

Dairy Cattle Management in the Peri-Urban Area of NDjamena: Case of the Artine Farm

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Abstract

The aim of this study was to study the dietary practice of dairy cows on the ARTINE farm. It was carried out from 05 July to 20 November 2017. It involved 128 cows out of a total of 382 cows (a survey rate of 33.51%). It was conducted by survey using a semi-open questionnaire. The information collected was processed using the SPSS software. The cows are on natural courses (79%). The health status of the majority of cows was satisfactory (87.5%). Average milk yield was 5.46 ± 1.69 liters per cow a day with a frequency of two milkings a day (89.9%). The majority of milk produced was self-consumed in the farm (89%). The lack of technical management of dairy farming, the absence of food calendar and organization on the farm, constituted the major constraints to proper development of milk production.

Keywords: Cows; Milk Production; Food; Artine Farm; N'Djamena

Introduction

In Chad, livestock sector plays an important role in national economy [21,23]. Livestock numbers are estimated at more than 100 million head of ruminants [20] and 34.6 million poultry, making Chad one of the largest livestock producing countries in sub-Saharan Africa [20]. Despite this relatively large number, Chad uses imports of milk and dairy products to meet the population needs [1,11,12]. This underperformance, particularly in milk production, is linked to low zootechnical parameters (age at first calving after 4 years, calving interval of 19 to 24 months, or longer, reduced lactation duration, etc.) and poor genetic potential [1].

Food, health, agrarian, environmental and economic problems limit the productivity of Chadian livestock. Its traditional way of driving and the archaic management of herds considered as savings or prestige value and not as a production tool. To these are added, the maladjustment of livestock policies, which in most cases do not meet the expectations of pastoralists [1].

On the other hand, in most developing countries, local breeds generally have very limited milk abilities where conventional breeding would be too slow to improve. Faced with the increase in milk requirements, the only quick way to increase production is the importation of cows from temperate regions with the "technological packages necessary for their acclimatization" [16].

In Chad, the high population growth, rapid urbanization and rural exodus related to different local and regional conflicts, have posed the problem of food insecurity and rendered more and more insufficient the availability of proteins of animal origin. In addition, the low

productivity of exploited local breeds, the irregular rainfall, the scarcity of grazing and the extension of cultivated areas have increased food insecurity [12].

In this context, improving milk production can be a sustainable solution. Thus, the sustained development of dairy farming would make it possible in the long term to stabilize part of mobile breeding and thus the population in rural areas. In addition, it provided livestock farmers with additional income and the regular supply of urban and urban populations quantitatively and qualitatively.

Even if practiced extensively, the high density of peri-urban milk production systems can play a key role in supplying the Chadian capital with milk and dairy products. It is only necessary to put in place coherent farming policies (mastering the structural and techno-economic aspects of livestock systems) [1,26].

Unfortunately, as far as milk production is concerned, there is almost no significant research/action program apart from individual actions related to artificial insemination.

In livestock, food is the main limiting factor in production and the cost of food accounts for about two-thirds of the total investment cost. It remains the main concern of the breeders. In fact, animals need food to satisfy their maintenance nutritional needs on the one hand and to grow, produce and reproduce on the other.

Like other African cities, dairy farms are beginning to be established in the peri-urban area of the city of NDjamena city. Among which, there is the "Artine" farm. Its objective is to meet a growing demand in milk and dairy products from the population of NDjamena. This goes hand in hand with the will of the Chadian government to ensure sustainable food security. The National Food Security Program is an example. He performed Artificial Insemination (AI) on farms in the peri-urban area of NDjamena city from where the presence of cross-breed cows in this area.

Aim of the Study

The present study aims to study the dietary practice of dairy cows in ARTINE farm.

Materials and Methods

Presentation of the study area

This study was conducted in the peri-urban area of NDjamena city, the political and administrative capital of Chad. Located in the Center-West at the confluence of the rivers Chari and Logone, on the right bank of the Chari, and extends between the 12° and 13° degrees of latitude North and the 15° and 16° degrees of longitude East. The city is experiencing rapid urbanization. Its population grows with an annual rate of 5% increased from 530,965 inhabitants in 1993 to 993,492 inhabitants in 2009 and to 1,092,066 inhabitants in 2012, representing more than 41% of the urban population of Chad [21].

