International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 10, Issue 3, pp: 1-8, 2025
https://doi.org/10.55126/ijzab.2025.v10.i03.001 **http://www.ijzab.com**

Research Article

ASSESSMENT OF COW MILK COLLECTION SYSTEMS AND YOGURT PRODUCTION PROCESSES IN LOMÉ, TOGO

[1,2]*Kpassi SEME, [2]Atouga Yembliman DJAGBA, [1]Abdoulaye DZRAM, [1]Nanipo NADJAGOU, [2]Oyegunle Emmanuel OKE, [1,3]Wéré PITALA

[1*]Higher School of Agronomy, Department of Animal and Veterinary Sciences, University of Lomé ESA/UL, 01PO BOX: 1515 Lomé, Togo.
[2]Institut Togolais de Recherche Agronomique ; Centre de Recherche Agronomique Savane Humide, (ITRACRASH) Station de Kolokopé, BP : 01 Anié, Togo
[3]Department of Animal Physiology, Federal University of Agriculture, Abeokuta, Nigeria.

Article History: Received 19th March 2025; Accepted 22nd April 2025; Published 31st May 2025

ABSTRACT

Cow's milk is a good source of protein, calcium, and nutrients that are important for the development of the human body. A study was carried out among the "Kuubal" mini dairy stakeholders to evaluate the health quality of dairy products based on cow's milk. The methodology consisted of conducting surveys with 92 actors involved in the production and marketing chain of the sector as well as monitoring several yoghurt production cycles in the so-called mini dairy. The results showed that the breeding system of the breeders concerned was essentially traditional and extensive (84%). The typology of milking practices showed that most breeders (71%) carry out type III (dirty) milking. The relatively long collection time (252.1 ± 38.06 minutes) significantly influenced ($p < 0.05$) the pH of the milk received (6.51 ± 0.35) at the mini dairy. Analysis of the transformation process revealed that the current technique for processing cow's milk at the mini dairy is artisanal. The milk pasteurization scale (86.15 ± 5.63°C for 15 to 20 minutes) complies with the recommended standards. The dairy produces approximately 75 litres of yoghurt daily for local consumption while the mini dairy contributes to local nutrition and income, significant improvements in hygiene practices across the milk collection and processing chain are necessary to enhance the safety and quality of the final products.

Keywords: Breeding system, Cow's milk, Processing, Yoghurt quality, Togo**.**

INTRODUCTION

In West Africa, the local dairy sector was identified as one of the 14 sectors for which regional intervention is a priority (IRAM, 2010). Despite the enormous potential of this dairy sector, both in terms of supply and demand, its development faces numerous challenges, including a lack of investment and technical support, policies favoring the importation of powdered milk, and the low productivity of local cow breeds (Célie and Koen, 2019). In this context, it is crucial to implement actions aimed at promoting this sector. In some West African countries, the experience of mini dairies has been considered valuable in terms of intensifying livestock systems, boosting family cash flow, and securing product supply chains (Corniaux *et al*., 2005). Furthermore, the number of mini-dairies in West Africa has steadily increased over the past few decades (Doufils, 2010).

In Togo, only a few mini-dairies have been developed over the years. One notable example is the experience of the peasant organization "Amélioration et Développement des Exploitations Agropastorales (ADEPAP)", which has been involved in cattle farming and milk production since the early 1990s and has supported five groups. This organization has largely drawn inspiration from the mini dairy development strategies implemented in Sahelian countries (Corniaux *et al*., 2014). It is estimated that around

*Corresponding Author: Kpassi SEME, Higher School of Agronomy, Department of Animal and Veterinary Sciences, University of Lomé ESA/UL, PO BOX: 01 Anié, Togo. Email: semejoseh@gmail.com.

300 to 400 litres of milk are processed daily, potentially reaching up to 500 litres daily (Corniaux, 2018). However, the demand for milk and dairy products is increasing, particularly in Lomé, the capital of the Maritime region, where most consumers are concentrated (FAO, 2013). Despite this, due to the small size of herds and the low productivity of local cows, national production falls far short of meeting the population's needs. According to the FAO (2012), the consumption of local milk and its derivatives in Togo covers only 15 to 26% of the total population's dairy product needs. As a result, Togo relies heavily on imports to fill the gap. The FAO (2022) reports that Togo imported nearly 30,188.54 tons of raw milk and dairy products in 2020.Another issue is the significant seasonal variation in milk production and consumption. Production is low during the dry season and high during the rainy season, while consumption is high during the dry season and low in the rainy season (Corniaux *et al*., 2009). Thus, due to the lack of processing units, excess production is often wasted during periods of high production, as milk is a highly perishable product. Therefore, it is important to encourage the emergence of mini dairies in Togo to value local milk for sustainable use and reduce dependence on imported dairy products.

