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Diagnosis of a Peri-Urban Ranching System: A case Study of the Kirkissoye Dairy Cooperative in the Urban Community of Niamey, Niger

Harouna Abdou[1,*], Abdoulkadri Laouali[1], Ibrahim Karimou Adamou[2], Roi Fhad Rafiou Ala[1]

Edited by:
Hussain Ahmad,
The Islamia University, Bahawalpur, Pakistan

Reviewed by:
Awais Ihsan,
COMSAT University, Islamabad, Sahiwal Campus, Pakistan
Talat Bilal Yasoob,
Nanjing Agricultural University, Nanjing, China

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Abstract: This study aimed to analyze the functioning of Kirkissoye Dairy Cooperative's (KDC) Cow Breeding System for better milk supply. A survey was conducted among 21 farms of cows in this Dairy Cooperative of Kirkissoye from January 1st to February 15th, 2019, using a systemic approach. Analysis of data revealed that the operators were mainly civil servants (65%) and livestock farming represented a secondary economic activity for them. No farm had a homogeneous breed herd. The most dominant races were Azawak (49.3%), Crusaders (26.6%) and Goudali (20.1%). The staple food was a mixture of *Echinochloa stagnina* and rice straw, supplemented brewing grains (100%), licking stones (100%), vitamins (80%), bush straw (50%) and wheat bran (35%). The main pathologies reported were diarrhoea (69%), foot and mouth disease (14%), retained placenta (11%) and mastitis (6%). All respondents practised health and medical prophylaxis. The same applied to the use of paid labour for the management of the herd. The age pyramid had a structure which contrasts with the characteristics of a dairy herd. Average production was 3 litres of milk per cow with little difference in performance between breeds. Reproduction was by artificial insemination (75%) or by natural breeding (25%). Besides, the farm typology presented three distinct profiles in terms of herd structure, feeding practices, genetic improvement and zootechnical performance. Ultimately, the farming system of this cooperative did not meet the principles of an efficient dairy farming system.

Keywords: Diagnosis of livestock system, Niamey, Niger, Milk production, Peri-urban.

***Corresponding author:** Harouna Abdou, bassarou74@gmail.com

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1. Introduction

The livestock sector accounts for 40% of global agricultural production and contributes to the food security of nearly one billion people (FAO, 2009). Almost 80% of the world's undernourished people live in rural areas, and most of them subsist on agriculture and in particular livestock (ONU, 2004; Rhissa, 2010; Hourcade 2010; Belkheir et al., 2015; Bettayeb 2017). Cattle farming is not only the source of diet for a significant segment of the population through dairy and meat production but also serve as a source of income for breeders and farmers (FAO, 2009).

In Niger, Animal husbandry is of significant socio-economic importance, as it engages the major portion (80%) of the national population, provides an independent livelihood for 20% of the community. Livestock is ranked second, after agriculture, for its share in economic activities in Niger, It is the most dynamic sub-sector of the tertiary sector with 11% contribution in the national gross domestic product (GDP) and placed second for its share in national exports (ME/Niger, 2014; MP/Niger, 2017). In the past, livestock was more concentrated in rural areas. However, recently it is becoming increasingly important in cities. Cattles in the Niamey Urban Community of Niger, are estimated to be more than

[1]Department of Animal Production, Faculty of Agronomic Sciences, University of Tillabéri, Niger
[2]Department of Animal Production, Faculty of Agronomic Sciences, University of Tahoua, Niger

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61,000 heads, used for milk production (INS-Niger, 2015).

Niger has significant cattle population estimated at 8.737 million heads (Rhissa, 2010). However, milk production remains poor and covers only 50% of national demand (Vias et al., 2010). The low milk productivity of the herd is linked to an extensive traditional breeding system, characterized by inefficient diet plan, both in terms of quality and quantity. Moreover, dairy imports to meet the growing demand for milk and dairy products also causing economic pressure on the country. According to statistics, Niger's imports of dairy products amount to around CFA Francs 6.6 billion per year (Marichatou et al., 2005a).

To reduce imports of dairy products, the Nigerien government has prioritized the dairy sector and has introduced policies to promote it. New cattle breeding stations and centres were created (Toukounous, Kirkissoye, Ibecetene, Fako, Sayam, Bathe) between 1976 and 1978 following the drought of 1973-1974, to preserve the breeds and ensure the rescue of calves and females to cope with natural disasters (RECA, 2011). Subsequently, national milk production has significantly increased from 262,810 tons to 715.200 tons (2008), with a major contribution (60%) from the cattle herd (Vias et al., 2010). Bovine genetic improvement programs were implemented in 2011 by the government of the time to boost milk and meat performance in animals (DGPIA/ME, 2011).