The area is characterized by a dry tropical climate, marked by the alternation of a short rainy season, which runs from June to September and a relatively long dry season. In 2016, the average annual rainfall was 658.2 mm. The average annual temperature is around 38°C with an average annual relative humidity of around 45°C.

The relief consists of large floodplains with tropical black clays and mounds of sand exuded in places. The main soil types are sandy, sandy-loamy, sandy-clay, clay and silty-clay soils. The vegetation is of steppe type consisting mainly of grasses. The most dominant trees are *Acacia spp*, *Calotropis procera*, *Faidherbia albida*, *Balanites aegyptiaca*.

Location of the farm

Artine farm is located in the peri-urban area of NDjamena city (Figure 1). This agropastoral farm was created in 2002 by ARTINE family. It has two sites: the first site is located Raf (40 km from NDjamena) in the prefecture of Koundoul and the second at Goz Aiche (70 km from N'Djamena). The areas are 40 and 420 hectares respectively.

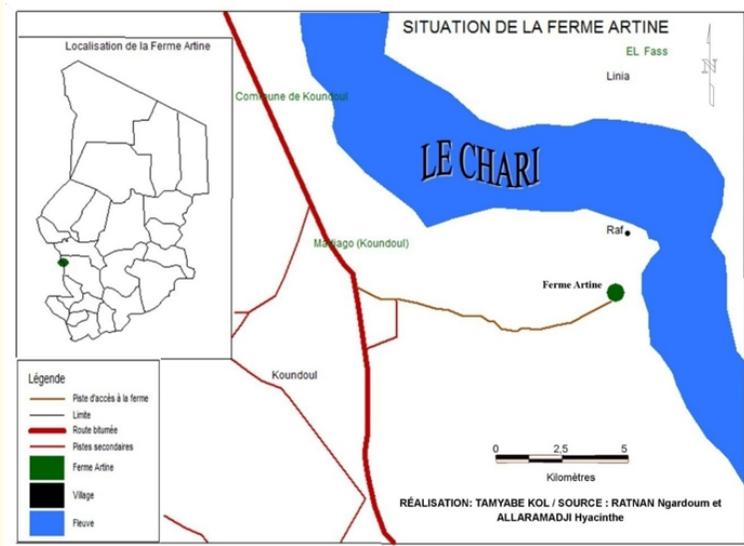


Figure 1: Location of the ARTINE farm.

Methods

Sampling

The study focused on dairy cows of Artine farm. The choice of cows was random in 128 cows out of a total of 382 cows. That is a survey rate of 33.51%. These cows are Montbeliard and Tarentaise F1 crossebreeds, as well as cows from local breeds such as Kuri, Bokolodji and MBororo.

Course of study

The study was conducted from July 05 to November 20, 2017. It consists of two phases: the pre-survey and the actual survey which focuses on the exploitation of the farm data register on the Artine farm.

Pre-survey

This phase focused on making contact with different managers of the farm. Its purpose was to identify the study area, conduct interviews with resource persons on the farm and adapt the survey questionnaire based on the information sought.

Investigation

The actual survey was based on interviews conducted with the various farm managers using a semi-open questionnaire as well as the exploitation of farm data from Artine farm.

The information sought focused on origin and number of exploited dairy breeds, certain reproductive parameters (age at first calving, lactation stage), the fattening status of cows, feeding practices (food supplements and feeding frequency distribution), health practices and milk production.

The quantity of concentrate to be dispensed was estimated using a Coro weighing 2 kg. On the other hand, the quantity of milk produced was measured using a graduated transparent bucket with a capacity of 13 liters.

Data analysis

Data collected was captured in Microsoft Excel before being analyzed using SPSS, 2009 (Statistical Package for the Social Sciences) and submitted for descriptive analysis. Descriptive parameters such as frequencies, sums, averages, standard deviations as well as maximum and minimum values were used for the presentation of the results. Chi² test was used to determine the level of significance between variables.

Results

Breeds and number of dairy cows

The results of the survey (Table 1) showed that the dairy cows of the ARTINE farm consist of cross-breeds of crossbreed in between local and exotic breeds, bulls and zebus. The Montbeliard and Tarentaise crossbreeds were obtained by Artificial Insemination (AI) with the local zebus Bokolodji and M'Bororo respectively.