In 2020, the company "FOUTA FOOD," supported technically by the Togolese Institute of Agronomic Research (ITRA), set up a mini dairy in Lomé (Agoè-Cacavéli) that processes local cow's milk into yoghurt. This mini dairy thus serves as a model that could spur the emergence of new mini dairies in Togo. However, attention to the sanitary quality of dairy products is becoming increasingly important in developing countries, just as in developed countries (Tourette *et al*., 2002). As a result, the entire milk production and processing chain must be systematically and rigorously controlled due to the potential health risks that milk and its products can pose to human health. This study aimed to evaluate the sanitary quality of dairy products made from cow's milk in Togo.

MATERIALS AND METHODS

Study Areas

This study was conducted at four (04) levels from April to September 2022. First, in dairy cattle farms and milk collection points located in the Zio prefecture (Maritime region) and the Haho prefecture (Plateau region); secondly, at the "Kuubal" mini dairy of the FOUTA FOOD Company, which represents the only mini dairy located in Lomé, the capital of Togo; and finally, at yoghurt sales points located in the city of Lomé and its surrounding areas.

The "Kuubal" mini dairy, created in 2020, aims to better value the milk produced by farmers through processing and marketing. It processes raw cow's milk into dairy products (firm yoghurt, couscous yoghurt, dègué). Today, it operates as a cooperative. The production unit is subdivided into two compartments: one for thermal treatment and one for packaging. For this study, certain localities within the Zio and Haho prefectures were targeted. This area enjoys a subequatorial climate with two rainy seasons, the duration of which varies from March to mid-July for the main rainy season and from mid-September to November for the short rainy season. Precipitation varies from 800 mm to 1,600 mm per year, with an average temperature ranging between 20 and 30°C (FAO, 2013).

Table 1. Surveyed Stakeholders.

Stakeholders	Number of Participants	Percentage (%)
Dairy cattle farmers	45	49
Fresh milk collectors	10	11
Mini dairy personnel	2	2
Yogurt distributors	35	38
Total	92	100

Data Collection Method

Data were collected through surveys in the form of interviews with the various stakeholders in the dairy sector, observations made during visits, and by following several yoghurt production cycles at the mini dairy. These data allowed for the characterization of the sector, including the classification of dairy cattle farms based on the methodology used by Seme *et al*. (2016a) and the typology of milking practices based on that of Tournette *et al*. (2002) and adapted by Seme *et al*. (2015). In this typology, three types of milking practices were distinguished: Type I "clean," Type II "correct," and Type III "dirty." The sex ratio (Number of cows per bull) was calculated following formula:

Sex ratio = Number of cows / Number of bulls **(1)**

The financial data collected were used to calculate the gross margin of yoghurt using the following formula:

Gross margin = Total sales – Total expenses **(2)**

Statistical Analysis

The collected data were processed by calculating percentages, means, and standard deviations using the statistical software GraphPad Prism version 8. The results were expressed as percentages and means ± standard deviation. An ANOVA test was used to assess the statistical significance of the results at a 5% significance level.

RESULTS AND DISCUSSION

The dairy cattle farmers involved in this study were all men (100%) with at least 5 years of experience (84.44%) (Table II). They milked between 10 and 30 litres of milk daily (Table III), with an average sex ratio of 22.44 ± 19.86 (Table IV) and daily milk productivity of 1.40 ± 0.45 litres of milk per cow (Table V). The most common milking practice was Type III (dirty) milking, practised by 71% of the farmers.

