INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print); 2222-5234 (Online)
Website: https://www.innspub.net
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Vol. 27, Issue: 6, p. 31-43, 2025

REVIEW PAPER OPEN ACCESS

Characteristics of urban and peri-urban dairy farms in the City of Bobo Dioulasso in Western Burkina Faso: A review

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Key words: Livestock farming system, Dairy cattle, Agro-industrial by-products, Burkina Faso

DOI: https://dx.doi.org/10.12692/ijb/27.6.31-43 Published: December 07, 2025

ABSTRACT

In West Africa, and particularly in Burkina Faso, local milk from dairy cattle is processed in several forms. Yet, actors in the sector fail to meet the demand for local milk consumers. To this end, a literature review was conducted to characterise the urban and peri-urban dairy farms in the city of Bobo-Dioulasso, in western Burkina Faso. The review shows that three (3) rearing systems are practised: (i) extensive agropastoral dairy systems; (ii) semi-intensive dairy systems; and (iii) intensive dairy systems. The Fulani breed accounts for nearly 80%, while crossbreeds make up about 15% of these systems. However, Fulani cows produce on average only 2 litres of milk per day over a lactation period of 243 days, compared to crossbreeds, which can yield up to 8 litres per day. This production is conditioned by multiple factors, the main ones being the cows' nutrition and their health status. Thus, regardless of the rearing system, feeding is based on natural pasture grazed on range or provided at the trough in intensive systems. To this base diet are added supplementary feeds made of cultivated forages, agricultural by-products (legume haulms, cereal straws), and agroindustrial by-products (oil cakes, bran), used in the form of concentrates for dairy cows. Despite these efforts, the cows' nutrient needs remain unmet, and in addition, there are health problems. Hence the adoption of feed formulations that match the cows' needs and that allow efficient, effective use of by-products in forms more adaptable to the socio-economic conditions of the farmers.

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INTRODUCTION

In Sahelian countries, and especially in Burkina Faso, the livestock sector plays a key socioeconomic role for rural households and contributes significantly to the national economy.

Economically, more than 80% of households derive all or part of their income from it, and it accounts for 10 to 20% of GDP (Behnke, 2012; Hesse *et al.*, 2013; Nouala *et al.*, 2011; Wane *et al.*, 2020). Recognised as the fourth-largest livestock country in West and Central Africa with a numerically large and diverse livestock population, it generates undeniable entrepreneurial opportunities and contributes to the economic and social sustainability of family and even industrial farms (Alary, 2019; MRAH, 2018). Apart from its economic role, milk and dairy products from livestock farming are also essential in terms of food, nutritional, and sociocultural aspects (Chatellier, 2019). In recent years, dairy farming has undergone profound changes in response to a sharp increase in demand for dairy products. Despite its importance, total milk.

Production in Burkina Faso barely exceeds 500,000 tonnes per year for an estimated population of over 20 million, equivalent to just 25 litres of milk per capita per year (MRA, 2010; INSD, 2019; Sodre 2022). However, FAO (2019) has recommended an average of 80 litres per inhabitant per year. Thus, despite the increase in milk production to supply the domestic market, Burkina Faso is still unable to meet the needs of its population, and the gap between production and consumption remains very large (Sib *et al.*, 2017; Vidal *et al.,* 2020). As a result, sub-Saharan African countries are increasingly turning to imports of reconstituted milk powder, the volumes of which are constantly growing (Broutin *et al.,* 2018; Ouédraogo *et al.,* 2023). These imports are estimated at more than 40 million litres of powdered milk of dubious origin per year, equivalent to more than ten billion CFA francs. Faced with this situation, there is an urgent need to find sustainable alternatives that meet consumer profiles. Sustainable alternatives include the creation of dairy basins on the outskirts of large cities and in traditional or developed pastoral areas. In addition, small-scale artisanal and industrial dairies have been set up to collect and process milk for local consumption around the major cities of Ouagadougou, Bobo-Dioulasso, Fada N'Gourma, Banfora, Djibo and Kaya (GRET and APESS, 2016; Broutin *et al.,* 2018; Gandi *et al.,* 2022). Despite all these initiatives, Burkina Faso continues to experience difficulties in supplying local milk due to the disparity in dairy farming and the low productivity of dairy cows (Sib *et al.,* 2017). Furthermore, the lack of secure outlets does not encourage the majority of farms to invest in improving the milk production of their animals, and the low level of trade protection against imported milk and dairy products of dubious quality (common external tariff of 5%) and chronic underinvestment in the structuring of local milk collection chains are also factors that hinder the emergence of a more robust local milk product chain. To this end, it is imperative, even necessary, to find solutions for sustainable management in the local milk value chain in Burkina Faso in order to make local milk available, competitive and accessible. Hence this initial summary studies on the characteristics of urban and peri-urban dairy farms in the city of Bobo Dioulasso in western Burkina Faso.

