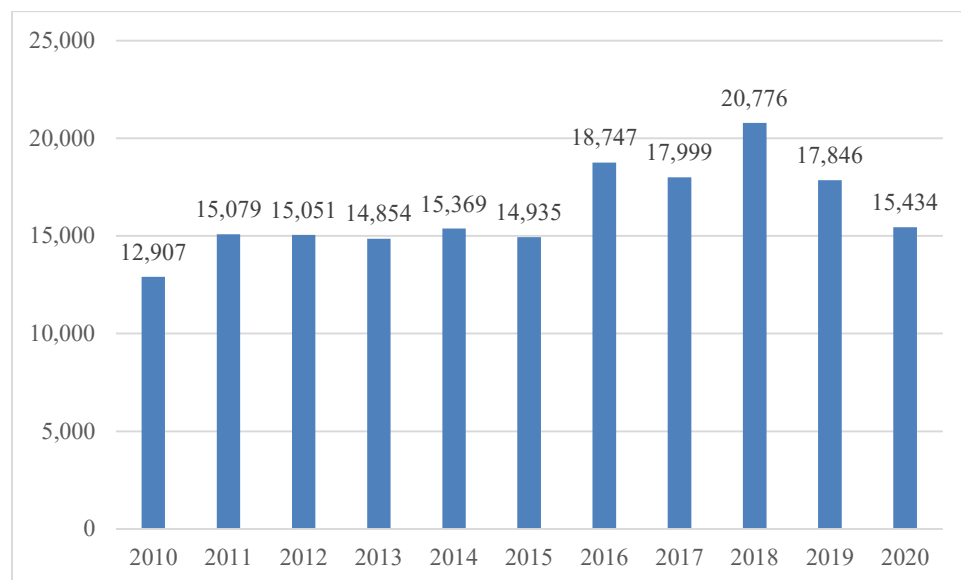
Years	Cattle	Sheep	Goats	Pigs	Camel	Industrial poultry	Family poultry	Total
2010	61,079	20,472	12,907	10,640	14	24,469	20,982	150,562
2011	65,052	23,166	15,079	11 107	14	28,688	27,090	170 196
2012	61,541	23,200	15,051	11,012	14	29,196	27,487	167,501
2013	63,626	24 102	14,854	11,548	12	36,223	28,284	178,650
2014	59,613	25,660	15,369	11,752	14	44,897	28,985	186 290
2015	58,622	24,914	14,935	12,000	15	52 115	29,826	192,426
2016	68,485	30,794	18,747	12,554	14	55,386	30,747	216,829
2017	60,499	34,056	17,999	14,506	14	63,561	31,492	222 127
2018	64,536	32,565	20,776	16,256	13	72,898	32,500	239,636
2019	66,673	30,521	17,846	17,198	5	80,710	35,782	248,733
2020	69,992	33,075	15,434	16,692	15	89,749	32,080	255,037

Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented by tons.

Goat meat production has steadily increased since 2010 and represented 6 percent of total meat production in 2020. It rose sharply from 2010 to 2018 at a rate of 61 percent but experienced a decrease in production since 2018 (Figure 2).

Figure 2 Rates of goat meat production between 2010 and 2020



Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented by tons.

Offal production has also increased, although marginally, between 2010 and 2020 (Table 4). Most of the offal production comes from cattle, but sheep, goats, and pigs represent a marginal percentage of national production.

Table 4 Growth of national offal production by species between 2010 and 2020

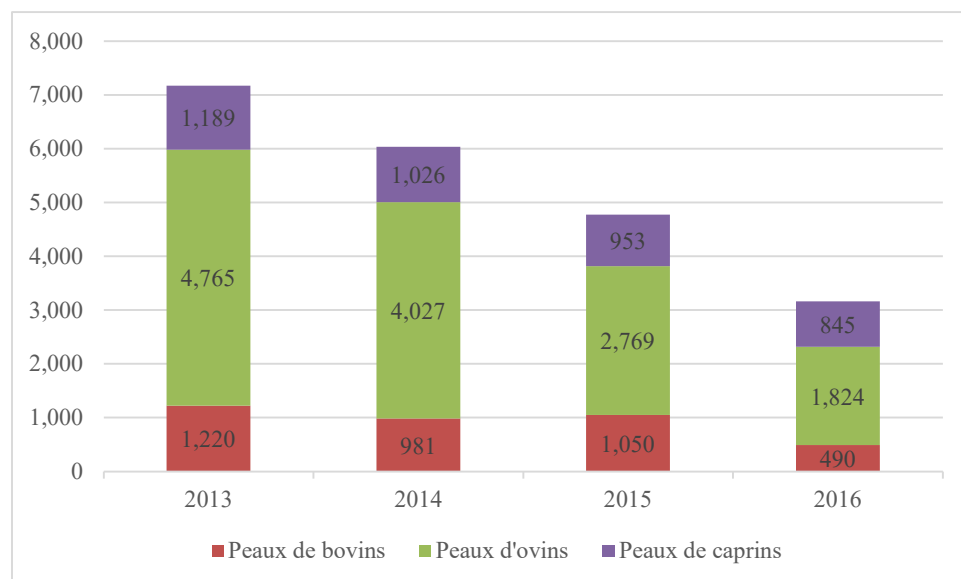
Years	Cattle	Sheep	Goats	Pigs	Camel	Total
2010	15,270	5,118	3,227	2,660	4	26,278
2011	16,263	3,475	2,262	1,111	4	23 115
2012	15,385	3,480	2,258	1,101	4	22,228
2013	15,907	3,615	2,228	1,155	3	22,908
2014	14,903	3,849	2,305	1,175	4	22,237
2015	14,655	3,737	2,240	1,200	4	21,837
2016	17121	4,619	2,812	1,255	4	25,812
2017	15 125	5,108	2,700	1,451	4	24,388
2018	16,134	4,898	3,116	1,626	4	25,779
2019	16,668	4,578	2,677	1,720	1	25,644
2020	17,498	5,837	2,724	1,855	8	27,922

Source: CEPSE/DIREL/MEPA, 2021

Note: These figures are presented by tons.

The most recent data available suggest a decline in exports of hides and skins by air and sea from various livestock species, including cattle, sheep, and goats (Figure 3). The downward trend in exports is explained by structural constraints that considerably limit the sector's capacity to comply with international regulatory requirements. In addition to these constraints, it should also be noted that there are land export channels, (i) for food purposes for bovine hides, particularly to Ghana and (ii) for processing by tanneries, for sheep hides, to Mali (MEPA, 2017).