The milk collection process is led by a chief collector who defines the collection routes for each milk collector. Each collector is responsible for a network of 2 to 4 villages, which they visit daily. Milk is collected early in the morning, between 6:00 AM and 8:00 AM. The milk takes 252.1 ± 38.06 minutes, or more than 4 hours, to reach the mini dairy. The daily amount of milk collected by each collector ranges from 25 to 50 litres during low-production periods and from 75 to 100 litres during peak-production periods. The milk is collected in 25-litre polyethene containers, transported by motorcycle to collection points, and then brought to the mini dairy in Lomé by car at ambient temperature (25 °C). During low production periods, the price of milk at the farm is 200 CFA francs per litre, compared to 140 CFA francs per litre during peak production periods; however, the price of milk remains constant at 400 CFA francs per litre at the mini dairy.

Table 2. Socio-professional Characteristics of the Dairy Farmers Surveyed Last Colon Proportions (%).

Socio-professional Characteristics	Number of Farmers (N=45)	Proportions (%)
Gender		
Male (1)	45	100
Female (2)	0	0
Marital Status		
Married (3)	*30*	66.67
Single (4)	*9*	20.00
Other (5)	*6*	13.33
Secondary Activity		
Agriculture (6)	35	77.78
Livestock farming (7)	2	4.44
Commerce (8)	8	17.78
Educational Level		
None (9)	30	66.67
Primary (10)	7	15.56
Secondary and above (11)	8	17.77
Experience in the Activity		
Less than 5 years (12)	7	15.56
5 years and more (13)	38	84.44

Table 3. General Characteristics of the Dairy Cattle Farms Surveyed.

Criteria	Number of Units (N=45)	Proportions (%)
Existence of a Stable		
Yes, but Traditional Improved (1)	0	0
Yes, but Traditional (2)	9	20
No (3)	36	80
Composition of the Feed		
Exclusively Grazing (4)	3	6.67
Grazing + Supplementation (5)	36	80
Grazing + Supplementation + Complementation (6)	6	13.33
Veterinary Care Responsibility		

Criteria	Number of Units (N=45)	Proportions (%)
Farmers (7)	27	60
Veterinarians occasionally (8)	18	40
Veterinarian only (9)	0	0
Existence of Zebu Cows		
No (10)	7	15.56
Less than 20 (11)	33	73.33
20 or more (12)	5	11.11
Types of Cattle Groups		
Zebu (13)	28	62.22
Crossbred (14)	15	33.33
Taurine (15)	2	4.44
Average Daily Milk Production (liters)		
10 liters or less (16)	3	6.67
Between 10 and 30 liters (17)	25	55.56
30 litres or more (18)	17	37.78

Table 4. Herd Composition by Localities.

Localities Concerned	Average Number of Cattle per Unit	Average Number of Cows per Unit	Sex Ratio
Haho (n=31)	91.58 ± 50.29a	39.68 ± 24.91a	27.41 ± 21.78a
Zio (n=14)	47.93 ± 22.32b	21.5 ± 14.65b	11.43 ± 7.05b
Average (N=45)	78.00 ± 47.85	34.04 ± 23.63	22.44 ± 19.86

Note: Values with different letters in the same column are significantly different ($p < 0.05$). UE = Production Unit, Sex Ratio = Number of cows / Number of bulls.

Table 5. Dairy Performance of the Dairy Cattle Farms Surveyed.

	Parameters			
Localities	Average Number of Cows Milked per Unit	Daily Milk Production (Liters/Unit)	Milk Productivity (QL*) (Liters/Cow/Day)	Average Lactation Duration (Months)
Plateau Region (31)	22.26 ± 9.10a	28.10 ± 12.21a	1.21 ± 0.25a	5.79 ± 0.68
Maritime Region (14)	10.50 ± 5.00b	17.29 ± 7.36b	1.88 ± 0.52b	5.92 ± 0.73
Average (N=45)	18.60 ± 9.70	24.73 ± 11.97	1.40 ± 0.45	5.83 ± 0.69

Note: Values with different letters in the same column are significantly different ($p < 0.05$).
QL = Milk Quantity per Day per Cow, UE = Production Unit.*

Table 6. Temperature and pH of Cow's Milk from Milking to the Mini Dairy

	Temperature	pH
At milking	34.51 ± 1.05a	6.75 ± 0.05a
At the mini dairy	31.03 ± 0.77a	6.51 ± 0.35b

Note: Values in the same column with different letters are significantly different ($p < 0.05$).