Cow breeds	Effectif (n)	P.100 (%)
Montbeliard crossbreed	40	31.3
Kuri	33	25.8
Tarentaise crossbreed	21	16.5
Bokolodji	20	15.5
MBororo	14	10.9
Total	128	100

Table 1: Number and proportion of dairy cow breeds exploited of farm.

Farm infrastructures

The farm had a fenced enclosure for housing animals with a restraining device, a field for fodder (Lucerne) equipped with a watering device that operated using a generator (experimental phase of the culture), tractors, a shelter and accommodation and a borehole connected to a water tower.

Distribution of dairy cows by age at first calving

The distribution of females by age at first calving showed that the proportion of cows having age at first calving of 4 was four times higher than those had between 2 and 4 years (Figure 2).

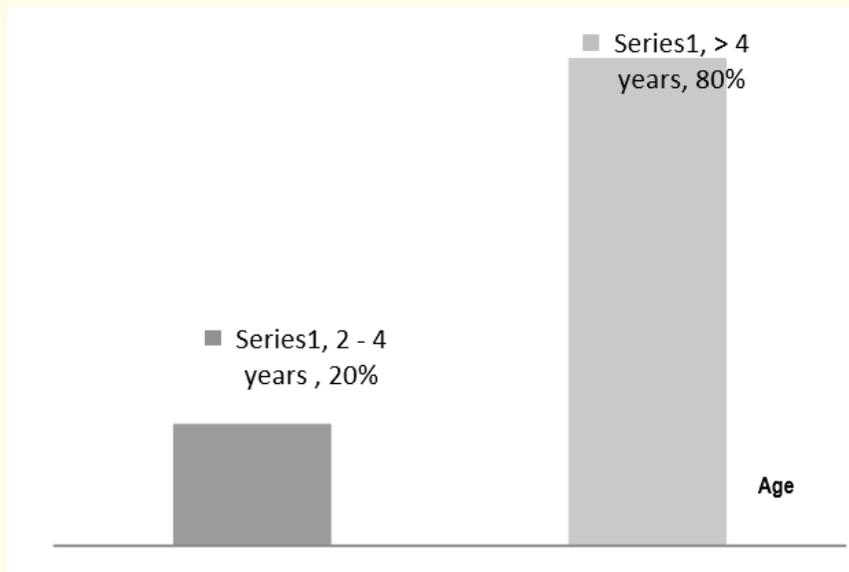


Figure 2: Location of the ARTINE farm.

The number of multiparous dairy cows was higher than those primiparous (Table 2).

Calving rank	Effectif (n)	P.100 (%)
Primiparae	26	20.3
Multiparous	102	79.7
Total	128	100

Table 2: Calving number of dairy cows in Artine farm.

Distribution of cows according to stage of lactation and age at birth

Results from lactation stage survey showed a statistically significant change in age at first calving (P < 0.05). The proportion of cows at the beginning early lactation was greater than those at the peak of lactation and during the dry period (Table 3).

Stage of lactation	Age at first calving (N = 128)		Total
	Calving number of 2 - 4 years	Calving number > 4 years	
Early lactation	14 (10.93%)	75 (58.59%)	89 (69.50%)
Peak of lactation	6 (4.68%)	22 (17.18%)	28 (21.90%)
Drying up	6 (4.68%)	5 (3.90%)	11 (8.60%)
Total	26 (20.30%)	102 (79.67%)	128 (100%)

Table 3: Distribution of cows by lactation stage and age at first calving.

Fattening status of dairy cows on the farm

The fattening status of cows was satisfactory in majority of herd (92%). In contrast, for about 8% of total, body condition score was relatively lower (Table 4).

State of cows	Effectif (n)	P.100 (%)
Good weight (3 - 3,5)	62	48.4
Very good overweight (4)	44	34.3
Too fat (5)	12	9.4
Skinny (2)	8	6.3
Too lean (2)	2	1.6
Total	128	100

Table 4: Body condition score of dairy cows on the farm.

Feed practices

Most of dairy cows were on natural pastures. However, a small proportion was fed to the trough (Table 5).

Types of conduct	Effectif (n)	P.100 (%)
Natural pastures	118	92.2
stalling	10	7.8
Total	128	100

Table 5: Feeding behavior of dairy cows.

With regard to the rationing mode of dairy cows, natural pasturage was the main source animals feed (nearly 79%). Very few cows were involved in partial stabling technique during the dry season (Table 6).