MATERIALS AND METHODS

Since the territorial reorganization in July 2025, Burkina Faso has had 17 administrative regions and 47 provinces. Bobo-Dioulasso, the country's second capital, is also the capital of Houet Province, one of the three provinces in the Guiriko region (Fig, 1). This region is located in western Burkina Faso and comprises three provinces: Houet, Kénédougou and Tuy. Bobo-Dioulasso, the region's main city, is located in the Sudanian phytogeographic domain, at latitude 11°06' N and longitude 4°24' W, with a South Sudanian climate. Rainfall ranges from 1,000 to 1,400 mm/year during the 5- to 6-month rainy season (mid-May to mid-October), and temperatures vary between 19 °C and 37 °C

(Fontes and Guinko, 1995). According to the National Institute of Demographic Statistics (INSD 2023), the population of Bobo Dioulasso was approximately 990,000 inhabitants with a density of more than 7,230 inhabitants/km². The vegetation is covered with a natural vegetative layer consisting of herbaceous, shrubby, arboreal and wooded fodder, which is favourable for feeding livestock ruminants. The shrub layer consists of Combretaceae and species such *as Piliostigma thoningii*, *P reticulatum* (D. C.) Hochst, *Guiera senegalensis* J. F. Gmel, *Zizuphus mauritiana* Lam, *Detarium microcarpa* Guill. et Perr, and *Gardenia ternifolia*. The herbaceous layer is dominated by the following species: *Andropogon gayanus* (fallow grass), *Andropogon ascinodis*, *Eragrostis tremulla*, *Loudetia togoensis*, and *Crotalaria retusa*. In addition to these non-exhaustive lists of natural vegetation, there are also exotic species such as *Eucalyptus camaldulensis*, *Gmelina arborea*, *Tecnona grandis*, *Delonix regia*, *Mangifera indica*, and *Azadirachta indica*. On the other hand, forage species such as *Andropogon gayanus*, *Echinochloa stagnina*, *Rottboellia exaltata*, and *Pennisetum pedisellatum* Trin are cultivated and marketed. In addition, there are peanut leaves (*Arachis hypogaea*), cowpea leaves (*Vigna unguiculata*), cereal residues and straw, and SPAI, in particular: brewery waste, cereal bran, molasses, sugar cane bagasse, seeds, oilcake, cotton and oilseed hulls, cassava peelings, and other unconventional foods, among others, are used in cattle farming in Bobo-Dioulasso.

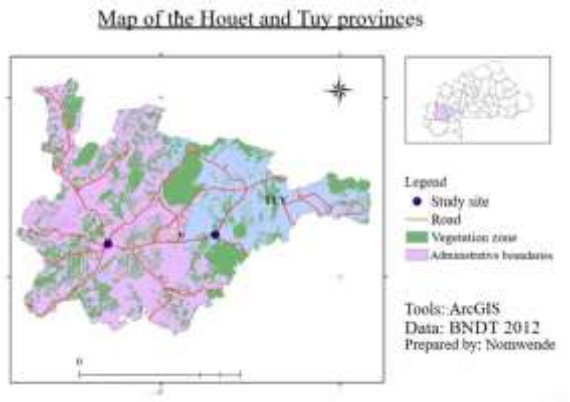

Fig. 1. Study area

RESULTS AND DISCUSSION

Types of dairy farming in Burkina Faso

According to recent studies (Hamadou *et al.,* 2003; Hamadou *et al.,* 2008; Sidibe *et al.,* 2004; Millogo *et al.,* 2008; Sib *et al.,* 2018; Vidal *et al.,* 2020; Vall *et al.,* 2021 and Sodre, 2022), livestock farms are classified according to criteria such as feeding practices, health management, cattle breeds used, the level of technical expertise on farms and the zootechnical performance of cows. There are three main dairy farming systems: i) extensive agropastoral dairy farms, ii) semi-intensive dairy farms, and iii) intensive dairy farms.