Table 7. Prices of Yogurt from the "Kuubal" Mini Dairy

Product Type	Container Size (ml)	Price at the Mini Dairy (CFA)	Price at the Market (CFA)
Firm Yogurt	250	250	300
	500	500	700
Dèguè	250	250	300
	500	500	700
Couscous Yogurt	250	250	300
	500	500	700

Table 8. Gross Margins for Each Type of Yogurt

	Yogurt Type		
	Firm Yogurt	**Dèguè**	**Couscous Yogurt**
Charges A (CFA)	69,350	82,350	84,650
Sales B (CFA)	100,000	120,000	120,000
Gross Margin (B-A) per 100L (CFA)	30,650	37,650	35,350
Gross Margin (B-A) per 1L (CFA	306.5	376.5	353.5

A decrease in both temperature ($p > 0.05$) and pH ($p < 0.05$) were observed from milking to the mini dairy (Table VI). The yoghurt production cycle at the mini dairy is summarized in Figure 4. The produced yoghurt is transported to sales points and/or sold directly to consumers at the mini dairy (Figure 5) at 250 CFA francs for 250 ml of the dairy product (Table VII). A gross margin of 350 ± 25 CFA francs is obtained for each dairy product (Table VIII). The study identified two (02) systems of dairy cattle farming: traditional (84%) and improved traditional (16%). Despite the study being conducted in both the Haho and Zio prefectures, the findings are similar to those reported by Djabangou (2021), who studied the state of dairy cattle farming in the Maritime region of southern Togo. Djabangou found that traditional and improved traditional dairy farming represented 71% and 20%, respectively. Additionally, Adanléhoussi and Adoméfa (2004) reported that the extensive traditional dairy farming system was the most commonly practised in Togo, accounting for 96% of the herds. On the other hand, Seme *et al*. (2016b) observed that traditional and improved traditional systems represented 39.4% and 38.2%, respectively, which could be due to their study being conducted only in areas with semi-modern farms.

In both prefectures surveyed, the herds consist exclusively of local breeds, dominated by zebu cattle (Goudali, White Fulani, and Red Fulani), which make up 62% of the herds. No high-performance foreign breeds were introduced, and breeding practices were unregulated, meaning genetic improvement was non-existent (Seme, 2017). Furthermore, the livestock feed primarily consists of natural pasture without supplementation (87%), and veterinary intervention is rare, with animals typically receiving care once a year. These farming conditions do not fully exploit the productive potential of the animals (Kassa *et al*., 2017). The average herd and cow numbers in farms in the Plateaux region are statistically higher than in the Maritime region. This may be explained by the better forage potential in the Plateaux region (Kassa *et al*., 2017). The higher daily milk production in farms in the Plateaux region is mostly due to the greater number of lactating cows (22.26 ± 9.10 cows) rather than their productivity (1.21 ± 0.25 litres). Chatellier (2020) noted that in West Africa, dairy production is largely driven by the increase in the number of animals raised in agro-pastoral zones, with only a small share attributed to improvements in herd productivity.

From a hygiene perspective, the milking practices were classified as type III (dirty) for 71% of the surveyed farmers. This classification is similar to that found by Seme *et al*. (2015) in the Maritime region, where 66.67% of farmers practised type III (dirty) milking. In the farms surveyed, milking is done manually outdoors (100% of cases), and milk is collected in calabashes or plastic cups, which are often inadequately cleaned (66% of the surveyed farms). Moreover, 90% of the farmers do not wash their hands before milking. Milk collection is carried out by individuals who do it as a secondary activity, and no formal milk collection structure is identified in the localities. A study by the FAO (2017) also showed that raw milk collection circuits in Togo are informal. The actors involved are primarily young men, mostly motorbike taxi drivers (87%), who have no formal training in milk collection. These individuals handle the payment and transport of the milk from the farm to the collection point (Wahala). The collection system is somewhat organized, and a chief collector oversees the operation, acting as an intermediary between the farmers and the mini dairy. Each collector has a network of 2 to 4 villages to visit daily within a 25 km radius of the collection point (Wahala)..

However, poor road conditions, especially during the rainy season, create a significant barrier to milk collection. Wahala was chosen as the collection centre due to its capacity to produce up to 150 litres of milk per day during the dry season and over 300 litres during the rainy season. The milk collection containers, particularly the 25-liter polyethylene cans, are often poorly designed with small openings, making them difficult to clean and prone to bacterial contamination (Broutin and Goudiaby, 2021). The use of larger stainless-steel containers with wider openings could address this issue. Moreover, mixing milk from different farms at the collection point (Wahala) is an unhygienic practice that could lead to the contamination of high-quality milk with lower-quality milk (Célie and Koen, 2019). Similar findings were reported by Djabangou (2021) in the Maritime region.

