

Assessment of Dairy Production and Milk Supply Systems in the Peri-Urban Area of Bamako, Mali

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Abstract :

Milk production in the peri-urban areas of Bamako has grown significantly in recent years, driven by the emergence of numerous dairy farms and milk collection centers. Despite this progress, information on cattle production systems remains scarce and fragmented. This study analyzes the dairy sector and milk production systems in the peri-urban zones of Bamako by compiling data on herd management, feeding practices, milk yield, collection, distribution, and marketing. Data were collected from dairy farms and milk collection centers located within a 50 km radius along the five main national highways leading to Bamako (Sikasso, Segou, Kayes, Koulikoro, and Guinea–Conakry axis). Questionnaires were designed and deployed using KoboCollect, and information was gathered from participating farms and collection centers. Bamako–Segou axis recorded the highest production of farms with 939 tons, while the Bamako–Kayes axis reported the lowest volume, with 151 tons. Regarding dairy farms, data on cattle herd sizes and feeding practices were collected. A total of 380 dairy farms were identified, of which 211 responded to the questionnaire. The Bamako–Segou and Bamako–Guinea axis accounted for the highest numbers of respondents, with 131 and 123 farms, respectively. Furthermore, a total of 16 milk collection centers were identified in the peri-urban area of Bamako, including five located along the Sikasso axis, five along the Segou axis, three along the Guinea axis, two along the Kayes axis, and one along the Koulikoro axis. Collectively, these centers handle an annual milk collection volume of 3,495 tons.

Keywords : Cattle breeding, dairy farms, Feeding systems, milk collection, milk production.

1. Introduction

Milk is an essential component of the Malian diet and plays a major role in both economic and social exchanges. Its importance extends across several dimensions nutritional, economic, and trade-related.

From an economic standpoint, milk production and trade represent significant sources of income and foreign exchange. Large milk-producing countries derive substantial benefits from international trade (Diallo, 2018). However, in many developing countries, including Mali, domestic milk production remains insufficient, leading to high levels of imports from developed countries (Corniaux, 2013). For rural households, milk is also an important source of monetary

income. Some farmers rely almost exclusively on the sale or barter of surplus milk to meet their daily needs (Duteurtre et al., 2020).

Mali ranks as the leading livestock-producing country in the West African Economic and Monetary Union (WAEMU) and the second largest in West Africa. The country's milk production comes 98% from traditional livestock systems and only 2% from semi-intensive, sedentary peri-urban systems (Diallo, 2018). While Mali possesses vast and diverse pastoral resources, their uneven geographical distribution has historically sustained nomadic and transhumant livestock systems (DNPIA, 2015 ; Coulibaly, 2008).

In recent years, a growing peri-urban livestock system has emerged in response to increasing urban demand for dairy products, driven by rapid urbanization and population growth. This system combines individual and collective initiatives, often involving semi-intensive or intensive production practices. Nevertheless, it faces numerous constraints related to production, marketing, processing, and consumption (Coulibaly, 2008).

Dairy farming in Mali remains predominantly extensive and transhumant, involving multiple species such as cattle, goats, sheep, and camels (Pradere, 2007). Urbanization has, however, reshaped the supply and demand for animal products particularly meat, leather, and milk through both increased production and higher imports (Coulibaly, 2008).

Despite Mali's high livestock potential, imported powdered milk accounts for over 90% of milk consumption in the capital (Pinaud, 2008). Average milk consumption per person in the region of Segou (Mali) is estimated at 60 kg/year, which exceeds earlier FAO estimates (45 kg/year/person) but remains below the FAO-recommended level of 62 kg/year/person (FAO, 2004). Consumption levels, however, vary widely: half of the population consumes less than 25 kg/year, two-thirds consume less than 50 kg/year, while about one-fifth consume more than 100 kg/year (Corniaux et al., 2005).

Consumption patterns also differ by ethnic group. Populations of pastoral origin, such as the Peul and Songhai, consume much more milk (89 and 60 kg/year/person, respectively) than groups such as the Bozo, Mossi, and Bobo (9, 20, and 21 kg/year/person) (Corniaux et al., 2005). Overall, Mali imports over 50% of its dairy products, a proportion that rises to 90% in urban areas and up to 95% in Bamako (Poccard-Chapuis et al., 2007).