Extensive agropastoral dairy farms

They are characterised by gradual investments. Most pastoral farmers are agro-pastoralists who combine agriculture with livestock farming on a smaller or larger scale. Livestock feed is based mainly on grazing on natural pastures with high animal mobility (small and large transhumance) as a resilience strategy for some (Gonin, 2018). Supplementation based on crop residues and feed concentrates (3 kg DM/UBT/day in total) is relatively low (Sib *et al.,* 2018; Sodre, 2022). In these systems, livestock infrastructure is almost non-existent, with fixed or makeshift night pens made of shrub branches during movements. The most common breed is the Sudanese Peul zebu, followed by its crossbreeds with local taurine breeds (Nougtara *et al.,* 2021). In terms of health prophylaxis, the care provided is relatively poor, most often limited to vaccinating all or part of the cattle herd against the dominant diseases in the area and a few rare treatments through self-medication and traditional medicine. In these systems, production objectives are not very fixed, so milk was not a production objective for agro-livestock farmers. Milking and milk marketing appear to be a secondary activity of cattle farming, which performs a range of functions in agro-pastoral farms, such as capitalisation, traction power and fertility transfer (Sodre, 2022). Most of the milk produced is for self-consumption, with the rest being sold by women, who derive most of their income from this activity. The majority of agro-livestock farmers in this farming system forms dairy clusters from

lactating cows, which do not participate in transhumance, in order to supply dairy processing units in large cities such as Banfora, Bobo-Dioulasso and Ouagadougou.

During the dry season, milk production falls considerably due to the lack of natural grazing land, which forms the basis of the cows' diet (Coulibaly *et al.,* 2007; Sib *et al.,* 2018). Cows produce an average of 1.3 litres of milk per cow per day during the rainy season and 0.7 litres per cow per day during the dry season (Sib *et al.,* 2018). Despite this low milk productivity, these farms account for 95% of total annual milk production (MRA, 2010).

Semi-intensive dairy farms

In this type of dairy farming, investment is moderately higher, with a marked improvement in farming factors compared to the extensive system. Feeding is based on natural grazing combined with supplementation in stalls in varying proportions. Lactating cows receive feed/mineral supplements mainly based on corn bran, oilcake and cottonseed in the order of 0.55 kg and 4.78 kg DM/day/cow (Hamadou and Kiendrébéogo, 2004). This supplementation maintains relatively good milk production during the dry season, allowing farmers to earn significant income from milk sales. Infrastructure in these systems is usually limited to sheds and pens as animal habitats. There are two semi-intensive systems in this type of farming. The first is the pastoral system, whose sedentarization has been encouraged by the public authorities in their desire to secure and increase animal production in the aftermath of the droughts of the 1970s and 1980s through the development of agro-pastoral areas (Gonin and Tallet, 2012; ONF-BF, 2017). The advantage of this system is that livestock farmers receive financial and material support, enabling them to manage the development of their activity more effectively (Kamuanga *et al.,* 2000). In addition, these livestock farmers organize themselves into groups that receive technical support and are made aware of technical issues relating to feed (fodder crops, bush hay production), the maintenance of agropastoral areas (reforestation, maintenance of firebreaks) and health, so that they can better understand and apply them. Although the cows are local breeds, as in the traditional pastoral system, they have the advantage of producing slightly more milk (Sodre, 2022). Milk production varies according to the seasons and can reach an average peak of 3 litres/cow/day in the rainy season, falling by half in the dry season (Hamadou and Sanon, 2006). The second system is semi-intensive farming, which is located on the outskirts of small towns and large urban centres (known as the traditional peri-urban system; Berd, 2010). Its sedentary pastoralists and/or newcomers to the livestock farming profession, namely farmers, traders and active or retired civil servants, mostly hire a cowherd to look after the herd. The breeds that make up the majority of these herds are local breeds with high milk production (Goudali, M'Bororo and Azawak zebu) and a small proportion of exotic breeds (Gir) and their crossbreeds (Gnanda *et al.,* 2016; Zampaligre *et al.,* 2019). However, these farms struggle to achieve high milk production targets due to the very low genetic milk potential of the cows, the high cost of concentrates and the low availability of crop residues.