The milk's average temperature and pH values immediately after milking were 34.51 ± 1.05°C and 6.75 ± 0.05, respectively. Similar values were reported by Seme *et al*. (2015) in southern Togo, with temperatures of 33.96 ± 1.25°C and pH levels of 6.90 ± 0.11. However, a significant variation ($p < 0.05$) was observed between the pH values immediately after milking (6.75 ± 0.05) and those measured at the mini dairy (6.51 ± 0.35). This variation could be due to the relatively long time (252.1 ± 38.06 minutes) between milking and the arrival of milk at the mini dairy, compounded by poor hygiene practices (71% of milking was dirty). The time taken for the milk to reach the mini dairy, averaging more than 4 hours, may affect the milk quality. Goudiaby *et al*. (2019) reported that the time between milking and processing should not exceed 4 hours at ambient temperature (25°C) to prevent milk spoilage. Therefore, equipping a vehicle with refrigeration to transport milk from the collection point to the mini dairy is a recommended solution.

The price of milk is sensitive to seasonal variations in milk production. During the dry season (December to March), when forage is scarce and of low nutritional value, milk production is low, and the price of milk at the farm is 200 CFA francs per litre, compared to 140 CFA francs per litre during peak production periods (April to July and September to November). However, the price of raw milk at the mini dairy remains constant at 400 CFA francs per litre, regardless of the season. The milk processing technology at the "Kuubal" mini dairy is artisanal, as is common in most mini dairies in West African countries. The pasteurization method currently used at the mini dairy is based on the "bain-marie" technique, typical of artisanal dairies. This method is chosen because it is easy to implement and requires less equipment. Several authors have reported that the same technique is used in mini dairies in Burkina Faso (Hamadou and Sinon, 2005; Broutin and Goudiaby, 2021) and Senegal (Broutin and Goudiaby, 2021). The average pasteurization temperature at the "Kuubal" mini dairy is 86.15 ± 5.63°C, maintained for 15 to 20 minutes. This is consistent with the recommendation by Gret and Iprolait (2020) for mini dairies using the "bain-marie" technique (85°C for 20 minutes). However, the "Kuubal" mini dairy lacks the necessary equipment to conduct quality tests on incoming milk, such as acidity, antibiotic detection, and density tests, which are essential for ensuring the safety of the products. These tests verify that no other liquids have been mixed with the raw milk and ensure the milk's sanitary quality (Broutin and Goudiaby, 2021). Moreover, the mini dairy's average production capacity (150 litres of milk per day) is limited by the lack of infrastructure, equipment, expertise and the irregularity of milk supply due to seasonal production. From April to September 2022, the mini dairy collected and processed 12,323 litres of raw milk (75 litres per day), representing only 50% of its production capacity. This is comparable to mini dairies in Mali (Badinko and Koumentou), which collect and process between 60 and 80 litres of milk daily (Tassou *et al*., 2015). However, this is much lower than mini dairies in Burkina Faso, Mali, and Senegal, which collect and process more than 500 litres of milk daily (Corniaux *et al*., 2014). The mini dairy provides yoghurt made from raw cow's milk to the Lomé population. The yoghurt is marketed primarily by Nigeriens (35%), Togolese (34%), and Guineans (23%). The sale of these products allows the mini dairy to generate significant profits, with gross margins of 26,250 CFA francs per day. Specifically, the gross margin per litre of raw milk is 306.5 CFA francs for firm yoghurt and 376.5 CFA francs for whipped yoghurt.