Type of rationing	Effectif (n)	P.100 (%)
Pastures alone	101	78.9
Pastures with complementation (stabling)	27	21.1
Total	128	100

Table 6: Types of dairy cows feed.

Distribution of feed supplements

The different supplements distributed consisted of fodder and concentrated feed (Figure 3). Fodder was composed of Alfalfa (*Medicago sp*), rice stalks, peanut leaves and cowpea.

Distribution frequency of feed supplements

The distribution of food supplements was in majority of cases, 2 times per cow a day depending on the case (Figure 4).

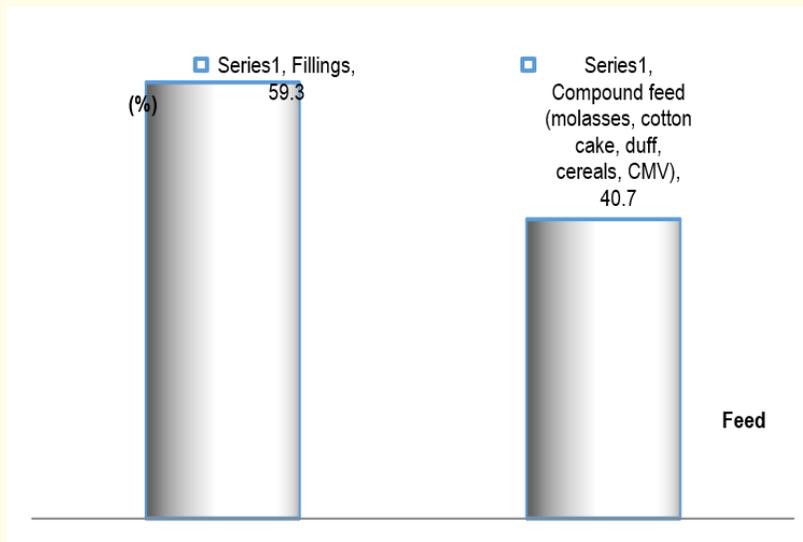


Figure 3: Feed distributed to dairy cows (%).

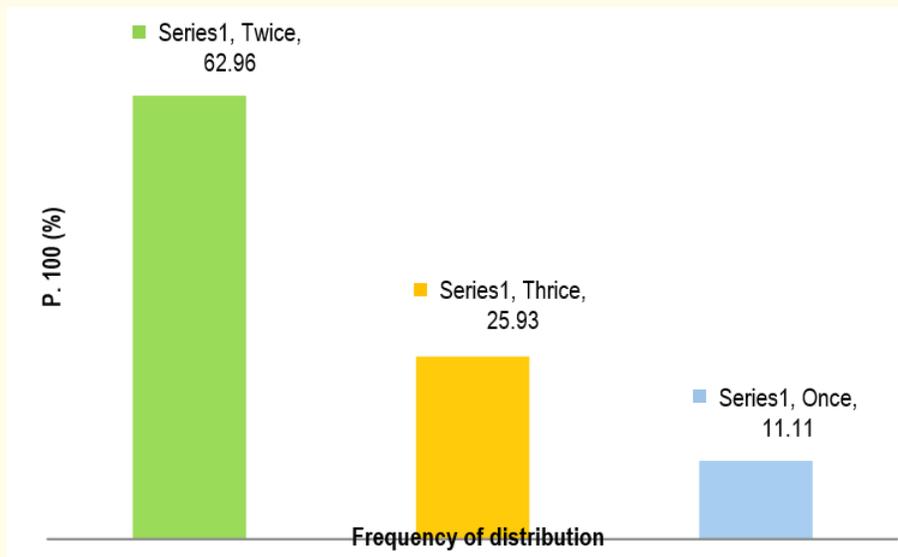


Figure 4: Distribution frequency of cows feed supplements.

Reasons for distribution of dietary supplements

The distribution of cow feed supplements to cows at Artine farm is aimed of increasing milk production, supplementing basic ration and strengthening sick cows (Table 7).

Main reasons for complementation	Effectif (n)	P.100 (%)
Increase milk production	19	70.37
Complete the basic ration	6	22.22
Strengthen weak and sick animals	2	7.41
Total	27	100

Table 7: Reasons for distribution of dietary supplements.

Health practices

Overall, dairy cows were in good health. Nevertheless, some animals appear to have a degraded state of health (Table 8).