Figure 3 Rates of hide and skin production by species between 2013 and 2016



Source: MEPA, 2017¹

Note: These figures are reported in tons.

Finally, research has explored attitudes, beliefs, and practices shaping goat product consumption in Senegal. Traoré et al. (2018) observed that consumption practices are largely shaped by attitudes and beliefs and can vary between rural and urban areas, where individuals have differing levels of access to information concerning best nutrition or consumption practices or actual food products. For example, coastal urban populations in Senegal prefer to consume more fish than livestock products – including goat and sheep – as fish are more readily available and lower cost compared to livestock. Households in rural areas that raise livestock often do not slaughter it for their own consumption, preferring to purchase meat or fish from the market (Traoré et al. 2018). Sheep meat is considered of higher value than goat meat, and often sheep meat is only consumed at major socio-cultural events. Many wealthier farmers near urban areas will raise sheep for prestige rather than for consumption or sale, and often have other sources of income beyond livestock.²

Cultural norms and beliefs influence meat and milk consumption. Women and children consume goat and cow milk, eggs, fish, and yoghurt (urban areas), and meat only at developmentally

¹ Information provided by the port and airport veterinary services.

² Raising *ladoum* sheep, one of the world's most expensive sheep breeds, is a popular practice among wealthy Senegalese and garners international attention. See <https://www.nationalgeographic.com/animals/article/ladoum-sheep-expensive-pets> for more information about this practice.

appropriate ages (Traoré et al. 2018). However, beliefs that goat products are more likely to be associated with certain diseases or conditions, compared to other livestock products, cause households to avoid giving goat milk or meat to their children. For example, rural women expressed beliefs that goats carry diseases, such as dermatitis and rheumatism, whereas in urban areas, women expressed that consuming goat products may cause allergies in children (Traoré et al. 2018). Such beliefs shape the way women, who are primarily responsible for decision-making around household diets, choose to feed their children.

2 METHODS

The methods used in this study relied on qualitative techniques to collect and analyze primary data from men and women research participants engaged in the goat value chains in three key areas of Senegal. The methods and analysis use a gender and agricultural value chains approach (Rubin et al. 2009) to understand and explore opportunities and bottlenecks around the gender dimensions of men's and women's participation, benefits, and empowerment in the goat value chain in Senegal. In this section, we present the methods employed to collect and analyze the data for this study to inform the research questions.

2.1 Qualitative Methods

This study employed two different types of primary qualitative data collection methods: focus group discussions (FGD) and individual interviews. All FGDs and interviews asked questions to understand the gender dynamics of men's and women's participation and benefit in each node of the goat value chain, and to shed light on constraints and opportunities to strengthen women's empowerment and to improve climate resilience and nutrition along the goat value chain in Senegal.

The FGDs were conducted with men and women agropastoralists, goat herders, processors, and traders in each village. These FGDs explored alternative options (breeding practices and priority investments) to strengthen the goat value chain, such as good practices and investments in veterinary care, changes in feeding and grazing, production and marketing information platforms, food handling and safety practices, consumer awareness and training of extension agents and other goat experts.

Individual interviews were conducted with key informants involved in the goat value chain in rural, urban, and peri-urban areas. These interviews asked informants questions about gender, climate resilience, and nutrition along the goat value chain. Additional individual interviews were conducted with representatives of key government ministries, farmer organizations, researchers and experts, and non-governmental organizations (NGOs) involved in the development and implementation of programs and projects aiming to strengthen the goat sector in Senegal. These interviews were primarily conducted in Dakar and served to inform an overview of programs, policies, initiatives, and practices in place to strengthen the goat sector. Examples of topics covered included good veterinary care practices and investments, changes in feeding and grazing practices, production and marketing information platforms, food handling and safety practices, raising awareness among consumers, and training extension agents and other goat experts.

2.2 Sampling

The study took place in three regions of Senegal: Fatick, Louga, and Dakar (Figure X). These regions were selected to represent the diversity of the goat sector across the country. Within each region, an area was selected that represented the main type of livestock system within that region (Table 5). Niakhar, Fatick was selected to represent a mixed crop-livestock area. This is a groundnut producing area which is increasingly exposed to drought and declining rainfall; livestock production is becoming more important for rural livelihoods; and NGOs have intervened

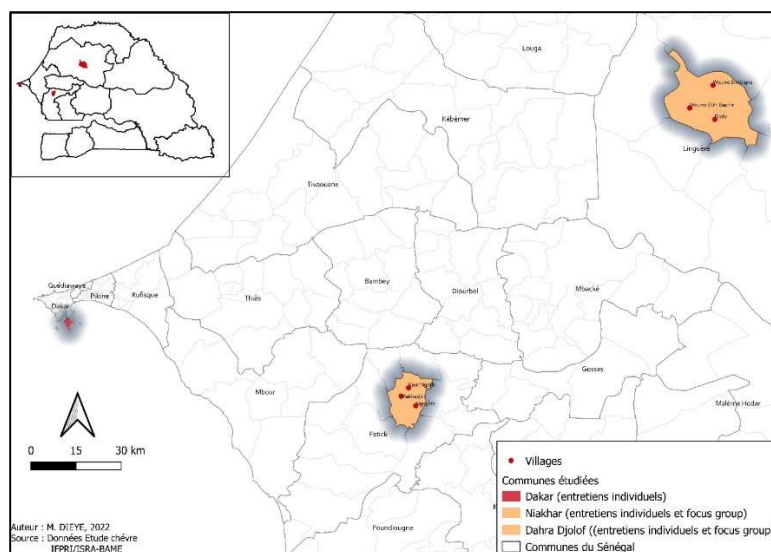
in the area to improve the goat value chain (milk and cheese production) particularly for women. The pastoral area in Louga close to Dahra Djolof was selected given its proximity to the largest cattle market in the country, its agroecological conditions, and exposure to climate risks. Lastly, research was carried out in and around Dakar to better understand challenges and opportunities at later stages of goat value chains through interviews with traders, vendors, and consumers in urban and peri-urban areas.

Three villages in each area were selected to conduct the primary data collection. They were selected if goat breeding practices occurred and if women were involved in these practices. There are key actors in each of the areas related to the goat sector. In Niakhar, the main institution dedicated to goats is the Center for Impetus and Modernization of Livestock (CIMEL), which aims to develop each node of the goat value chain. In Dahra Djolof, the ISRA Zootechnical Research Center is the main institution dedicated to livestock (and goat) breeding, which conducts research on livestock management, particularly on food rations, milk production, and artificial insemination for cattle and goats.