CONCLUSION

This study has provided an overview of the current functioning of the "Kuubal" mini dairy. In summary, the livestock farming system of the "Kuubal" cooperative members, who supply milk to the mini dairy, is essentially a traditional extensive system where natural grazing is the primary feed source, without any supplementary feeding. Milk collection is carried out by individuals who are untrained in this activity, leading to questionable milk quality. Additionally, the long collection time (more than 4 hours) and the lack of hygiene during milking negatively affect the milk quality. The analysis of the milk processing system shows that the current pasteurization technique is artisanal, using the "Bain-Marie" method. This technique is less demanding in terms of equipment and easy to implement. The pasteurization schedule complies with the recommended standards. The mini dairy processes 75 litres of cow's milk daily into yoghurt (i.e., 50% of its production capacity) and generates an average profit margin of 340 CFA francs per litre of milk processed. This mini dairy provides the population with a range of dairy products made from local cow's milk. The distribution of these yoghurts is primarily carried out by individuals from Niger, Togo, and Guinea. At this scale, several actions remain to ensure the quality of the dairy products available to the population.

ACKNOWLEDGEMENTS

We want to express our gratitude to Mr. El Hadj BALDE Amadou Oury Bah, the "Kuubal" mini dairy manager, for allowing this study to be carried out in their processing unit

and for his moral and financial support. Our thanks also go to all the stakeholders in the dairy sector for their willingness to answer our questions.

CONFLICT OF INTERESTS

The authors declare no conflict of interest

ETHICS APPROVAL

Not applicable

AI TOOL DECLARATION

The authors declares that no AI and related tools are used to write the scientific content of this manuscript.

DATA AVAILABILITY

Data will be available on request

REFERENCES

Adanléhoussi A., Adoméfa K., (2004). *Report on the Workshop Presenting the Results of Research on Improving the Dairy Sector in Togo*, ITRA and CIRDES, 27 p.

Broutin C., Goudiaby M.C(2021). *Transforming Local Milk in West Africa: Processes and Key Development Factors for Mini Dairy Farms*, Editions du Gret/Éditions Quæ, Practical Guide, 272 p. https://www.alimenterre.org/system/files/2022-04/GP-31_Transformer-le-lait-local-en-AFO_WEB.pdf.

Célie T., Koen V. T. (2019). *The Local Milk Sector in West Africa: A Promising Entrepreneurial Sector*, Veterinarians without Borders, Report, 16 p. https://veterinairessansfrontieres.be/wp-content/uploads/2020/05/202005_Local-milk-WA_summary.pdf.

Chatellier V. (2020). *The Dependence of West Africa on Dairy Product Imports*. INRAE Animal Productions, 33(2), 125-140, https://productions-animales.org/article/download/4027/13255/32426.

Corniaux C., Duteurtre G., Dieye P.N. Poccard Chapuis R., (2005). *Mini Dairy Farms as a Model for Organizing Dairy Sectors in West Africa: Successes and Limitations*, *Revue d'élevage et de médecine vétérinaire des pays tropicaux*, 58 (4). DOI: https://doi.org/10.19182/remvt.9918.

Corniaux C., Alary V., Cloarec M. (2009). *The Role of Livestock in the Monetary Economy of Households and the Vulnerability of Agro-Pastoralists in the "Office du Niger" Zone (Mali)*. In: Sixteenth Meeting on Ruminant Research, INRA. Paris: Institute of Livestock, 341-344. ISBN 978-2-84148-812-4. 16, Paris, France, December 2–3, 2009. Communication with proceedings. https://openknowledge.fao.org/server/api/core/bitstreams/3620ee11-79f9-4e51-b5d8-1bcb82d0d4c9/content

Corniaux C., Duteurtre G., Broutin C. (2014). *Dairy Sectors and Livestock Development in West Africa: The Rise of Mini Dairy Farms*, Paris, Karthala, 220 p. https://agritrop.cirad.fr/574407/.

Corniaux C. (2018). *State of Dairy Sectors in the 15 ECOWAS Countries, Mauritania and Chad*, Annex 13: Togo Sheet, 13 p.

Djanbangou P. (2021). *State of Dairy Cattle Farming in the Maritime Region of Southern Togo*. Master's Thesis in Animal Production Sciences, Higher School of Agronomy, University of Lomé (ESA /UL), 50 p. https://www.memoireonline.com/09/22/13123/m_Etat-des-lieux-de-l-levage-des-bovins-laitiers-dans-la-rgion-maritime-au-Togo3.html

Doufils A., (2010). *Analysis of the Rural Mini Dairy Model in Mali: Defining Success Factors and the Role of Mini Dairy Farms in National Dairy Development*, 16. http://www.interreseaux.org/IMG/pdf_Synthese_de_l_etude_mini_laiteries_au_Mali.pdf;