Although Mali's national herd is among the largest in West Africa estimated at 13,234,158 head of cattle in 2022 and 13,631,181 in 2023 (DNPIA, 2022 ; DNPIA, 2023) and milk production increased from 687,012 tons to 707,622 tons, this still falls short of national demand. Consequently, the local milk valorization sector is expanding rapidly. Mali remains the largest milk producer in the WAEMU zone, followed by Niger (667,002 tons annually) (DNPIA, 2021).

Today, urban and peri-urban dairy farms are increasingly characterized by modern, intensive production systems, requiring higher levels of investment than traditional agropastoral farms (Duteurtre, 2004). Nevertheless, data on these emerging systems remain scarce (Duteurtre and Corniaux, 2013), particularly in the peri-urban areas surrounding Bamako.

- This study aims to provide a comprehensive overview of dairy farming, milk production, and distribution patterns in Bamako peri-urban areas.

2. Methodology

We first developed a questionnaire in the form of an inventory sheet, which was deployed using KoboCollect. It was then administered to stakeholders in the dairy sector (farmers and milk collection centers) through structured question-and-answer interviews conducted with each stakeholder. The data collection software KoboCollect was installed and configured on smartphones following the methodology described by (Ahmed et al., 2020). This tool enabled the collection of both quantitative and qualitative data related to milk production, cattle breeding systems, and livestock feeding practices. The study targeted cattle farms and milk collection centers located within a 50 km radius along the five main national road axes leading to Bamako. Geolocation data (X and Y coordinates) were automatically recorded and later used to create a geographical distribution map of the identified farms along these axes, using the QGIS mapping software. The configuration and use of QGIS followed the approach described by Friendly and Denis (2006). Data collection was conducted from August 2022 to August 2023, covering a full year of observation.

3. Results and Discussion

3.1- Mapping of Dairy Farms in the Peri-Urban Area of Bamako

The figure 1 below shows the geographical map of the different farms that have been identified within a radius of 50 km on the five-road axis leading to Bamako.

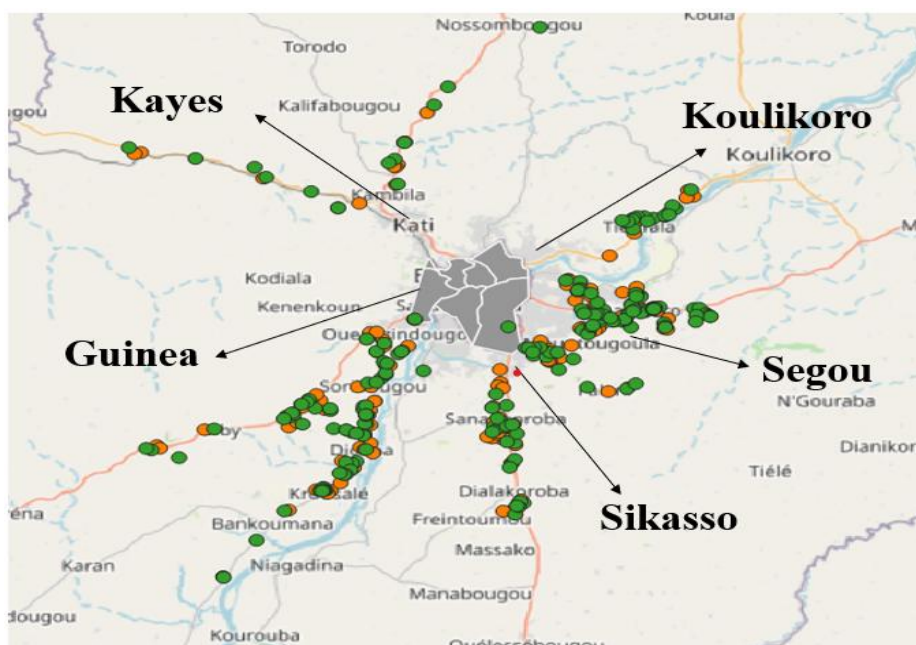


Fig.1. Global Map of Identified Farms along the Different Axis (green = "responding farms" and orange = "non-responding farms" to the survey questionnaire"). **Map scale : 1: 998647**

3.2- Overall size and distribution of livestock

The 211 farms respondents have a total of 7,733 cattle (calves, heifers, bulls and cows, whether they are lactating or not) , which represents an average of about 36 animals per farm, highlighting a great diversity of farm sizes , and lactating cows in total was 1454, being 18.80 % of total cattle.