Table 5 Description of Study Areas

Region	Area	Villages	Type of System	Data Collection Methods
Fatick	Niakhar	<ul style="list-style-type: none"> Keur Ngoth Makhadji Ngoyère 	Extensive agro-pastoral system	<ul style="list-style-type: none"> Focus Group Discussions Individual Interviews
Louga	Dahra Djolof	<ul style="list-style-type: none"> Wourro Simbigne Wourro El Hadji Bachir Diaffy 	Extensive pastoral system	<ul style="list-style-type: none"> Focus Group Discussions Individual Interviews
Dakar			Intensive peri-urban	<ul style="list-style-type: none"> Individual Interviews

Figure 4 Map of Study Areas



Source: ISRA-BAME, 2022

A total of 12 FGDs were conducted in Niakhar and Dahra Djolof. Two FGDs were carried out in each village, one with men and one with women. A total of 43 men participated in FGDs and a total of 55 women participated in the FGDs. In addition, a total of 20 men and 7 women were interviewed as key informants (Table 6).

Table 6 Total Sample Size by Activity, Gender and Village

Participant	FGDs						FGDs total	KII	Total
	Niakhar			Dahra Djolof					
	Keur Ngoth	Makhadji	Ngoyére	Wourro Simbigne	Wourro El Hadji Bachir	Diaffy			
Men	7	7	10	7	6	6	43	20	63
Women	10	13	10	7	6	9	55	7	62

Additional interviews were conducted with key market actors and other relevant stakeholders both at the village level and in Dakar. Participants were purposively selected to participate in these activities based on their role and level of involvement in the goat value chain. A total of 17 interviews were conducted. Several interviews convened more than one participant, for a total of 26 interview participants (Table 6).

2.3 Data Collection, Management, and Analysis

After the training, the individual interview guides were pilot tested in the suburbs of Dakar with participants of a similar profile to those targeted for this study. Specifically, the tools were tested with six actors in the goat value chain, including two goat producers, a meat processor, a veterinarian and two milk processors. The FGD guide was not pilot tested in Dakar as these were only scheduled in villages in Niakhar and Dahra Djolof. The pilot testing ensured that the interview tools were relevant and comprehensive to collect the needed data. All data were collected in between June 8 to July 22, 2022. With participants informed oral consent, the FGDs and individual interviews were audio recorded and transcribed into detailed summary notes in French. The summary notes were used as the raw qualitative data for analysis. A codebook was designed to include both deductive and inductive themes to code the qualitative data. Coding was completed using NVivo software following a thematic analysis technique.

2.4 Limitations

The study design and implementation faced a few limitations. First in terms of geographical representation, the study only covers 2 of 14 regions in the country (Louga and Fatick) and only 2 municipalities out of 557 (Niakhar and Dahra). These two regions and municipalities were selected because they represent key goat production areas and the two main livestock systems in the country: agro-pastoral and pastoral. However, the largest goat production area in the country, namely the Tambacounda Region, was not included. Despite this limitation, the selected areas remain representative of the three main livestock systems in the country. Moreover, in certain areas, notably in Dakar, it was difficult to obtain interviews with a significant number of key informants due to the lack of technical services among other reasons. Finally, movement

restrictions during the COVID-19 pandemic caused a disruption to survey schedule, resulting in the postponement of field activities from 2021 to 2022.

2.5 Ethics and Compensation

This study was approved by Senegal's National Ethics Committee for Health Research (CNRES) as well as the Institutional Review Board of IFPRI. Prior to participating in an interview or FGD, the research team read a prepared statement of voluntary participation and informed consent regarding the research study, its purpose, and how the data would be stored, shared, and used. Precautions were taken to reduce the risks posed by COVID-19, such as physical distancing and masking, and participants had to agree to abide by these conditions to participate in the study. Prior to participating in either an interview or an FGD, the research participants provided their informed oral consent to both participate and to be audio recorded. As a token for their participation, each study participant received a transport reimbursement of 5000 XOF, approximately \$8.50 USD.

3 RESULTS

In this section, we present the results of the qualitative analysis organized by key topics aligned to each research question.

3.1 Women's Empowerment, Climate Resilience and Improved Nutrition in the Goat Value Chain

To address the research question, *“What is the role of goats and the goat value chain for climate resilience, women's empowerment and improved nutrition in Senegal?”*, participants were asked to describe gender-related roles and dynamics at each node of the value chain as well as the challenges and opportunities at each node.

3.1.1. Goat Management

With respect to goat management, this is primarily women's responsibility, whereas men are responsible for larger ruminants and other livelihood activities. Men also own goats and contribute to goat management but treat goats as an asset, which can be sold when funds are needed. Women's motivation for rearing goats goes beyond holding them as a store of wealth—they also engage in the production of goat products such as milk, cheese, and soap. One woman explained, “Men rely more on the breeding of sheep and large ruminants” for their incomes [FGD, Women]. And a man further confirmed, “Usually women have no decision on sheep and cattle. However, they are the ones who mainly manage the goats. They meet most of their needs and those of their children thanks to these goats” [FGD, Men].

In the agro-pastoral system, women also participate in field work, while also caring for small ruminants; while in the pastoral areas, women focus more on goat rearing and processing activities. Although women have a heavier time burden with both domestic and production responsibilities, goats are a relatively low maintenance ruminant to raise. Goats also require less in terms of access to quality land or high investments, which enables women—who often lack access to such resources such as pastureland—to manage goats effectively. Some women also rely on goat rearing because their other livelihood options are more constrained. One woman explained, “Women do not always have access to fertile land to be able to fully develop their agricultural activities. Therefore, we can only fall back on goat breeding to fill the gap” [FGD, Women].

However, even though goat rearing is more accessible for women, they are still limited by their lack of access to pastures and other resources and their greater time burden, which prevents them from leaving the homestead to graze goats or obtain sufficient quantities of fodder. Respondents described multiple methods to manage goats, sometimes varying by seasons. Many respondents did not practice transhumance, citing challenges related to livestock theft or lack of individuals available to go with the herds. Several respondents described their typical practices,

“We do not do transhumance because of the phenomenon of cattle theft and the lack of shepherds because all our children are practically in school. The latter served as shepherds of sorts. So, for [goat] management, we let them wander almost all day. Usually at noon, they come home to drink and then leave again until five p.m. In the evening, we tie them to stakes in a place in the enclosure” [FGD, Women].

Another woman explained,

“We make a simple enclosure, which does not require a lot of financial resources, in order to protect the goats from the rain during wintering. When it comes to their food, we often collect cowpea or peanut residue. We also store and reserve fodder. Our goats do not practice major transhumance. They graze in the morning and return in the evening” [FGD, Women].