FAO. (2024). FAOSTAT Database, available at www.faostat.org, accessed on January 15, 2012. https://www.fao.org/faostat/

FAO (2013). *Fourth National Agricultural Census (2011–2014)*, Ministry of Agriculture, Livestock, and Fisheries (MAEP), Agricultural Statistics Directorate, 51 p., 2013. http://www.fao.org/3/a-bs651e.pdf

FAO, (2017). *Review of the Cattle/Meat and Milk Sectors and the Policies Affecting Them in Togo*, 76 p. https://www.fao.org/family-farming/detail/en/c/1068344/

FAO. FAOSTAT Database, accessed on August 25, (2023), available at www.faostat.org, accessed on January 21, 2024, 2022. https://www.fao.org/faostat/

Goudiaby M.-C., Broutin C., Petitdan M., Faye M.C. (2019). *Guide to the Dairy Collector Profession: Starting and Developing a Milk Collection Activity*, Gret, AVSF, Ministry of Livestock and Animal Production, Dakar, 84 p., https://agritrop.cirad.fr/597139/7/Rapport%20Cirad%20Impact%20Lait-MGV%20Final%208%20dec%202020%20ENG%20FV.pdf

GRET, IPROLAIT. *Guide to Good Dairy Hygiene Practices: Mastering the Quality of Dairy Processing in Burkina Faso*, Nogent-sur-Marne, Gret, 114 p. 2020. https://gret.org/wp-content/uploads/2021/12/Guide-Bonnes-Pratiques-dhygiene-lait.pdf

Hamadou S., and Sanon Y. *Bibliographic Synthesis on Dairy Sectors in Burkina Faso*. Working Paper (03), 2005. https://catalog.ihsn.org/citations/43364.

IRAM. *Case Studies on Vulnerability and Adaptability of Livestock Farmers to Events in the Commune of*

Tessékré, Senegal. Research and Development Methods Institute (IRAM), 105 p., 2010. https://www.fao.org/4/i3084e/i3084e17.pdf

Kassa K.S., Ahounou S., Dayo G.K, Salifou C., Issifou M.T., Dotché I., Gandonou P.S., Yapi-Gnaoré V., Koutinhouin B., Mensah G.A., Adbou I. (2017). *Milk Production Performance of Cattle Breeds in West Africa*n *International Journal of Biology Chemical Science*, 10, 2316-2330. 2017. https://www.ajol.info/index.php/ijbcs/article/view/154919

Seme K., Pitala W., Kulo E.A., Zongo M., Boly H., and Gbéassor M. (2016). *Study of Dairy Cattle Farming Conditions and the Possibilities for Introducing Artificial Insemination in Togo*, RASPA Vol. 14, n°1-2, 23-29, 2016a.

Seme, K., Pitala, W., Osseyi, G. E. (2015). *Nutritional and Hygienic Quality of Raw Milk from Lactating Cows in the Maritime Region of Southern Togo*. European Scientific Journal, 11(36). https://eujournal.org/index.php/esj/citationstylelanguage/get/apa?submissionId=6773.

Seme K., Pitala W., Kotoe M.D.(2016). *Challenges in the Production of Local Milk in Togo*. RASPA Vol.14 N01-2, 3-9, 2016b.

Seme K, (2017). *Improvement of Bovine Fertility through Artificial Insemination in Southern Togo*. Doctoral Thesis, Higher School of Agronomy, University of Lomé, 161 p. 2017. https://d-ist.univ-lome.tg:8082/opac_css/index.php?lvl=notice_display&id=6299.

Tassou Z., Aboudou F., Soule B. (2015). *Support for the Process of Participatory and Cross-Cutting Capitalization of Experiences in Milk Collection and Marketing*, Cross-sectional Analysis of Experiences from Mali, Senegal, Mauritania. PowerPoint Presentation, 18 slides. https://pmc.ncbi.nlm.nih.gov/articles/PMC9656659/.

Tourette I., Messad B., Faye S. (2002). *Impact of Milking Practices on the Sanitary Quality of Camel Milk in Mauritania*. Rev-Élev-Méd-Vét-Pays Trop., 55 (3): 229-233. https://revues.cirad.fr/index.php/REMVT/user/setLocale/en_US?source=%2Findex.php%2FREMVT%2Farticle%2Fview%2F9827%3FarticlesBySameAuthorPage%3D5.