The figure 2 highlights the details on the number of cattle and lactating cows by axis.

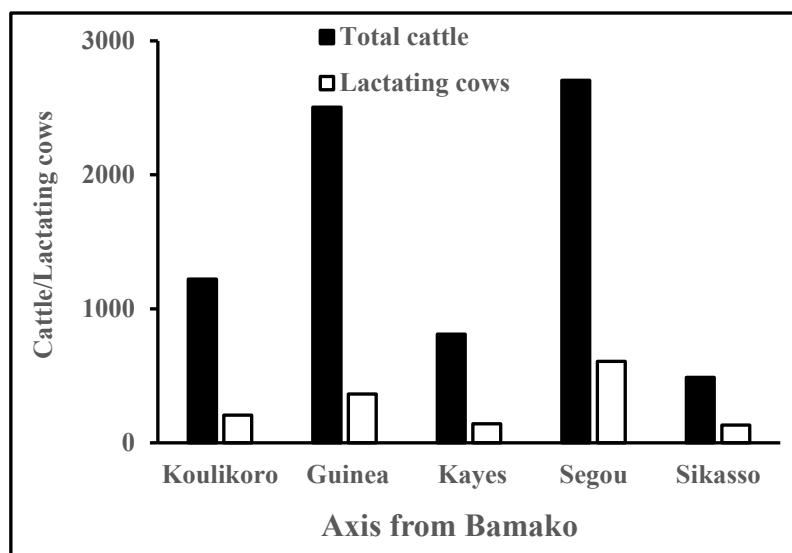


Fig.2. Number of cattle and lactating cows

The number of lactating cows was found to be closely correlated with the total number of cattle per axis. This relationship explains the overall distribution of the data obtained.

On the Bamako–Segou axis, 607 lactating cows were recorded, followed by 365 on the Bamako–Guinea axis and 207 on the Bamako–Koulikoro axis. The lowest numbers were observed along the Bamako–Kayes and Bamako–Sikasso axis, with 142 and 133 lactating cows, respectively.

3.3- Number of Local and Crossbred (Mixed) Lactating Cows

In many dairy farms, both local and crossbred (mixed) cows were observed. Crossbreeding is performed by mating local breeds — such as N’Dama, Maure Zebu, Peuhl Zebu, Touareg Zebu, and Méré (Bambara) — with exotic breeds like Montbéliarde and Holstein.

The Montbéliarde breed, originating from the Doubs region in the Jura Mountains of France, is valued for its robustness and good milk yield.

The Holstein breed, a black-and-white dairy cow from the Netherlands, is widely recognized for its exceptionally high milk production potential.

These crossbred cows, commonly referred to as “improved breeds”, produce more milk than purely local cattle. As a result, they play an increasingly important role in peri-urban dairy systems, where farmers adopt them to enhance productivity and meet the rising demand for milk in urban markets.

The figure 3 shows the number of local and mixed cows in lactation on the different axis.

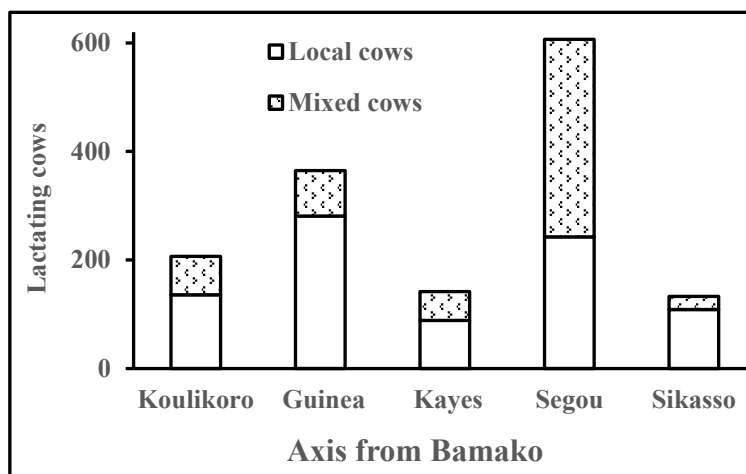


Fig.3. Number of Local and Crossbred (Mixed) Lactating Cows

The Bamako–Segou axis recorded the highest proportion of crossbred (mixed) cows, with 60% of lactating cows being mixed breeds and 40% local breeds. The combination of a large number of lactating cows and the prevalence of mixed breeds likely explains the higher milk production on this axis, which reaches 939 tons per year.