However, this style of management can lead to conflict, as wandering goats can destroy fields and consume crops, which can contribute to farmer and herder conflict in a community. One participant did explain that they practice transhumance because they don't have enclosures for their goats,

“Most of the time, we do transhumance. This is why we camped here. So, we are called to leave these places at any moment. The goats are forced to wander because we do not have an enclosure to hold them and protect them from bad weather” [FGD, Women].

However, participants explained that they wanted support to build better enclosures for their goats to both protect them from potential theft but also to keep them safe during the rainy season and mitigate potential illnesses that could affect their herd.

During the day, goats feed while they wander, and then women would supplement their diets with specific feed sources. A common practice to maintain healthy goats is to do “destocking” where a household may sell one or two goats to use the money from the sale to feed the rest of the herd. One woman explained this as a common strategy to manage a lack of resources with maintaining a healthy goat herd, “I find that a woman can manage up to fifteen goats but beyond this figure it risks being difficult due to lack of resources. Usually what I do is sell the old goats to buy young females” [FGD, Women].

Others expressed they want to grow fodder crops or invest in higher quality fodder crops, such as “maralfalfa” but are challenged in doing so due to variable climatic conditions, lack of access to water, and in certain cases, a lack of access to land. Quality livestock feed is also expensive, and many women do not have the means to invest in it. Others highlighted challenges related to limited pasture areas available for goats to wander, as explained by one man,

“You know, some refuse to milk their goats because of lack of means. Since pasture is becoming increasingly scarce, breeders are forced to supplement the goats' diet from their own means” [FGD, Men].

Livestock diseases are a key challenge affecting goat breeders, and there exist access challenges that limit rates of vaccination among goat breeders. One key informant explained, “People who only have a few heads and who generally stay in the area do not vaccinate too much due to the lack of means. As you know, it is women and children who take care of the goats and they generally do not have the means” [KII, CPV]. The two main diseases, PPR and *Pasteurellosis* are both very contagious and require vaccination. As explained by a key informant, while the PPR vaccine is covered by the State and the other is not, both vaccines are not always available. Several respondents explained that while they are aware that goats require regular vaccinations, the

households reserve investments into veterinarian services for larger ruminants, such as sheep or cattle. There are few veterinarians who provide access to vaccination services or access to the vaccines for purchase. Certain livestock associations, such as ARECAP in Fatick, provide access to vaccines purchased in bulk or to technical advisors who can train members on how and when to vaccinate their goats, but those outside an association are limited in their ability to access veterinarians or vaccines for their livestock herds. A key informant explained,

“We can say that women have access to veterinary care thanks to ARECAP because at the association level we have technical advisors in each department, they are livestock agents who have motorcycles, a package of drugs. For the cost, it is ARECAP which buys drugs in bulk, which it distributes to its groups and the doses are sold within the groups. So, with the money from the sale of these doses, the association buys medicines. ARECAP centralizes group purchases but there is a problem at this level because medicines are excessively expensive at the pharmacy level, and we are not allowed to buy directly from wholesalers without going through veterinarians. So, we first have to have a veterinarian who tries to work with us. So, accessibility to quality medicines at reasonable costs remains a problem and this encourages people to buy on the markets. Now, those who are not members of the association have downright problems accessing veterinary services” [KII, Association Coordinator].

3.1.2. Processing Goat Products

While men sometimes participate in certain livestock management activities, processing activities remain the domain of women. Such activities include processing goat milk for sale or transforming goat milk into different products, such as cheese or soap. One woman explained, “Goat's milk cheese is very good. I got into the habit of consuming it. On the other hand, others are not used to eating cheese and yet they know that it is a good food. We also use soap made from goat's milk” [FGD, Women].

However, these gender roles may vary from location, as explained by one key informant,

“Here in Dahra, it is women who are most active in the milk sector, which is quite the opposite in the Kolda region. There it is the men who practically manage the milk sector” [KII, APAFIL].

Those that engage in processing activities, such as making cheese or soap, also referred to having had access to training opportunities that taught the required technical skills. Those with training but without access to reliable electricity engage in soap making as it does not require refrigeration for preservation, as noted by one woman, “For the moment we can only work on soap, which does not require a cold chain for conservation” [FGD, Women]. Another woman described her experience,

“Personally, I like goat's milk. In fact, I often give it to my children because it is very nutritious. But, with farm work I no longer have time to milk the goats otherwise it has become a habit for me to milk the goats. We even use this milk to make soap. It was ARECAP that trained us on this. The soap does not require the use of a large quantity of goat's milk, plus it is very profitable economically. However, we do not rely too much on

transforming goat's milk into cheese because we do not even have means of preservation such as refrigerators” [FGD, Women].

While respondents expressed a desire to engage in more processing activities from goat milk, a lack of access to training or electricity are key constraints limiting women’s expansion into more processing activities. One woman cited a lack of training, “We want to process goat's milk but unfortunately, we do not have the required skills. We have not received any training for this” [FGD, Women], while another noted that a lack of refrigeration or electricity access limits their ability to preserve cheese or other types of products, “We also have a concern about preserving our products, especially milk. In the whole village, there are only four fridges and it's really minimal” [FGD, Women].

With respect to slaughtering goats for meat, one key informant explained that goats are a more productive livestock species than cows or sheep and are also more affordable at 25,000 CFA for a young goat compared to 50,000 CFA for a similar-aged sheep. This makes it possible to slaughter and consume or sell more goat meat compared to other livestock species. A key informant elaborated,

“We can slaughter up to 40 goats per day [during the week] and on Saturdays and Sundays, we can go up to 100 goats on average. Now compared to sheep, we can slaughter 20 sheep on ordinary days and 40 on [weekends]. Likewise for cattle, we can slaughter 6 for ordinary days and 15 or even 40 for [weekends]. Goats remain the most slaughtered in slaughterhouses...Goats are more productive. In one year, the goat can give birth twice and generally it is two or even three babies per birth” [KII, CPV].

Another explained that *dbitiers*³ in urban areas prefer to use goat meat received from slaughterhouses, where goats are slaughtered at higher rates than other livestock. One key informant explained that high slaughter rates of young female goats often lead to high rates of aborted fetuses, which should be curbed,

“However, it would be really nice if they stopped killing young females because we are losing a lot of fetuses because of it. We even introduced a decree prohibiting the killing of young sheep as well as young female goats but until now it has not come into force” [KII, Inspector].