Intensive dairy farming

These are run in peri-urban areas by senior civil servants, either active or retired, private companies and/or religious organisations. The infrastructure is modern and traditional, with barns for housing the animals, haylofts/sheds and/or stores for storing feed, and livestock equipment (feeders, water troughs, scythes, carts, milk collection cans, etc.). The farms are very well equipped. The animals are fed in stables (‘zero grazing’) or in quasi-stables for all or part of the year (Hamadou and Sanon, 2006). Farmers provide most of the animals' feed at the trough (supplementing when the animals have access to pasture). To do this, they build up large feed reserves by mowing and preserving natural fodder, storing crop residues and purchasing agro-industrial by-products (oilcake, cereal bran, brewery draff, etc.). The cows are kept in stalls for all or part of the year and fed fodder and concentrates. In this system, the

breeds raised are crossbred cows resulting from the crossbreeding of local breeds and exotic European breeds (Tarentaise, Brune des Alpes, Montbéliarde, Gir, Girolando, Jersiaise, Holstein and Limousine). Recently, some farms have benefited from pure exotic heifers (Sodre, 2022). In this dairy system, cows have higher milk productivity, ranging from 5 to 13 litres per cow per day depending on the season and the farm (Sib *et al.,* 2018).

Cattle breeds

In Burkina Faso, several local cattle breeds are found in dairy farms. According to the work of (Zampaligre *et al.,* 2019), the Sudanese Peul Zebu breed is the most widespread (80%), followed by the Méré crossbreed, which is a cross between the Peulh Zebu and taurine breeds (15%). This particularity of Peulh Zebu breeding can be explained by their versatility for milk and meat production and animal traction, their resistance to disease, their adaptation to precarious climatic conditions, and also their low cost compared to crossbreeds and exotic breeds, making them ideal for extensive and pastoral systems. Apart from these zootechnical qualities, Peulh Zebu breeding is deeply rooted in Peulh pastoral culture through the promotion of cultural heritage and plays an important role in social status, marriage and family economic capital by serving as a financial reserve. In addition to these two breeds, there are also Goudali, Gir, M'Bororo and Azawak zebus, as well as their crossbreeds resulting from their interbreeding with the aforementioned local breeds. Since 2023, with the 'Faso Cow' programme, other inseminations have been carried out with French breeds, resulting in the presence of breeds such as Tarentaise, Brune des Alpes, Montbeliarde, GIR, Girolando, Jersey, Holstein and Limousine. Table 1 shows the origin of dairy cows found on dairy farms in Burkina Faso. Despite the realities on the ground, the local breed most prized by farmers is the one that produces less milk than all the other breeds. This result clearly shows that dairy farming by pastoralists does not always prioritise profitability, but rather prestige (Kouakou *et al.,* 2016). Furthermore, the exotic breeds found on dairy farms produced on average twice as much milk as the local breeds. Unfortunately, these breeds are very demanding in terms of breeding systems, feed, treatment and hardiness (Table 2). In addition to these factors, breeding exotic breeds requires heavy investment, which limits their accessibility to the public.

Table 1. Productivity of dairy breeds encountered according to season.

Dairy cows	Origin	Height at withers (Cm)	Production in dry season (l/d)	Production in rainy season (l/d)	Age at culling/sale (years)
Peulh Zebu	Niger/Mali	125	2	1	9 à 12
M'Bororo	Niger	140	3,5	2	9 à 11
Goudali	Nigeria	140	5	4	8 à 10
Azawak	Niger	130	6	4,5	10 à 11
Tarentaise	France	115	8	7	9 à 10
Brune des Alpes	France	120	10	8	9 à 10
Montbeliarde	France	130	9	6	9 à 10
Gir	Brazil	135	8	6	9 à 10
Girolando	Brazil	135	9	6,5	9 à 10
Jersey	England	120	10	8	9 à 10
Holstein	Netherlands	120	11	7	9 à 10
Limousine	France	125	10	8	9 à 10