As part of the promotion of milk sector, many producers use Artificial Insemination (AI) to obtain mixed breeds reputed to be very productive (10-15 litres of milk per day). Unfortunately, these products from crossbreeds between exotic and domestic breeds had lower performances than those of their country of origin and are sometimes confronted with problems of adaptation (environmental stress) and health. This has led breeders to transform domestic breeds to be more productive, e.g., Azawak or Goudali, the breeding of which has experienced remarkable growth, particularly at the Kirkissoye Dairy Cooperative (KDC), Niamey, Niger. This study was designed to analyze the breeding practices of the Zebu Azawak and Goudali at KDC to identify improvement strategies. After presenting the study area, the animal equipment and tools used were indicated.

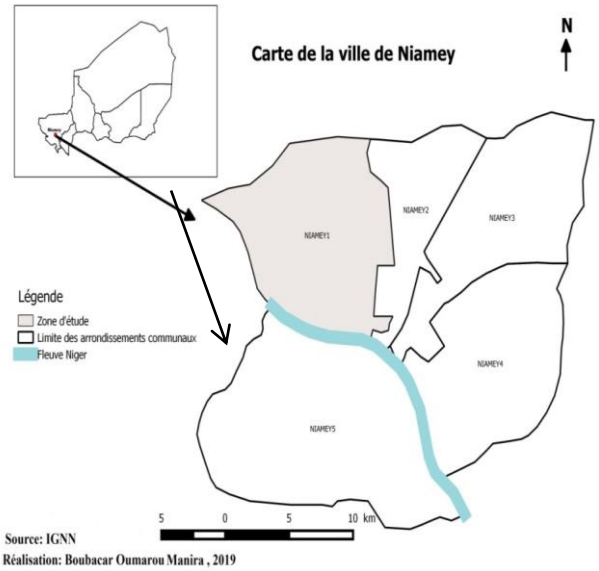

Fig 1: Location of the study area

2. Materials and Methods

2.1. Study Area

The study was conducted at the KDC located in the Urban Community of Niamey (UCN), between the parallels 13°35 North and 13 ° 24 South and the meridian 2 ° and 29 ° 15 East (Fig 1). The UCN covers an area of 239.30 km^2 (Abdou, 2007). The climate is of Sahelian type with temperature ranging from 13 ° C (cold and dry season) to 42°C (hot and dry season). The rainy season lasts a maximum of four months (June-September) for a rainfall varying from 550.4 mm for 57 days of rain in 2013 to 833.2 mm for 45 days of rain in 2017 in Niamey (INS-Niger, 2018).

Kirkissoye Dairy Cooperative was formed in 1998 to meet the demand for cow's milk and bovine dairy products. However, KDC holds limited area (36 ha). Most of which is allocated to the rice cooperative following the creation of the National Office for Hydro-Agricultural Development. Three types of activities are carried out at the KDC level. First, applied research on fodder practices, including a fodder crop component of domestic or imported species conducted in irrigation to ensure the basic ration of animals. Second is the research on improving the genetic potential of the Azawak breed and possibly of the Sokoto Goudali breed oriented towards dairy and fattening skills. The third type of activity is the popularization of technological packages on cultivation and breeding practices developed at the station with a view to the

constitution of farmer breeding for the supply of milk to the dairy of Niamey and the improvement of domestic fattening.

2.2. Methodological approach

Within the framework of this study, the system approach was favoured to analyze the assets but also the constraints of the cattle breeding system of KDC. Through a combination of zootechnical and socio-economic surveys, three poles, namely the breeder, the herd and the terror were identified and characterized on the one hand. On the other hand, the dynamic interactions between these three poles were analyzed (Fig 2).

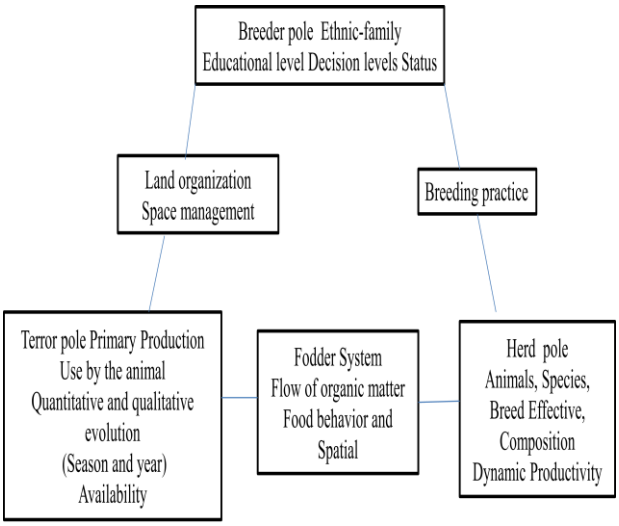

Fig 2. Systemic analysis of the three poles of the farming system and their interactions (adapted from Lhoste, 2001).