3.1.3. Marketing and Sales

While women are largely responsible for managing goats and processing goat products, men are primarily responsible for managing the sale of goats at the market. However, men give the income generated from goat sales to women to manage and control. Often this income is expected to be used by women to support their husbands in meeting household expenses, such as children’s school fees, and there is sometimes less latitude for women to decide how to spend the income without agreeing first with her husband. One woman explained,

“Goats generally belong to women, but men are responsible for selling them. However, the income from this sales activity belongs entirely to [women] and we spend part of this

³ *Dbitiers* are those who braise meat and sell to customers.

income within the family, particularly on the education and health of the children and on food. Sometimes, we even offer part of this income to our husbands, especially when they have needs and do not have the means” [FGD, Women].

A man confirmed,

“Generally, goat farms are the responsibility of women, and they are the main owners, and the related income also belongs to them. Most of the time, they meet the financial needs of the family with this income such as school fees for their children, food for the family and even offer part of this income to their husbands” [FGD, Men].

Men typically manage goat sales, as described by one man, “because access to markets is more difficult for women” [FGD, Men]. Cultural norms limit women’s access to livestock markets as men are perceived as those who should be generating incomes for the household. However, such intrahousehold dynamics around decision-making and control over incomes regarding goat sales can vary by household. One man elaborated,

“For me everyone manages their own property and their own income, whether the man or the woman. In reality everything is discussed within the family. Me, for example, my wife even if she sells one of her goats, before doing anything with the money, she shows it to me first. On the other hand, other women will sell their goats, using the money from this sales activity without even their husbands knowing” [FGD, Men].

And another woman explained that often, while women can manage the income from goat sales, they often consult with their husband or spend the money on certain items for the family’s needs,

“Concerning goat farming, it is women and children who take care of the goats more. Women are the main owners. The income from the sale of goats belongs exclusively to them. Most of the time, this income is spent within the family, always with the consent of the husband. They use this income to pay their children's school fees and other necessary family needs” [FGD, Women].

Women cited benefits from their involvement with goat activities, particularly noting how their incomes enabled them to contribute to household expenses and improve their dietary diversity. One woman explained, “We help our husbands with the children's school fees thanks to income from goat breeding. Even in terms of food, our households consume both goat milk and processed products. I myself decorated my bedroom with this income” [FGD, Woman].

3.2 Climate Change and the goat value chain: tradeoffs and opportunities

The qualitative results also address the research questions, “*What risks does climate change pose to the goat value chain compared to other comparable key animal source food value chains?*” and “*What advantages or disadvantages does goat farming have in terms of climate resilience and other environmental trade-offs compared to other types of farming?*”

In general, many respondents considered goat raising as a durable and risk-adverse livelihood activity as goats are easier to raise, require less resources and investments, are less vulnerable to changing climatic conditions, and still produce milk and meat for both consumption and sale. One man explained the preference for raising goats as, “Goats are easier to raise than other domestic animals because they are hardier and more resilient to the vagaries of nature” [FGD, Men]. A key informant also explained, “But speaking of resilience, I think the goat is the most resilient small ruminant to climate change compared to the sheep. Indeed, the goat is resourceful and resistant and if left alone, it is able to consume aerial grass (small trees) while sheep and cattle are less able to do so.” [KII, Association Coordinator].

As climate change negatively affects agricultural production, a key livelihood source for rural households, participants described being able to rely on goat breeding and production as more resilient livelihood source to still generate an income during times of environmental stress,

“...[Climate change] impacts our food security to the extent that our food availability is reduced. Most of the crops that were grown in this locality are being abandoned given the scarcity of rain. So, we can only fall back on goat breeding. These constitute our main resource. Goats help us solve these dietary problems” [FGD, Women].

While goat farming is affected by climate change throughout the country, climate challenges are particularly acute in the pastoral system, where there are fewer livelihood alternatives for people to fall back on. Goat farmers in the agropastoral system have easier access to crop residues as an alternative feed source when pasture becomes scarce.

Existing goat breeds are perceived to be hardy against changing climatic conditions and still can reproduce more quickly than other livestock species to raise herds more effectively. One key informant elaborated,

“First of all, targeting the *Maradi* and *Sahelian* races is not a coincidence. These two breeds are very resilient to climate change and can adapt very quickly to local climatic conditions. Additionally, when grass is scarce, then the goat may have the ability to use aerial grazing [i.e. grazing on small trees]. Furthermore, these types of breeds are very prolific and reproduce very quickly. They have the capacity to have two litters in the same year” [KII, CNDN].

However, while goat breeding is considered a more climate resilient livelihood activity than other agricultural and livestock options, participants described the ways in which the negative impacts of climate change are affecting goat breeding and productivity. Changing climatic conditions are observed to affect available pastureland on which goats graze, which then reduces the available external food sources for goats. Certain invasive grasses (called *Mauritania*) are observed in the pastureland, which are harmful to goats, requiring herders to supplement the goat feed with higher quality, and often expensive, feed sources. In the event herders cannot afford to supplement goat diets, the goats become thin and sick more quickly and often either produce less (or no) milk or become diseased and die prior to being sold. A woman herder explained, “We also notice that the rainy season is becoming more and more variable. Moreover, this year, we recorded our first rains very early. For the last two years, the rainy season arrived late, and this affected our millet yields.

Even our goats were tired because the grass we used for pasture was becoming scarce. As a result, their food was lacking” [FGD, Women].

In summary, irregular rainfall and increasing temperatures are reducing available pastureland for goats to graze, requiring households to supplement goat diets with supplemental feeds, which are often very expensive. Attempts to increase cultivation of fodder crops as part of livestock development projects have been largely unsuccessful due to a variety of constraints to production including harsh climate conditions, limited availability of key inputs such as fertilizer and seeds and limited technical knowledge of how to breed and cultivate appropriate forage species (Eeswaran et al. 2022). Moreover, local production of formulated feed is limited in Senegal (ibid). As such, poor feed contributes to reduced milk productivity and constrains goats’ ability to reproduce quickly and healthily. One woman summarized these observations,

“The rains have become more and more irregular, and temperatures are increasing day by day. This has a negative impact on our goats because pasture is becoming rarer and even the small trees that served them as aerial grazing are starting to disappear, we hardly see them anymore. So, we are forced to feed them on our own. As another impact, we realize that the goats are no longer able to give birth at the right time. The quantities of milk are also reduced. Previously, when milking goats, you could get up to five liters per day but now this is no longer the case; we even struggle to get a liter” [FGD, Women].