Feeding

In domestic ruminants, feed quantity and quality are the basis of all animal production. The main nutritional requirements for these animals are energy, followed by nitrogenous substances and finally minerals. These nutrients enable ruminants to meet their maintenance and production needs (milk, growth, fattening, working strength) and their energy requirements if they are on the move. For dairy cows, feeding must be based on two main objectives: reproduction and milk quantity, enabling maximum udder development during the post-pubertal period,

covering maintenance and production needs, and allowing reserves to be replenished through energy and mineral sources (CIRAD-GRET, 1991). However, throughout Africa, and particularly in Burkina Faso, the diet (energy and nitrogen content) of dairy cattle is based mainly on natural grazing, which is unlikely to meet the animals' needs, regardless of the farming system and production objectives, especially during the dry season. Nevertheless, it is imperative to take action by improving feed in order to increase milk production. To this end, Rivière (1991) and MRA (1998) have suggested that a slight increase in the ration of around 1 UF per day during the dry season and an improvement in feed could lead to an increase of around 50% in usual production. Furthermore, Dudouet (1999) and Sodre (2022) have stated that although improving the diet improves the nutritional level in dairy cattle, it can also lead to fattening rather than milk production if precautions are not taken in the rationing plan. Recently, Agani *et al.* (2022) stated that, apart from the endogenous practices used by farmers to improve milk production in local breeds of dairy cows, good husbandry practices and improved feeding, far from leading to the fattening of the cows, promote a considerable increase in the milk productivity of local breeds. However, until now, whether in the south, west, centre or Sahara, dairy cows have been fed mainly on natural pastures, supplemented either by agricultural and industrial by-products (AIBs) or, rarely, concentrates and/or, frequently, fodder crops. Better still, dairy cows are fed on natural pasture + feed supplements for the most part and, to a lesser extent, on cultivated fodder plus AIPs and/or concentrates in Burkina Faso. In view of this, are the available fodder and AIPs sufficient to meet the animals' needs in order to achieve milk production targets?

Table 2. Comparative study of Peulh zebu and exotic dairy breeds

Criteria	Sudanese Peulh zebu	Exotic breeds (Holstein, Montbéliarde, Girolando, etc.)
Origin and genetics	Bos indicus adapted to African conditions	Bos taurus (European breeds) or crossbreeds (taurine x Zebu)
Heat tolerance and climate adaptation	Very good tolerance to heat stress	Less heat tolerant
Resistance to tropical diseases	Hardy	Vulnerable to uncontrolled tropical conditions
Lactation period/calving intervals	Moderate lactation and fairly long calving interval	Shorter calving interval promoting production
Breeding efforts and genetic improvement	Limited genetic progress due to traditional practices	Use of artificial insemination, advanced genetic monitoring
Robustness and maintenance	Very robust: low feed requirements, adapted to poor pastures, good walking ability, endurance, low maintenance costs in extensive systems	Requires richer feed (high- quality fodder, concentrates), infrastructure (shelter, feed storage), more rigorous health monitoring.
Profitability	Profitable in a pastoral or extensive system, particularly in areas where resources (water, fodder) are limited and climatic conditions are difficult. Low maintenance costs offset low milk production.	Potentially profitable in a well-structured intensive or semi-intensive system: high milk production can generate more income, but requires heavier investment (infrastructure,feed, veterinary services).
Risks and constraints	Low milk production limits the volume of marketable milk without genetic improvement. Long reproduction cycles and risk of inbreeding depending on breeding practices.	High risks without good management: heat stress, mortality, disease, high input costs; if poorly managed, the farm becomes unprofitable. Difficult adaptation of animals to traditional pastoral systems without technical support.
Crossbreeding potential	Very interesting as a parent in crossbreeding: Peulh zebus can pass on their hardiness and tolerance to heat and disease to crossbreds. This can combine the advantages of both groups (hardiness + productivity).	Crossbreeding (exotic × zebu) produces animals that are better adapted to the local climate while increasing production compared to purebred zebus. These crossbreeds are often used in genetic improvement programs.