2.3. Sampling and data collection

A total of twenty-one holdings have been selected from the twenty-five of KDC. The criterion for the choice of farms was based on the availability and consent of the owners and the herdsmen to collaborate. The survey work for collecting data from farms (farmers and shepherds) was carried out from January 1st to February 15th, 2019. The survey consisted of interviews with farmers using questionnaires. Direct observations and measurements on herds have been made. Two types of respondents were involved in the study, namely the operator or owner of the animals and the herder responsible for the management of these animals. The questions related to the socio-professional status of the farmers, the demographic structure of the herds, the breeding practices (including feeding and housing, reproduction and health practices) and the reproduction and milk production performance of the herds.

Milk production has been estimated according to the method proposed by the FAO (2013): the cowherd of each farm sampled was asked to give an estimate of the daily milk production per fully lactating cow. Assessments were made for the start, peak and end of lactation for each cow concerned. The daily milk production per cow was then estimated by the average of the daily production of these three sections of the lactation period. The sale of milk being done daily by the herdsmen using the litre as a unit of measure, this sale routine was more than a proven experience for the more reliable and rapid estimation of the milk production of the animals. To confirm the responses of the shepherds on the milk production of the cows, an experimental milk control device was set up from the milking at 9 a.m. and that at 5 p.m. for two weeks. These checks were carried out on a sample of 5 Azawak cows and 5 Goudali cows chosen at random from different cowsheds.

2.4. Statistical analysis

The collected data was encoded using the Excel spreadsheet before being submitted to SPSS software for statistical analysis. Reproductive performance was assessed, at the herd scale, by the calving rate according to the model for calculating demographic rates in discrete-time over a one-year step proposed by Lesnoff et al. (2007). The herd age pyramid was established using R software and its "Pyramid" package. The zootechnical data were calculated individually for the 21 holdings. The holding x Zootechnical Data matrix thus obtained was submitted to the R Core Team 2013 software and its FactoMineR package for a first Principal Component Analysis (PCA), which made it possible to identify groups of farms with more or less similar profiles. Thus, each class (farm group) resulting from the typology was subjected to a comparative descriptive analysis according to the total sample of the study population. Quantitative variables that best characterize the partition thus obtained were determined. However, the chi² test between each additional qualitative variable (breeding constraints and selection practice) and the class variable was done for the characterization of the classes. The effect of each modality of the additional variables on a given category was evaluated according to the reduced centred normal law.

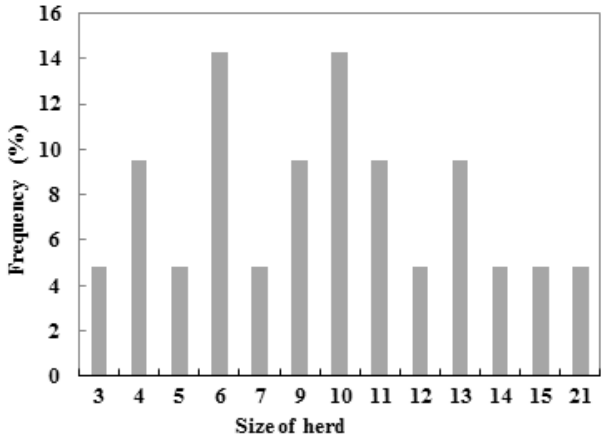

Fig. 3. The Size distribution of herds at KDC.