As an adaptation strategy, women expressed wanting to produce more feed crops to supplement the goat diets, but climate change is also negatively affecting the production of two key fodder crops—cowpea and peanut. Women often do not have access to land to grow or expand options for high quality feed crops, which is a pressing limitation to improve goat productivity and quality of byproducts. In Fatick, for example, salinization of the land is a key problem. A woman explained,

“These climate changes are not without consequences. This has repercussions on agricultural yields as well as on goat breeding. Last year, due to a bad rainy season, we did not have enough grass to feed our goats and we recorded many deaths among them. So we had to buy livestock feed (‘Ripass’) to feed them and it was so expensive. We think this is all because of climate change. Likewise, the yields of peanut crops were not at all good, we could not even get peanut oil” [FGD, Women].

Feed quality does affect goat productivity and reproductivity, as explained by a key informant, “However, there is still an impact on production. In fact, when the goat is well fed, it can give birth three times a year. On the other hand, if she is not well fed then she may only give birth once or twice a year.” [KII, ANPROVBS]. Women goat herders also observed changes in goat reproductivity associated with variable climatic conditions, as described by one woman,

“Now what we see is that the goats are no longer able to reproduce like they used to. A goat gave birth several times and could even give birth twice a year, although today this is no longer the case. We note a lot of mortality among these small ruminants and even [spontaneous] abortions that we cannot always explain” [FGD, Women].

In addition to the challenge of insufficient feeds, climate extreme events, such as heat stress, also affect goat health directly by weakening the animals, their immune systems, and their ability to reproduce. One man explained how goats are affected by both the lack of feed and excessive heat,

“Last year, for example, there were many deaths of [goat] kids due to lack of mother's milk because their mothers were unable to feed properly due to insufficient quantities of grass, mainly due to a poor rainy season. We also note a lot of [spontaneous] abortions in goats and we suspect excessive heat as the main cause” [FGD, Men].

Participants describe employing or wanting to employ various adaptation strategies to offset the negative impacts of these changing conditions, but do observe that overall, goats require fewer adaptive strategies than other livelihood sources. One man explained,

“For goats, we are not developing many strategies to deal with climate change, other than purchasing livestock feed to supplement their diet. As you know, goats are very hardy and resourceful, they can adapt to any situation” [FGD, Men].

As previously mentioned, many participants described using ‘destocking’ as a technique to maintain the quality of their overall herd. One woman explained,

“Suppose I have fifteen goats, and I don't have any grass or fodder to feed them, then what I do most often is sell at least two goats. This will allow me to obtain at least 50,000 CFA. With this money, I can buy three bags of livestock feed (*Ripass*), which I will give to my goats while waiting for the grass to develop. These three bags can last with me because we must remember that goats are very resilient and are not very demanding” [FGD, Women].

In addition to selling goats to purchase better quality feeds, most participants noted that they do not store their feed or have the mechanisms to effectively store feed, rather relying on purchasing feed as needed. Exceptions to this were several goat herders who had received training from the livestock association, ARECAP in Fatik, to practice feed storage. One woman described,

“We are developing the forage storage and reserve strategy thanks to the training offered by ARECAP. You can even collect harvest residues, which you can keep carefully in bags and put them away. I remember last year I had up to fourteen bags. When there is no more pasture, you can clear them and feed your animals” [FGD, Women].

Participants also highlighted that by constructing sturdy enclosures, they can better protect the goats from rainfall, which is observed to increase the incidence of illness and disease. Several participants noted needing to strengthen these enclosures to better protect their herds.

3.3 Goat Consumption for Improved Nutrition

In response to the question, “*How does the consumption of goat products contribute to the diets of rural and urban communities compared to other foods of animal origin?*,” participants described the motivations and factors that shaped the ways in which men and women consume or prefer not to consume goat products, such as milk and meat, and how these products contribute to their diets.

Several men and women described consuming goat milk and preferring goat milk to other types of milk for its nutritional benefits. One woman explained, “I consume goat's milk and I really like it. It gives me a lot of energy” [FGD, Women]. Many participants described current diets in Senegal rely heavily on rice and high amounts of fat, which are believed to contribute to negative health outcomes. Perceptions of the “best” nutritional foods include millet and milk, which are common ingredients in traditional dishes. One woman explained,

“We cannot prove this, but we believe that consuming millet-based foods like *thiéré* and milk are the best foods for our health. For example, our parents, in their time, lived only on millet-based dishes like *thiéré*, *gniry mbouna*, *mboum*, *lakh* and yet they felt so good, had no health problems and were so active. On the other hand, today we encounter a lot of health problems, and we think that it is because of our consumption patterns, which have completely changed. We only eat rice, and we consume a lot of fat too” [FGD, Women].

However, healthier options, such as millet, are more expensive and less available than rice. Moreover, many young people do not know how to prepare traditional dishes or are aware of the benefits of consuming milk and millet. As a result of this lack of knowledge, as well as shifting food preferences, there is less interest in these food sources among younger people.

Research participants also highlighted that goats are a relatively easy ruminant to maintain, and thus it is preferable to keep goats for milk. An NGO representative observed,

“You know I am not a nutritionist but in terms of choice, we noticed that women chose goats much more than sheep because for them, the goat is much easier to manage than the sheep from the point of view of food. The goat is much more resourceful than the sheep. Goats are also much more prolific as they are capable of giving birth to twins or triplets. For goat's milk, I still saw certain communities who did not use it because of certain beliefs or cultural considerations. But I know that goat's milk and its meat are much more nutritious” [KII, NGO].

A man also explained, “I like both milk and goat meat. Everything is important in the goat...its milk, its meat, its skin, its manure, etcetera). Even its manure is much more resistant than that of the cow. His manure is very useful to us in our fields. On the management side, the goat is much easier to manage than the sheep” [FGD, Man].

Another factor that shapes participants’ perceptions and motivations for consuming goat products are cultural practices and beliefs, which vary in their influence. For example, one woman explained that goat milk was believed to convey intelligence and thus prioritized for newborns, “We even had the tradition of first giving goats milk to our newborns before mother's milk because it is considered that the goat has a high degree of intelligence” [FGD, Women]. Another participant explained that there were beliefs that goats milk transferred leprosy and thus was avoided,

“In fact, we have a lot to say, especially about goat's milk. You know traditionally, people said that goat's milk gave leprosy. In reality, this was not true. It was just a strategy of our ancestors. It was just a kind of belief that our parents instilled to prevent children from drinking goat's milk all the time, thus allowing the kids to grow up quickly. Once the goat

herd grew, parents used it to buy cows. The cow was for them a sign of wealth” [FGD, Men].