Animal health status	Effectif (n)	P.100 (%)
Healthy cows	112	87.5
Sick cows	16	12.5
Total	128	100

Table 8: Animal health status.

Average milk production and milking frequency of cows

The results of the survey showed that daily milk production of cows of all breeds combined averaged 5.46 ± 1.69 liters with minimum of 1.75 liters and maximum of 9.5 liters. The frequency of milking was 2 times a day for the majority of cows (Table 9).

Frequency of milking per day	Effectif	P.100 (%)
Once	13	10.2
Twice	115	89.8
Total	128	100

Table 9: Frequency of milking per day.

Dairy production per cow and per day according to breeds

The amount of milk produced per day by breed is shown in table 10, showing that a large proportion of crossbreed cows produced more than five liters per day. The quantity of milk produced remains low for the Kuri breed and mediocre for the MBororo breed.

Milk breeds	Quantity of milk produced (liters a day)		
	< 4 l/j	4 - 5 l/j	> 5 l/j
Crossbreed Montbeliard (40)	0 (0%)	6 (15%)	34 (85%)
Kuri (33)	2 (6.06%)	21 (63,63%)	10 (30,30%)
Crossbreed Tarentaise (21)	1 (4,76%)	7 (33,33%)	13 (61,90%)
Bokolodji (20)	0 (0%)	13 (65%)	7 (35%)
M'Bororo (14)	11 (78,57%)	3 (21,42%)	0 (0%)

Table 10: Mean of milk produced by breed (liters a day).

Average quantity of milk produced (liter/day/cow) according to age at first calving

The results of the survey on mean of milk produced (liter per day a cow) as a function of age showed that the mean of milk produced at calving age of 2 - 4 years was higher in Montbeliard crossbreed, Kuri and Bokolodji breeds. On the other hand, among the Tarentaise crossbreeding and the MBororo breed, this quantity was higher in cows calved after 4 years ($P < 0.05$) (Table 11).

Age	Montbeliard crossbreed	Kuri	Bokolodji	Tarentaise crossbreed	MBororo
2 - 4 years	6,83 ± 1,57 (12)	5,63 ± 0,95 (4)	6,75 ± 0,35 (2)	4,75 ± 1,45 (6)	2,50 ± 0,71 (2)
> 4 years	6,53 ± 1,26 (28)	4,93 ± 1,16 (29)	5,14 ± 1,12 (18)	6,38 ± 1,47 (15)	2,88 ± 0,92 (12)
Average	6,62 ± 1,34 (40)	5,02 ± 1,15 (33)	5,30 ± 1,17 (20)	5,92 ± 1,61 (21)	2,82 ± 0,88 (14)

Table 11: Mean of milk produced (liter per day a cow) as a function of age.

Destination of milk produced at Artine farm

Much of the milk produced is self-consumed at the farm and the rest is sold (Figure 5).

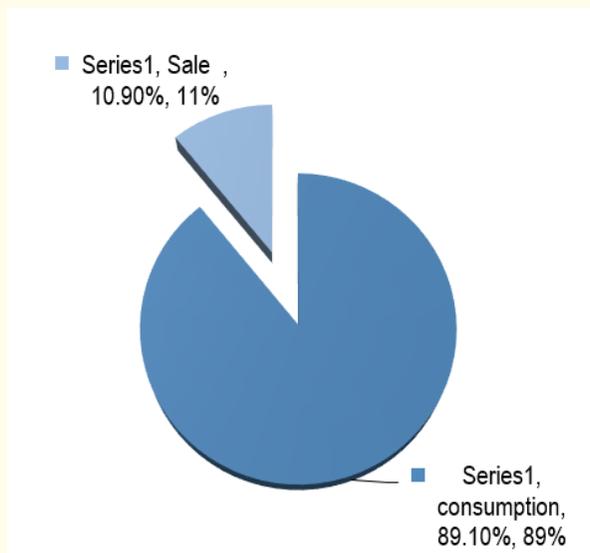


Figure 5: Destination of milk produced at Artine farm.

Discussion

Our study is carried out on Artine farm located in the peri-urban area of NDjamena and aims to make the feeding inventory of dairy cows exploited in production.