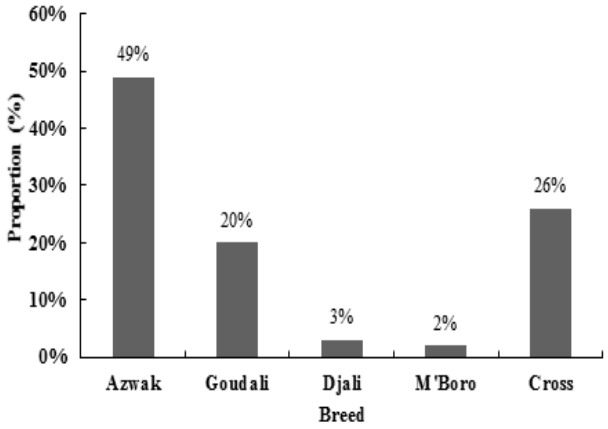

Fig. 5. The breed structure of the KDC herd

3. Results

3.1. Socio-economic characteristics of farmers

The ethnic groups that responded to the survey were four (4) in the following proportions: Zarma (40%), Hausa (35%), Peulh (15%), Touareg (10%). The majority of farmers were young (65%), and the age group over 50 represented only 35% of the sample. The respondents are all married men and heads of households. The results of the survey indicated that 75% of them had small families (maximum of five children). Besides, 70% had knowledge of the French language and/or Arabic language against 30% of illiterates. Analysis of the data also indicates that for farm owners, livestock represents secondary economic activity. They are mainly civil servants (65%) or traders (30%). Farmers came last (5%). However, this activity is market-oriented.

Fig. 4. Age pyramid of KDC herds.

3.2. Demography and structure of the KDC herd

The average size of a cattle herd at KDC was 9.1 ± 3.6 heads per farm. Groups of 6 and 10 head of cattle represent 14.3% of the sample. Herds with 14 to 21 heads are uncommon. Herds smaller than six heads represent 18% of the sample (Fig. 3). The age pyramid established at the scale of the herds of the cooperative has a sawtooth structure (Fig. 4). Overall, both sexes are kept in the herds, but breeding females dominated the pyramid. With a reduced basis, the frequency pyramid also shows, for both sexes, the low presence of individuals aged one to two years. None of the studied farms had a homogeneous herd (Fig. 5). However, Azawak cattle dominate clearly (49.25%), followed by crossbred (26.63%), Goudali (20.10%), Djali (2.51%) and M'Bororo (1.51%).

The survey revealed that buying and inheriting were the two methods of acquiring animals by operators. Purchasing is the most dominant mode for 95% of respondents. The flow analysis of the animals highlights two ways of entry, namely the purchase, which represents 60% and the birth with 40%. The exit of animals is characterized by sale (67%), mortality (14%) and slaughter (19%). However, a common practice is observed which can be registered in the entries as well as in the exits. These are loans from a male for natural breeding without any retribution. Farms surveyed in this study used males of Azawak (30%), Djéli (25%), 20% for the Goudali (20%) and crosses (5%) and M'Bororo (2%) breeds.

3.3. Herd productivity

Milking cows is done manually by the shepherds, twice a day, in the morning and the evening. The daily milk production evaluated at the sample scale varied between 1.7 to 5 litres for an average of 3 litres per cow (Table 1).

Table 1. Daily milk production performance of KDC cows

Breed	Number	Aver (L/cow)	Standard deviation	Min (L/cow)	Max (L/cow)
Average	46	3.0	0.5	1.7	5.0
Azawak	32	3.0	0.4	1.7	3.3
Cross	4	3.5	1.0	2.7	5.0
Goudali	10	2.9	0.5	2.3	4.0

Analysis of the daily dairy averages indicates little difference in performance, which is probably not significant between the breeds. With a daily average of at most 3 litres per cow, the two domestic breeds (Azawak and Goudali) seem to be less efficient compared to the mixed-breed cows resulting from the crossing between these domestic breeds and the Holstein (3.5 litres day^{-1}). Experimental results of the milk control conducted for two weeks on a sample of five cows of the Azawak breed and five cows of the Goudali breed show reduced performance. The average daily milk production per cow varied from 1.32 ± 0.07 litres in the Azawak breed and by 1.4 ± 0.4 litres in the Goudali breed.

The average age at which heifers reproduce was two years, and the age at first birth is estimated at four years (Table 2). Annual farrowing rate changes with age, going from 33% in primiparous heifers to 40% in females over five years old with a calving rate peak in cows aged four years.

3.4. Breeding practices

Dairy cattle breeding at the KDC were done in free stalling. The cooperative had 25 farmers who were also members of the Board of Directors. It employs 17 auxiliary agents including 16 shepherds and one caretaker. The financial resources of the cooperative are based on farmers' contributions to pay the keeper and ensure the production of fodder. However, each operator paid his shepherd to manage his operating unit (stable).

Table 2. Calving rate related to cow age

Age of females	No. of females	No. of births	Career birth rate	No. of career	Annual birth rate
2 years	4	0	0	0	0
3 years	15	5	33	1	33
4 years	67	64	96	2	48
5 years	10	12	120	3	40

For 80% of operators, the payment of this workforce was in cash and varied from 15,000 to 20,000 CFA francs month^{-1}. For the others (20%), payment in cash (milk and manure). All the farms surveyed had concrete barns of equal dimensions (12 m × 8 m) where the animals are kept. The latter lived in free stalls and had drinking troughs and mangers feeders at their disposal. Animals only come out in rare situations (weighing and surgical procedures).