Natural pastures

Natural pastures, characteristic of the savannahs of the Sudanese zone, consist of spontaneous herbaceous and woody vegetation that animals use for food (Kagoné, 2000). They are the main source of food for approximately 71.5% of cattle in Burkina Faso (MRAH, 2019). However, the availability of forage resources in these pastures varies over time and space due to differences in rainfall, soil fertility and other environmental factors.

During the rainy season, from May to October, the pastures are green and rich in nutrients. However, when mature, the grasses become tough and lose their nutritional value. In the dry season, when soil moisture permits, bush fires destroy much of the biomass, promoting limited regrowth of perennial grasses, which is generally insufficient to meet the needs of livestock.

Natural habitats are experiencing a continuous decline estimated at between 105,000 and 250,000 hectares per year, due to increasing anthropogenic pressures (Vall *et al.,* 2006; Kiema, 2015; DGEAP, 2018; Richard *et al.,* 2019). Between 1975 and 2013, the area dedicated to rain-fed agriculture increased from 15% to 39% of the national territory, a 160% increase, mainly at the expense of pastoral areas and protected areas (Tappan *et al.,* 2016; Gonin, 2017).

This reduction in grazing land and pastoral areas has led to heavy pressure from livestock on the remaining vegetation, causing soil degradation and denudation (Bied-Charreton *et al.*, 2006). It also exacerbates tensions between local and migrant populations, between livestock farmers and crop farmers, and between rural communities and the state (Gonin and Tallet, 2012). Furthermore, growing insecurity in Burkina Faso, combined with the COVID-19 health crisis, has profoundly disrupted pastoral mobility and the use of natural grazing lands (FAO, 2020).

Fallow land is arable land that is left to rest for a specific period of time, depending on local conditions, in order to obtain fodder resources for feeding livestock ruminants. Notwithstanding the realities observed in the field, these fallow lands, which were once used to feed extensive pastoral and agropastoral systems during the wet season, are disappearing at an exponential rate (Samandoulgou *et al.,* 2019). According to the work carried out by Vall and Diallo (2009) and Richard *et al.* (2019), this disappearance is due to land pressure resulting from population growth, inappropriate agricultural practices and climate change, which is pushing farmers to extend cultivated areas to land previously considered unsuitable for agriculture, or to significantly reduce the duration of fallow periods, or even to abandon them altogether.

However, the fodder resources produced by fallow land give it very good pastoral value after the first few years of abandonment (Koutou *et al.,* 2017).

Cultivated fodder

According to Mazoyer (2002), cultivated fodder consists of plant-based feed for herbivorous animals whether ruminants or monogastric animals. Its cultivation involves the deliberate production of plant material for the purpose of feeding livestock (Klein *et al.,* 2014). This practice involves applying a technical process on dedicated plots of land, including ploughing, sowing, maintenance, harvesting and storage.

Crop-based fodder is generally rich in protein and energy. It is therefore an excellent supplement for animals grazing on natural pasture during the dry season. However, their milk feed unit (MFU) and digestible nitrogen content is intermediate between that of dry natural grazing resources or crop residues and that of agro-industrial by-products (cereal bran, brewers' grains, cottonseed meal) (Sodre, 2022).

Depending on the plant species used, fodder crops can consist of legumes (for protein supplementation) or a combination of grasses and legumes (for energy supplementation). Depending on their lifespan, they

are classified as annual and perennial forage crops (Davaine, 2012). It should also be noted that there is no clear-cut boundary between specific forage crops and food crops whose residues or multiple uses are valued as fodder (Klein *et al.,* 2013).

According to the work of Sodre (2022) in Burkina Faso, the term 'forage crop' encompasses any plant species produced for the explicit purpose of harvesting fodder—either exclusively or in combination with other purposes (grains for human consumption, soil protection/fertilisation, etc.). In this context, certain varieties of cowpea, sorghum, maize, groundnut, etc., known as 'dual-purpose' (fodder and food crops), make it possible to increase fodder production without sacrificing grain production, the latter remaining primarily intended for human consumption.