The results of the study show that the choice of exploited local breeds is based on their performance in milk production [9,13]. The dairy abilities of Montbeliard and Tarentaise crossbreed cows, their ability to adapt to farming conditions in the African environment,

were decisive factors in the choice of these exotic breeds [5,17]. The relatively high proportion of crossbreed cows (47.8%) highlights the orientation of the farm towards milk production. In contrast, the study by Tellah, *et al.* [24] on the impact of insemination on peri-urban dairy cattle production in NDjamena shows that the crossbreed cows used come from crossbreeding with other exotic breeds such as Holstein, Alpine Brown and Jersey.

With regard to livestock infrastructure, the farm has the necessary equipment to ensure good fodder production. The farm arrangement of a tractor with its equipment and establishment of a forage crop such as Alfalfa, will ensure the sustainability of production. For, the intensification of animal production is essentially based on fodder production. Thus, the choice of fodder to put in place to distribute to the animals so to produce on the farm must take into account both agronomic and zootechnical criteria. This choice must be made in a global manner that is to say for the whole of the livestock and not for a group of individuals. However, the species to be retained should be complementary to the problems of rotation and rotation of the farm, zootechnical criteria and the spread of production over time.

With respect to age at first calving, our observations show that the majority of cows calved at an age greater than 4 years. This age is higher than the observations made by Gouro [9] and Tellah, *et al.* [23] on Kouri cows which is between 3.5 - 4 years and 41.43 ± 60.66 months, respectively. This relatively late age at first calving is related to several intrinsic factors (genetic type, weight, age, physiological and health conditions, etc.) and extrinsic to the animal (environment, operating system, feeding method, etc.).

Among the cows involved in the survey, the age at first calving of crossbreed cows is earlier than that of cows of local breeds. Studies in some African countries show that the age of crossbreed cows varies from 26.3 to 58.9 months [10,18]. It is 29.6 months in Morocco [3] and 30 - 37.92 months for F1 in Senegal [7].

Compared with calving numbers, the majority of cows on Artine farm are multiparous. Regarding the stage of lactation, our study shows that the majority of cows are in early lactation. The relationship between cow age and lactation stage is statistically significant ($P < 0.01$).

In dairy farming, BCS (Body Condition Score) is an excellent tool for checking the fattening status of cows and a good indicator of their fertility state [15]. The body condition of most of cows surveyed is good and very satisfactory. This state would be due to the effect of the season during which the studies were conducted, during which there is food abundance. The low overall appearance of some animals is related to their health status.

In terms of eating behavior, most of cows are on a natural pasture and don't receive dietary supplement. These results are consistent with observations made in Niger [4,25] and in Senegal [2] where all dairy cattle farmers in peri-urban areas use natural pastures as a staple for their herds. The basic ration consists of straws and crop residues. Cows kept in stalls and fed at the trough are for specific reasons. Natural range management and feed type used show that cows are conducted extensively. These are Coro. In dairy cows, there are two periods of sensitive feeding for reproduction; it is the pre-calving and the fertilization period [15]. During these periods, a deficit of 1.7 UFL reduced the calving-insemination interval in primiparous women by three weeks [8].

Cows in stabling (sick), receive supplements based on forage and concentrate. The latter consists of molasses, cotton cake, curd, cereals and CMV, distributed at rate of 2 - 3 times/day. However, the amount distributed is not well quantified. It is estimated at a Coro and a half at most (1 Coro is estimated at 2 Kg). This quantity does not cover all needs of the cow, which vary according to weight, age, lactation stage, physiological state and animal husbandry conditions [10].

The main reasons for distributing dietary supplements are the increase in milk production, the supplement to the basic ration and the strengthening of lean and sick cows. On dairy farms, food expenses are relatively high. To reduce the cost, it would be desirable that during the period of food abundance, to substitute food supplements by the fodder distribution of good quality [6].

On the farm, average daily milk production is about 5.5 liters/cow/day. This production varied from 6.62 ± 1.34 to 5.92 ± 1.61 liters respectively for Montbeliard and Tarentaise mixed race. Despite a relatively large number of crossbreed cows and a good period of food abundance, the quantity of milk produced remains low compared to the observations made by Tellah, *et al.* [24] which is of the order of 9.44 liters for crossbreed cows grown in the urban and peri-urban areas of N'Djamena. Although the majority of cows are multiparous, this weak production is linked to the lactation stage where about 70% of cows surveyed are in the early lactation period, but also to cow management and quality food received from others. However, it is necessary to relativize the quantity of milk produced because; the measurement was carried out only during the period of the study realization and not on a whole lactation.