Since farmers collect and mix milk from all cows, it was not possible to precisely determine the contribution of mixed cows to total milk output.

Across all axes, however, local breeds remain dominant, accounting for approximately 65% of lactating cows, while crossbred cows represent 35%. This indicates that, despite the higher productivity of mixed breeds, local breeds continue to constitute the majority of lactating animals in the peri-urban dairy sector.

3.4- Annual milk production

The milk production per farm, expressed in tons, is shown in Figure 4. This figure provides a comprehensive overview of milk output across the surveyed dairy farms, highlighting variations between different axes and farm types. It also illustrates the contribution of each farm to the overall milk supply in the peri-urban area of Bamako.

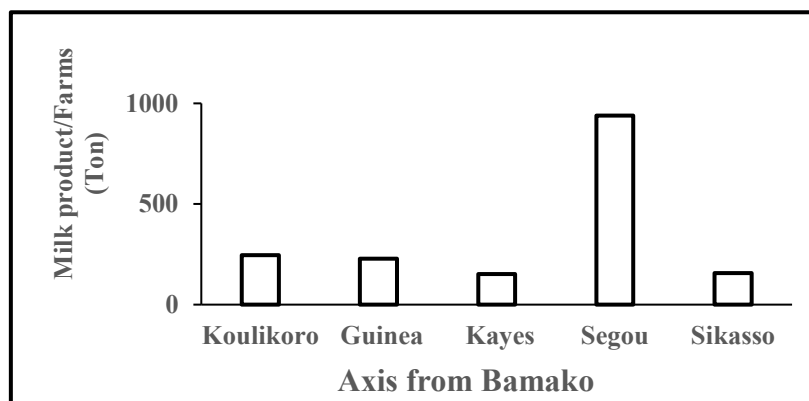


Fig.4. Milk production per farm/axis

The graph in Figure 4 shows that farms along the Bamako–Segou axis have the highest milk production, totaling 939 tons per year, due to the larger number of lactating cows on these farms. They are followed by farms on the Bamako–Koulikoro axis with 245 tons, while the Guinea Conakry, Sikasso, and Kayes axis produced 227 tons, 156 tons, and 151 tons, respectively. This pattern reflects differences in herd size, breed composition, and farm management practices across the axis.

3.5- Use of coarse and concentrated feed

The annual consumption of concentrated and coarse foods is illustrated in the figure below (figure 5).

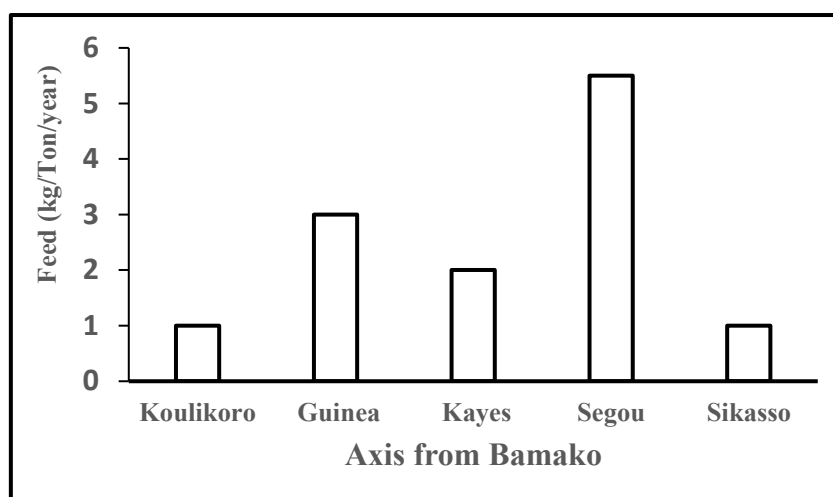


Fig.5. Feed Consumption (Kg/Ton/year)

Dairy cows in the peri-urban area are primarily fed with concentrated and coarse feed during the lean season, in addition to grazing. Farms along the Bamako–Segou axis distribute the largest quantity of livestock feed, totaling 4,858 tons per year, reflecting both the high number of cattle and the intensive feeding practices.