Consequently, a distinction can be made between purely fodder crops on the one hand, and dual-purpose cereals and legumes on the other. Despite these advantages, and due to a variety of technical, agronomic and socio-economic constraints, the adoption of fodder crops by the majority of producers has remained limited.

Crop residues and agro-industrial by-products

Crop residues are the parts left unused after plant production, including cereal straw and legume tops. According to Savadogo *et al.* (1999), crop residues and agro-industrial by-products met the nutritional needs of almost all ruminant livestock (76 to 98%) in the Sudanian zone of Burkina Faso during the dry season four decades ago. However, MRAH statistics (2021) now show an 80% decline in the use of these residues, as they can only meet the nutritional needs of 18.4% of ruminants in the Haut-Bassins region and 6% of those in the Cascades region. This decline is due to several factors, the main ones being exponential population growth, an increase in livestock numbers, conflicts between livestock farmers and crop farmers, and urbanisation. Consisting of cereal stalks and leaves left in the fields after the grain has been harvested, straw or cereal residues (maize, sorghum, millet and rice straw) are very low in nutrients (Millogo *et al.,* 2019) despite their significant quantities after harvesting. Cereal straws, including millet and sorghum, are very low in nitrogen and consist mainly of cellulose, but they mainly provide ballast for animals (Montcho *et al.,* 2016). Unlike straw, legume tops, consisting of stems, leaves and part of the root system left after the pods have been harvested, are of better quality, but this varies greatly depending on the harvesting method, the care taken during this operation and the harvesting season (Anele *et al.* 2012; Bahini *et al.,* 2016). Crop residues are a supplementary resource during the first half of the dry season, especially in urban and peri-urban areas, but they are quickly depleted and sometimes wasted by ruminants during grazing (Lawal *et al.,* 2017).

Those stored by some farmers are insufficient in quantity and generally of low nutritional value due to inappropriate harvesting and storage practices such as storage in sheds, trees or on rooftops (Kiema *et al.,* 2008; Sanfo *et al.,* 2022). In short, the efficient and effective use of crop residues and agro-industrial by-products requires a combination of different ingredients in order to provide complete feed for ruminants and achieve dairy production targets. Nevertheless, there is an urgent need to explore the concentrates available on the Burkinabe market, their periods of availability and the possibilities for sustainable production.

Concentrates

Paradoxically, unlike monogastric livestock farming, where there are a wide range of concentrate manufacturing units, livestock feed manufacturing units are almost non-existent or fragmented.

In Burkina Faso, concentrated feed for dairy cows is mainly derived from the industrial processing of agricultural products, including oilseed meal. This consists mainly of cotton seeds and meal, cereal bran, including low-grade rice flour, and industrial and local brewery draff.

Despite this disparity, extensive farmers have great difficulty accessing these products, as they are very

expensive and located far from the dairy production sites of small farmers (Deffo *et al.,* 2009). According to the work of Sodre (2022), of all the feed given to dairy cows as concentrates, only cottonseed meal was able to provide cows with a better nutritional value of more than 400 g of CP/kgDM and 1.1 UFL/kg DM. Next came brewers' grains and cotton seeds, with an average of 200 g DM/kg DM and 1 UFL/kg DM. Then came young grasses, four-week rainy season grass cover, fodder crops and legume tops, which provided an average of 120 g DM/kg DM and 0.8 UFL/kg. Finally, cereal straw, bush hay and dry season grassy mats dominated by grasses represented the lowest category with a low nutritional value of 20 g CP/kgDM and 0.4 UFL/kg. To this end, it is necessary to supplement these types of feed in order to achieve better milk production and thus contribute to food security.