Food safety concerns also prevent more widespread consumption of milk products. Goat milk is typically unpasteurized and unrefrigerated which increases the risk of microbiological contamination (Leone et al. 2022). Other unsafe practices, such as unsanitary conditions during milk collection and processing, can introduce chemical and physical contaminants in goat milk (ibid). Several participants raised concerns about negative experiences consuming unpasteurized goat milk, which some women explained was not always a commonly understood or widely-used practice. One woman explained, “I personally don't like goat milk. By consuming it, I can spend a whole day scratching my skin, it makes me really uncomfortable. This may be because I'm not used to pasteurizing it” [FGD, Women]. Another woman in the same discussion further elaborated, “In reality, people often encounter these problems because they are not used to heating milk before consuming it. Additionally, people who consume processed milk do not experience these problems” [FGD, Women].

However, a common theme raised was that goats represent a key source of income for households and thus, men and women only slaughtered or consumed goats for specific celebrations. Almost all research participants explained that for households that raise goats, it is rare for them to slaughter their own goats, which are typically saved and sold for income or slaughtered only to celebrate a special occasion. One woman described,

“We can say that we actually consume goat meat only during festivals and ceremonies such as baptisms, weddings, during the circumcision of children, etcetera. We are really not used to eating goat meat without any ceremony. Instead, we prefer to sell the goat and use the money to pay for our needs” [FGD, Women].

A man also explained, “Generally, the meat we eat is bought at the market. Indeed, our goats constitute our portfolio, they allow us to obtain income and meet our family needs. So, we cannot afford to consume them constantly” [FGD, Men]. Compared to other sources of meat, goats represent a significant source of quick cash, so households prefer to keep them for sale instead of slaughter. One man explained, “Instead of slaughtering goats all the time, we prefer to use our chickens because a chicken costs a maximum of 3,500 CFA francs while the goat, which can cost up to 50,000 CFA francs, helps us for the most part time to resolve certain [financial] problems” [FGD, Men]. Another man explained that sometimes individuals are unaware of the benefits of goat milk, and therefore choose to sell it rather than consume it at home, “For milk, there are some who prefer to sell it instead of consuming it because they are not aware of the benefits of goat's milk” [FGD, Men].

3.4 Key Interventions to Strengthen Women's Empowerment, Climate Resilience, and Nutrition in the Goat Value Chain in Senegal

Participants also addressed the research question, “*What are the main interventions to strengthen women's empowerment, climate resilience and nutrition in the goat value chain in Senegal?*” Throughout the interviews and FGDs, respondents reflected on key interventions that would strengthen goat value chains, enabling men and women to better participate in and benefit from

their participation and contribute to strengthened climate resilience and improved nutrition. Several common interventions are presented here, and overall, such interventions focus on addressing gaps in current programming as well as addressing normative and structural barriers that limit women's empowerment, climate resilience, and nutrition in the goat value chain.

Several participants pointed to existing associations that promote women's participation and benefit from goat activities, particularly those focused on processing and marketing. A key informant summarized the activities of ARECAP, a livestock association in Fatick, that has built the capacity of their members – mostly women – to process goat milk into multiple products such as curds, cheese, soap, and milk, and meet the demand for these products. As explained by the informant,

“So this is to tell you that there really is a market there and there are even some who manage to market their cheese made from goat's milk in supermarkets, which is not the case for other types of cheese made from the milk of other animals. All this means that the goat industry has a certain specificity in terms of potential. Nutritionally, there are certain specific characteristics that make people much more inclined to goat's milk than to cow's milk. This is a remark made at the global level and scientific studies have even demonstrated it” [KII, Direction Elevage].

However, access to these associations is limited, as one key informant from such an association noted that they must keep their membership levels low due to budgetary constraints. In the same vein, others saw a need to form new cooperatives or associations to organize breeders into groups to leverage the collective agency of an association, as described by one key informant from the municipal level, “Goat farming has great potential in this area. It would be better to organize ourselves more to take full advantage of this potential” [KII, Prefet].

Other key areas of opportunity include interventions that address acute challenges along the goat value chain, such lack of access to feed and land to grow fodder, as well as other barriers that reduce benefits along the goat value chain. Multiple participants raised concern over the lack of access to adequate feed for their goats to maintain a healthy milk supply. One key informant explained, “The other problem concerns access to livestock feed. Households are often vulnerable and cannot afford to buy bags of feed all the time to properly feed their animals, hence the opportunity to develop or strengthen fodder cultivation” [KII, CNDN]. Access to land to expand feed crop production is limited for women who raise goats. A key informant highlighted this issue,

“Especially since it is women who practically manage the goats and they often do not have access to land to be able to develop fodder crops. Even those who have access to land, unfortunately do not have access to labor or agricultural machinery. So, there is work to be done to optimize the land that remains, taking into account the problem of climate change” [KII, Association Coordinator].

Another challenge to address is to expand access to vaccination efforts and veterinarians for goat breeders to ensure their herds are vaccinated against contagious diseases. One key informant explained, “At the national level, this program is managed by the Directorate of Veterinary Services. Therefore, it consists of increasing the vaccination coverage rate in small ruminants with

the aim of eradicating PPR within a few years. This is really important as there is too much mortality in goats, and this is mainly due to PPR” [KII, Direction Elevage].

Many pastoral areas of the country lack access to basic services, including extension and climate information services. Thus, goat farmers have little access to information about how climate change will affect their livestock including goats and what they can do to manage the risks. Multiple participants explained that there is a need to increase awareness of best goat herding, management, and processing practices. For one example, a key informant who works on projects to promote best goat production practices explained that there needs to be an increase in awareness of the income potential for selling goat milk, instead of the goat itself. She explained,

“...people have not understood that milk saves a lot of money, more than meat. Because milk creates regular and even daily income. There are still some who have understood this and who try to milk their goats every day at the same time. They also reduce production [herd size] because they will make an effort to feed the goats and subsequently they will realize that their goats are capable of making milk even though they did not believe in it” [KII, Association Coordinator].

One key informant explained that given key differences between goat rearing practices and support structures, including livestock associations, in Niakhar compared to Dahra, one opportunity could be to conduct field trips for herders to learn from one another, “We must do what we call knowledge transmission. Organize trips, arrange for Dahra herders to go to Niakhar to see what is happening there. There must be exchanges between breeders in these two areas, particularly in terms of milk processing and genetic improvement of breeds” [KII, Inspector]. Another raised the need for increased capacity building opportunities for herders and women to learn new techniques to process goat milk into new products and earn higher values from their activities,

“The other point that deserves to be strengthened is capacity building on how to process basic goat products. We had started carrying out activities on this and we even trained them on processing milk into ‘*Boudi Cosam*’ and cheese but there was still a lot to do. This is consequently due to the fact that we often favor consumption and leave marketing behind. Therefore, improving capacity building on the processing and conservation of products from the goat value chain could considerably help women” [KII, CNDN]

Another highlighted a need for programs and support to reach those who most need it,

“The minister is certainly taking action in this area, but he is not reaching the poorest. For example, instead of giving livestock feed to a breeder who has more than two hundred head, I prefer to give it to a breeder who has ten goats. Because someone who has two hundred goats has the means to buy their own feed, he can, for example, sell two goats and buy livestock feed. Currently, in stores, a bag of food costs 5,200 CFA. The 200 CFA constitute, in a way, the maintenance costs of the store” [KII, President of Livestock Sellers].