This is followed by the Guinea Conakry axis with 1,692 tons/year and the Kayes axis with 1,152 tons/year. The lowest feed distribution was recorded on the Koulikoro and Sikasso axis, with 580 tons/year and 434 tons/year, respectively.

3.6- Feed efficiency

The figure 6 illustrate milk production relative to the amount of feed distributed across the different axis. This analysis considers all types of feed, including : Fodder, Straw, Silage (dried grasses), Concentrated feeds, such as cereals (barley, oats, corn), legumes (peas, soy), and oilseeds (flax, peanuts, sunflower).

Concentrated and coarse feeds are generally provided during pasture shortages, but the exact share of these supplementary feeds in total cattle feed is not precisely known. This figure helps to understand the efficiency of feed use and the relationship between feeding practices and milk yield across the different peri-urban axis.

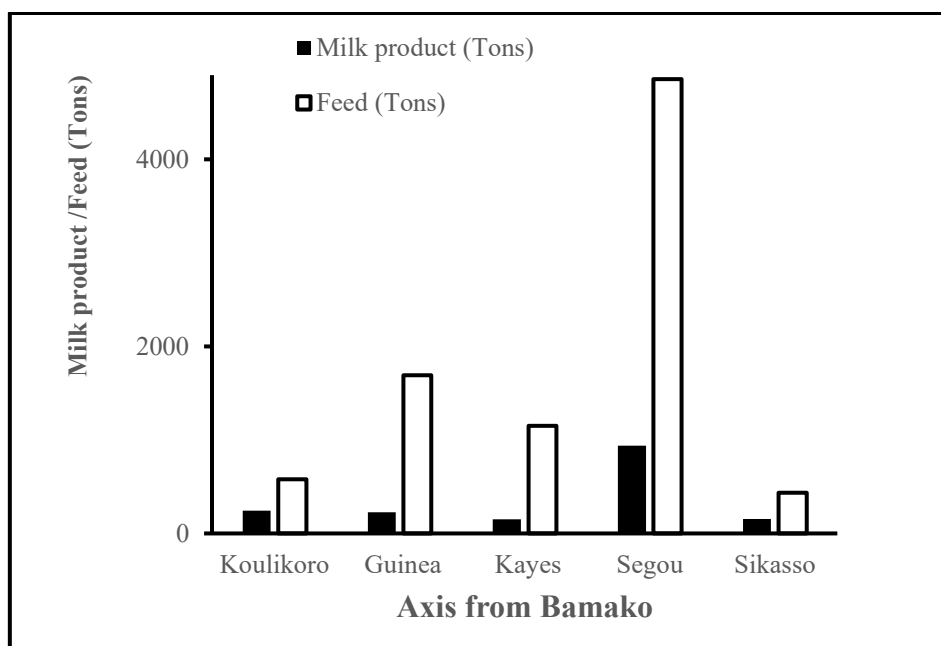


Fig.6. Milk production /Feed per axis

Some differences were observed between the axis in terms of milk produced relative to feed consumed.

The Koulikoro axis achieved the highest milk-to-feed efficiency, with a yield of 0.42, indicating that farms on this axis produced the most milk per unit of feed distributed.

In contrast, the Guinea Conakry and Kayes axis recorded the lowest milk-to-feed yields, with 0.13 and 0.13, respectively.

These differences highlight variations in feeding efficiency, herd management, and productivity across the peri-urban dairy farms of Bamako.

4. Milk distribution in the peri-urban area

4.1- Annual milk collected on all axis

The total annual milk collected from the five main axis supplying Bamako is presented in Figure 7 below. This figure illustrates the contribution of each axis to the city's milk supply, providing a clear overview of the spatial distribution and volume of milk collection from the peri-urban dairy farms surrounding Bamako.

The annual milk collection from the five main axis supplying Bamako is summarized below and illustrated in Figure 7.