Dairy cow health

In Burkina Faso, dairy cattle health is a complex issue, especially given the climate (temperature and humidity), which promotes the development of several pathogenic germs. The health of dairy cattle is much more closely linked to health, zootechnical, ecological and socio-economic constraints. Although dairy cattle farming represents a significant part of agricultural activity in Burkina Faso, with 37% of households engaged in cattle farming (Hama *et al,* 2018). The dairy sector is considered a strategy in livestock development policy, with efforts including the importation of dairy breeds and/or insemination to modernise dairy value chains. In addition to the dairy cattle farming system, feed, water, farming equipment and health are factors that limit milk production on peri-urban dairy farms in Burkina Faso. Despite the efforts of the Burkinabe government since 2023, through the 'La vache du Faso' project to improve milk production by crossing local zebu with French dairy breeds and health (preventive treatments, insemination and veterinary monitoring), the health risk in dairy cattle persists. Among the main diseases encountered, trypanosomiasis has been identified as the most common parasitic disease in dairy farms, with a seroprevalence of 34.2% of cattle tested and 23% of cattle with infections of *T. vivax*, *T. congolense* and sometimes *T. brucei* infections (Sow *et al.,* 2023; Mereta *et al.,* 2023; Lassane *et al.,* 2022). Frequently encountered in the south, south-west and near the wetlands of Burkina Faso, trypanosomiasis control relies on trypanocidal treatments, but farmers report drug resistance or product quality issues (Zongo *et al.,* 2014). However, the consequences, including reduced milk productivity, infertility, abortion and mortality, represent enormous socio-economic losses for livestock farmers and for the country. Recently, an epizootic outbreak of foot-and-mouth disease struck Burkina Faso, causing significant economic losses due to high morbidity in cows and mortality in calves (Dahourou *et al.,* 2022). Apart from these two very common diseases in Burkina Faso (Musallam *et al.,* 2019), a regional study on dairy chains in West Africa found that brucellosis (zoonosis) is present in urban dairy herds. In Ouagadougou (Burkina Faso), the prevalence of brucellosis is lower than in some other countries, but it nevertheless poses a risk to public health. Furthermore, ILRI (2019) detected anti-Hepatic Viral E (HEV) antibodies in the blood of more than 5.1% of the cattle studied, which represents a zoonotic risk, particularly through the consumption of unpasteurised dairy products by humans.

In addition, chemical contamination by aflatoxins has been identified in milk from traditional and peri-urban systems, mostly due to poor hygiene during milking or milk processing (ILRI, 2019). Faced with this situation, many structural and health challenges remain to be addressed, such as: (i) training and raising awareness among farmers due to the misuse or uncontrolled use of antibiotics or other inputs, as well as vaccination campaigns that are not always well followed; (ii) resistance to trypanocides reported by farmers, complicating control by stakeholders; (iii) production systems that remain extensive, requiring the use of natural pastures, which limits the capacity for strict health control and further exposes dairy cattle to vectors; (iv) the poorly structured dairy value chain, where milk collection, processing and

marketing take place under poor hygiene conditions, exposing not only animal health but also consumers to risk; and (v)- limited infrastructure and resources due to a lack of veterinary facilities, laboratories for diagnosing diseases and resources for treating animals (Soudre *et al.,* 2013; Sow, 2013; Hama *et al.,* 2018). As an initiative, it is proposed to improve the genetics of dairy cattle and strengthen bovine health through development projects such as the 'Faso cow' programme, the sanitation of dairy products and livestock feed by the relevant actors, the progressive control of trypanosomiasis through epidemiological atlases and field data, while targeting risk areas to make interventions more effective, the improvement of milking practices by encouraging the adoption of good hygiene practices in dairy farming through cleaning, pasteurisation and packaging of dairy products on dairy farms to reduce microbial risks, and strengthening the veterinary supply chain by ensuring access to quality medicines and vaccines and improving the training system for livestock farmers and veterinary technicians.

CONCLUSION

The local dairy industry is booming. To better understand the dairy cow industry, this study identifies the innovation strategies adopted by farmers to make the industry profitable. The strategies vary from one type of farming system to another, based on feed, and enable farmers to make the most of their business. Nevertheless, it presents serious problems that farmers cannot solve individually. Furthermore, those who try to solve them use a feeding system that remains in the minority to this day. It is therefore urgent that all actors involved in the local milk value chain work together to find the necessary and sustainable solutions. With regard to the health status of dairy cattle in Burkina Faso, significant challenges related to diseases such as trypanosomiasis and foot-and-mouth disease, zoonotic risks and hygiene issues must be addressed in the local milk value chain. However, there are promising initiatives, including development projects and vaccination campaigns by veterinary agents to improve the situation. For the sustainable development of the dairy sector, it is essential to invest more in animal health, training for farmers, and veterinary infrastructure.

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