In addition to addressing acute challenges and structural and normative barriers, it is important for future interventions to consider key differences in motivations, access to resources, and capacity

among different social groups to fully participate in and benefit from goat value chain activities. A key informant highlighted differences ethnic groups in Senegal placed on cultural values for goats compared to other livestock species, and suggested different levers to motivate improvements in the sector for each,

“In fact, for a Serer, the goat is so important to him that he will prefer a goat instead of a cow. So it will be very easy to start the intervention because they already know the value of the goat. However, among the Fulani, there are certainly several opportunities because they have goats, sheep and cows, but for the Fulani, the cow represents a sign of wealth and personality. So to promote the development of goats in this locality, we will have to put in place a machine that works on the economic level, that is to say, in such a way that it is an income-generating activity to convince the stakeholders” [KII, APAFIL].

Several other key informants raised that needs for interventions vary by region, as there are different levels of access to and availability of resources for men and women to engage in and benefit from to promote best practices in the goat value chain. For example, one key informant from Niakhar explained, “Here in Niakhar, there are a lot of good things being done in the livestock sector. There is not a family in this area that does not practice livestock farming” [KII, Prefet] whereas a key informant from Dahra explained,

“The women of this locality are not too interested in exploiting goat milk unlike the women of Niakhar. Consumption alone is a problem. In fact, they are not used to it. Even when it comes to processing, they don't know much about it, apart from a few who are still lucky enough to take part in training. However, the knowledge resulting from these training courses is not popularized” [KII, CPV].

4 DISCUSSION AND CONCLUSIONS

These qualitative results shed light on the opportunities and bottlenecks in the goat value chain to strengthen women's empowerment, climate resilience, and improved nutrition from goat activities. The results of this study contribute to the literature by describing the gender dynamics surrounding goat management and the ways in which goat breeding can serve as an entry point to strengthen women's empowerment, climate resilience, and improved nutrition in Senegal.

Overall, consistent with the literature (Sow et al. 2021), we find that goat breeding and processing activities are primarily women's responsibility within the household. Goats typically require minimal investments and are low-maintenance ruminants. Goats also represent a key source of insurance for households, and are sold for immediate cash during times of shock or stress. As such, goats are important contributors to household resilience and enable men and women to navigate periods of economic stress. Goats are consistently referred to as a more durable and risk adverse source of livelihoods for those participating in this study, which aligns with previous studies (Assan 2021; Dubeuf et al. 2023). However, the negative effects of climate change are perceived to reduce overall productivity and health. Such effects include declining availability of pastureland and feed sources, requiring households to adapt by purchasing additional feed to supplement diets to maintain productivity. Men and women described employing adaptive techniques to offset these effects, but maintain that goats are still a hardier livestock species to raise compared to others.

While men are primarily responsible for managing the actual sale of goats at the market, women manage the incomes from goat sales. However, it is unclear the extent to which women have full latitude to make decisions around how this income is spent beyond expectations to contributing to household expenses or feeding the herd. For example, this study did not shed light on whether a woman could use income generated from goat sales to invest into other livelihood activities she is interested in pursuing. Additionally, we found that women are primarily engaged in goat milk processing activities, but this engagement is dependent on their access to opportunities to strengthen their capacity, access to markets, and access to necessary resources, such as electricity. In this study, those in Niakhar were more engaged in a diversity of processing activities, such as making cheese and soap, compared to those in Dahra, where participants were not engaged with a livestock association and primarily relied on the sale of milk or the whole goat for income. Those in Niakhar benefited from associations, such as ARECAP, and targeted capacity building and access to necessary resources that expanded their knowledge of and capacity to engage and benefit from processing activities. However, in both areas, a key factor constraining women's ability to expand processing options is the lack of reliable access to electricity and cold storage, which limits the types of products able to be processed from goat milk.

We found that goats are mostly reserved for sale and considered a *de facto* household insurance mechanism. Households rarely slaughter goats for their own consumption except for celebrations, preferring to sell goats and purchase other, cheaper meat options for consumption. While goats are primarily considered as a source of quick income, women describe consuming goat products, mostly milk. However, consistent with previous literature (Traoré et al. 2018) the consumption of goat products is primarily shaped by access to affordable food options, which vary by region and area, and perceptions and beliefs. Goat milk is commonly consumed, but typically milk is unpasteurized, posing safety risks. Greater efforts are needed to make producers and consumers

aware of common food safety practices and to expand access to processing and refrigeration equipment needed to increase the safety of milk products (Leone et al. 2022). Goat products are perceived to be less consumed by younger generations, who prefer cheaper food items, such as rice.

While this study explored various dimensions of the goat value chain in Senegal, it also raised important areas requiring further research. From this research, it is unclear to what extent women are involved in managing the sales of goat milk or other goat products and how these markets are established in Senegal. Future research should explore the market dynamics of goat products and how strengthening market linkages and women's access to these markets can further support women's empowerment objectives. Future research and programs should also explore the extent to which women can participate in and benefit from collective efforts to expand their engagement in higher value activities in the goat value chain (such as processing) and leverage wider access to markets to benefit from this engagement.

In conclusion, we find that the goat value chain offers entry points to strengthen women's empowerment, climate resilience, and improved nutrition. Future programming should address acute challenges as well as normative and structural barriers facing women that limit their ability to fully benefit from or expand their engagement in the goat value chain, or consuming goat byproducts to improve household nutrition. Acute challenges include limited access to vaccination services to maintain the health of their herd, declining availability of feed resources due to climate change, and lack of access to refrigeration options for expanding processing options. Normative and structural barriers include women's limited access to land or resources to invest in higher quality feed options to maintain the health and productivity of their herd, cultural beliefs that limit consumption of goat products, and lack of awareness of pasteurization techniques to improve the safety of goat milk products for consumption. Existing associations that provide access to services and support at scale for members are key entry points to engage with women herders, although additional research is needed to understand how best to engage with and strengthen such associations and their reach. However, despite existing challenges, goats remain a sustainable source of livelihoods and nutrition for women and their families and represent a promising entry point to strengthen overall empowerment and climate resilience.

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