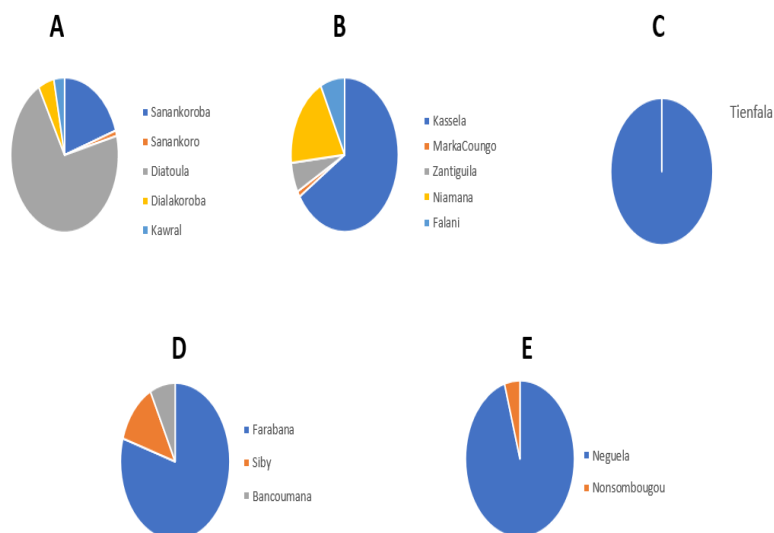


Fig.7. Annual milk collected on all axis to Bamako

4.2- Daily milk volumes delivered to collect centers

In local production systems, not all milk produced is delivered to collection centers. A portion of the milk is sold directly on-site at the farms to individual buyers, while some is reserved for family consumption.

The daily volume of milk delivered to the collection centers was recorded during the survey. These data allow for an assessment of the total milk volume delivered to collection centers on each axis, as illustrated in Figure 8, providing insight into the distribution and utilization of locally produced milk in the peri-urban area of Bamako.

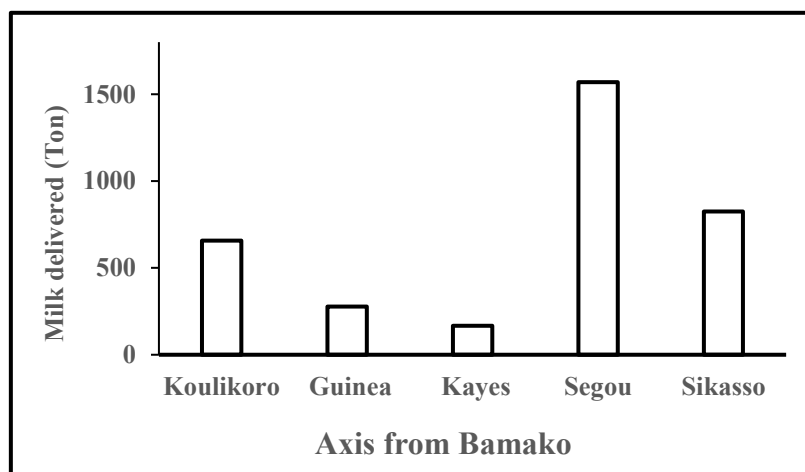


Fig.8. Daily milk delivered to collection centers per axis (Ton/year)

The daily milk volume delivered to the collection centers on each axis is closely linked to the number of lactating cows on the farms. On the Bamako–Segou axis, the total annual milk delivered exceeded 1,570 tons, making it the axis with the highest volume of milk supplied to

collection centers. The Bamako–Sikasso axis followed, delivering 825 tons per year, while the Bamako–Koulikoro axis delivered 657 tons annually.

The lowest milk volumes were recorded on the Bamako–Guinea axis and the Bamako–Kayes axis, with annual deliveries of 277 tons and 166 tons, respectively. These results reflect both the size of the lactating herd and the efficiency of milk collection along each axis.

4.3- Number of individual customers supplied / axis

The number of individual clients served by the centres is an indicator of commercial intensity. The Bamako–Segou axis registers 193 customers per day, a level significantly higher than the other axis, which confirms its strategic role in urban supply, followed by the Bamako–Sikasso axis, which serves 55 customers per day, then the Guinea–Conakry axis, with 32 customers per day. Conversely, the Koulikoro and Kayes axis, with only 20 customers per day, appear as dairy systems of low market intensity.