The study by Ba, *et al.* [2] showed that the large variations in milk production are due to the impact of climate on the availability of water and rainfall pastures.

Calving number and milking frequency greatly influence the quantity of milk produced per cow. Generally, the multiparous cow improves milk production in relation to her primiparous age [10].

Among local breeds, milk production of Kuri and Bogodji are comparatively similar to that reported in the literature [9]. On the other hand, the quantity of milk produced by Bokolodji remains lower than the observations made in Niger, which is of the order of 7 - 8 liters a day [13]. For Montbeliard and Tarentaise crossbreeds, numerous studies carried out in sub-Saharan Africa have shown that their milk production is higher than that of local breeds [5,17,19]. Improvement in rearing conditions and feeding behavior could improve the quantity and quality of cow milk productions in farm.

With respect to the average quality of milk produced, our results show that there is a statistically significant difference in the quantity of milk produced per day by calving age ($P < 0.05$). The variation in quantity of milk produced would be related to the age of calving. Thus, Tarentaise crossbreed and MBororo which calved after 4 years have a higher production than those which between 2 and 4 years conversely the Montbeliard crossbreed, Kuri and Bokolodji.

During the study period, milk produced is left to the mercy of cattlemen, where most of it is consumed. This abandonment would be related to the dispersion of cows in different places, the lack of adequate means of collection, transport and storage of milk. During the rainy season and in most cases, the quantity of milk produced exceeds that consumed. This often leads to cowboys being wasted, sometimes even throwing away excess milk. This is a huge shortfall for the breeder.

Artine farm has a relatively numerous cows. In addition, it is located near the largest urban center and capital of the country where the deficit in milk and dairy products is recurrent. At this city, N'Djamena, all liquid and curd milk sold in various markets, outlets, restaurants, street vendors, are made from imported milk powder. The marketing of milk and dairy products from the farm, will no doubt allow it to conquer these markets, remained for a long time without competition. It also reduces dependence on imports even though it is only a small part.

With regard to the marketing of milk, a small quantity is sold on the market of Dourbali by cattlemen. In this market, demand is often lower than supply. Milk processing, seems to be an alternative to solve this problem. As such, the farm has a dairy located in Klessoum which unfortunately is difficult to operate, because production seasonality does not allow a regular supply of milk throughout the year. These observations seem paradoxical and/are contrary to economic objectives of farmers [6]. Similar cases are observed by Ba, *et al.* [2] in Senegal where milk production, provided by local breeds, is seasonal: abundant in the rainy season, it is suspended in the dry season. In most countries in sub-Saharan Africa, milk traditionally remains a product of the rainy season [2].

In most African countries, commercial supply of milk by producers is often marginal or low both in terms of herd production and in relation to imported products [14]. The majority of producers are located in rural areas and herds are in transhumance more or less dis-

tant. Therefore, collection is difficult, if not impossible. The marketing possibilities then depend on a solvent local demand which remains very limited in rural areas. According to Metzger, *et al.* [14], a more distant distribution to the city will depend on several key factors.

Health practices indicate that the health status of the majority of cows is satisfactory (87.5%). Sick animals (12.5%) are affected by infections, infestations and stress. To treat them, we use conventional drugs (Oxytetracycline, Vitamin C, Fluxidin, Ivomec-D, etc.).

Conclusion

This study, conducted in peri-urban area of NDjamena, characterized cow rearing at Artine farm.

The results of the survey show that cows used were dairy breeds. Cow feeding is based on exploitation of natural pastures generally characterized by its low nutritional value. While the expression of the genetic potential of crossbreed cows and local cows is highly dependent on adequate nutrition.

The relatively large number of cows exploited, the establishment of the farm in the peri-urban area of city of N'Djamena, the presence of a mini-dairy and the absence of major health constraints are major assets to conquer a potential consumer market whose milk is an important part of their eating habits.

Despite the significant investment made, farm animal management remains extensive.

However, the lack of mastery of technical management of dairy farming, the absence of a feed calendar and organization at the farm, constitute the major constraints to the good development of milk production.

In view of these results and in view of the constraints revealed by this study, it is important that improvement actions and prospects be envisaged in order to support the actors of milk production for its sustainable development in Chad. These actions are carried out at different levels and concern veterinary revitalization and zootechnical research centers in order to enable them to carry out research/actions related to the introduction and transfer of technological packages aimed at long-term intensification of breeding.

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