4.4- Milk Delivered to Small Dairy Processing Units

The daily quantities of milk delivered to small dairy processing units are summarized in Figure 9. This figure provides an overview of the volume of milk supplied by the collection centers to local processing units in Bamako, highlighting the contribution of each axis to the dairy processing sector and the role of these centers in supporting local milk transformation and distribution.

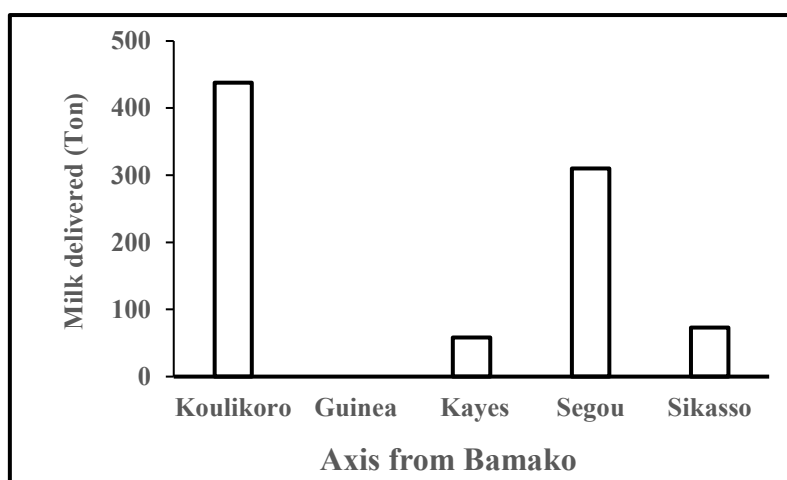


Fig.9. Milk delivered to dairy companies / axis (Ton/year)

Malilait-SA is the only large processing company that receives milk from the collection centers. However, the majority of milk collected is sold to small dairy processing units.

Based on the daily volumes of milk received by the different centers, the Bamako–Koulikoro axis delivered the largest volume to small processing units, totaling 438 tons. This was followed by the Bamako–Segou axis with 310 tons, the Bamako–Sikasso axis with 73 tons, and the Bamako–Kayes axis with 58 tons.

The Bamako–Guinea Conakry axis did not supply milk to processing units and served only individual customers, contributing 0 tons to small-scale dairy processing.

5. Daily milk sales in Bamako

The table 1 presents the different points of milk resale in Bamako. A total of 116 resale points were identified, of which 90 responded positively to the survey on milk consumption in the city. These points of resale provide insight into the distribution network of milk, showing how milk collected from peri-urban farms is circulated and consumed within Bamako.

Table 1. Distribution of existing milk resale outlets and respondents by district

District	Number of existing milk resale outlets	Milk resale outlets respondents
District 1	29	20
District 2	11	9
District 3	9	9
District 4	9	6
District 5	12	9
District 6	37	31
District 7	9	6
Total	116	90

The table above shows the distribution of milk resale points across the seven districts of Bamako. A total of 116 points of resale were contacted, of which 90 responded positively to the survey, providing the data on milk consumption in the city. This corresponds to a response rate of 77.6%, while 26 points did not respond, representing 22.4%.

Among the districts, the 6th district has the highest number of resale points (37), followed by the 1st district with 29 points. The 3rd, 4th, and 7th districts each have the lowest number of resale points, with 9 points per district.

• Daily milk distribution in Bamako

The figure 10 summarizes the details of milk consumption across the seven districts of Bamako. This figure provides an overview of consumption patterns, highlighting variations in milk demand and purchasing behavior among different districts.

The data were collected from milk resale points through questionnaires deployed on KoboCollect, allowing for a comprehensive analysis of how milk is distributed and consumed throughout the city.

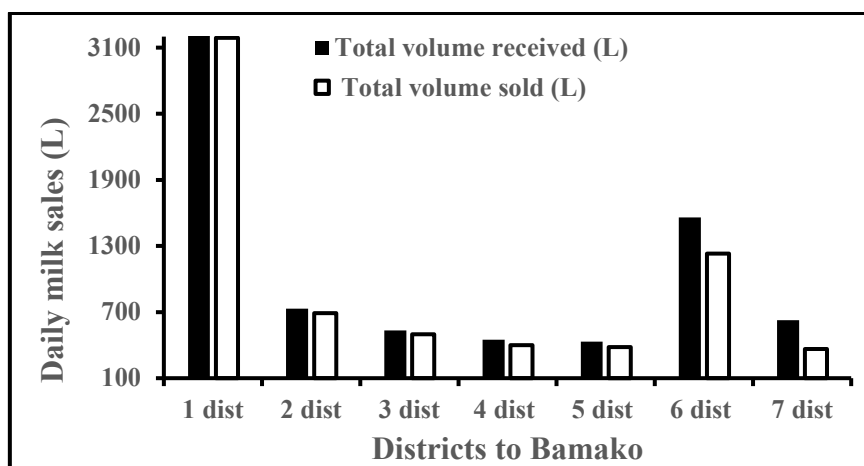


Fig.10. Daily milk sales in the 7 districts of Bamako

The fig.10 in above shows that the 1st district records the highest the daily milk sales, with more than 3304 L of milk sold daily. This indicates that milk sales is greater in this district compared to the others and suggests that the volume of milk received is roughly proportional to the number of resale points in the area.

The 6th district follows, receiving 1560 L of milk daily, while the 2nd district receives 730 L. The 7th district sales more than 625 L, the 3rd district sales 532 L , the 4th district sales 450 L , and the 5th district sales 433 L of milk per day.

Overall, these results highlight the differences in milk sales among districts and illustrate how the distribution of milk resale points influences the supply and availability of milk across Bamako.

6. Conclusion

This study provided a detailed assessment of the dairy and livestock sector in the peri-urban area of Bamako, covering the period from August 2022 to August 2023. A total of 380 dairy farms were identified along the five road axis leading to Bamako, with the Bamako–Segou axis hosting the largest number of farms (131) and producing the highest annual milk volume (939 tons/year). The Bamako–Koulikoro axis followed with 245 tons of milk produced annually. Other axis, including Bamako–Guinea, Bamako–Sikasso, and Bamako–Kayes, produced smaller volumes in line with the number of farms and lactating cows present.

The total cattle population across all axis amounted to 7,733 heads, with the highest numbers recorded on the Bamako–Segou axis (2,707) and the Bamako–Guinea axis (2,504). Milk production was closely linked to the number of lactating cows, which were predominantly local breeds (65%), while crossbred or “improved” cows (35%) contributed significantly to higher milk yields. The distribution of supplementary feed reflected herd sizes, with the Segou axis supplying 4,858 tons/year, whereas the Sikasso axis distributed only 434 tons/year, highlighting differences in feeding strategies and production potential across axis.

Daily milk deliveries to collection centers also varied. The Segou axis delivered 1,570 tons/year, followed by Sikasso (825 tons), Koulikoro (657 tons), Guinea (277 tons), and Kayes

(166 tons). These differences illustrate the combined effects of herd size, lactation rate, and feed management on milk availability for urban consumption.

The study further examined milk marketing and sales patterns in Bamako. A total of 116 milk resale points were identified across the seven districts, of which 90 responded to the survey (77.6%). The 1st district recorded the highest sales with 3304 L per day, followed by the 6th (1560 L) and 2nd (730 L). The remaining districts—7th, 3rd, 4th, and 5th—recorded progressively lower sales levels, ranging from 433 to 625 L per day. Most collected milk was sold to small dairy processing units, with the Bamako–Koulikoro axis delivering the largest volume (438 tons/year), while the Guinea axis supplied milk only to individual consumers.

These results demonstrate the significant potential of peri-urban dairy farming to meet the growing milk demand in Bamako. They highlight the need for targeted interventions, including enhanced feed management, promotion of crossbreeding programs, improved milk collection center capacities, and optimization of milk distribution channels. While this study provides a valuable baseline, further research is needed to obtain more precise data on seasonal production variations, feed efficiency, and milk yield per breed, which could further strengthen the efficiency and productivity of the sector.

Overall, the findings suggest that with strategic investments and improved management practices, peri-urban dairy farming in Bamako can play a critical role in supplying urban populations with milk, while also generating economic benefits for farmers and local communities.

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