3.5. Herd Management

Echinochloa stagnina, known in Niger as bourgou, and rice straw make up the bulk of animal's diet both in the winter season and in the hot and cold dry seasons. The average seasonal variations in the duration of use of these two basic rations were respectively 2.75 to 3 months and 1.33 to 2.56 months per farm, which indicated an essential diet of the dominant *E. stagnina* type (Table 3). Feed enrichment also had a major role in the feeding of cattle. For this, some KDC operators supplemented the daily ration with vegetable and mineral enriched feed. The feed supplements used are marketed on the market. These are mainly brewer's grain, wheat bran, peanut cake and the remains of fruits such as watermelon. Furthermore, the analysis of the fodder calendar showed that supplementation was not widespread current practise (13 to 16 farmers depending on the season). Still, the feed supplements were distributed periodically to the animals and only lasted for a few months on average (1. 31 to 2.13 months depending on the season). The animals also benefited from a mineral supplement of a variable nature depending on the availability of the market, among which the licking stones are used permanently. Similarly, 80% of them also used vitamins periodically.

Table 3. Forage calendar of the KDC

Feed Source	Season	No	Ave duration (months)	SD	Min	Max
Echinochloa stagnina	Rainy	20	3.00	0.56	1	4
	Hot dry	20	2.85	0.59	2	4
	Cold dry	20	2.75	0.79	1	4
Rice straw	Rainy	15	1.33	0.72	1	3
	Hot dry	20	2.25	0.79	1	4
	Cold dry	20	2.56	0.61	2	4
Bran	Rain	13	1.31	0.48	1	2
	Hot dry	14	2.07	0.73	1	3
	Cold dry	16	2.13	0.72	1	3

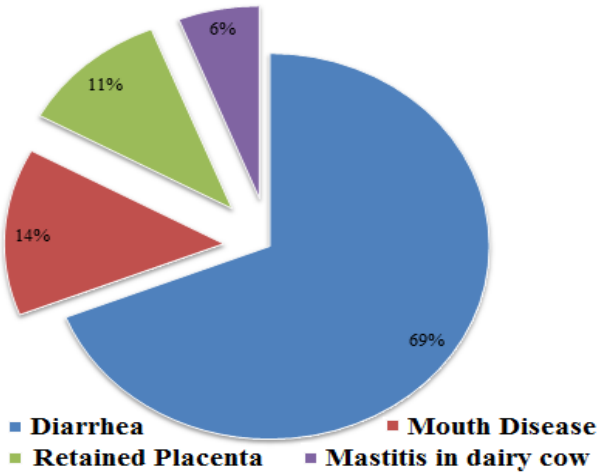

Fig. 6. Disease occurrence in KDC herds.

The water used for watering animals raised at KDC comes from the Niger River. The number of drinkers varies from one to two, depending on the barns. Donkey carts were used to supply water in the surveyed farms. The daily frequency for watering animals is not controlled, as the drinkers are always filled with water.

Main pathologies declared by the respondents include diarrhoea (69%), foot and mouth disease (14%), retained placenta (11%) and mastitis in lactating cows (6%) (Fig. 6). In terms of cowshed hygiene, 65% of respondents said they cleaned the cowshed more than twice a week compared to 20% who did it once a week, while 15% of the respondents cleaned their animals only occasionally. Moreover, all the respondents declared having practised, internal and external deworming of their animals, quarterly. This was done every three months. The supply of deworming products was obtained from an approved veterinary pharmacy.

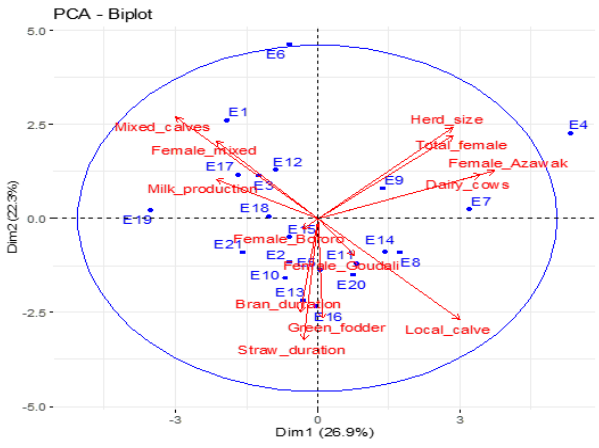

Fig 7. Correlations between variables and identification of groupings.

Artificial insemination (AI, practised by 75% of operators) and natural breeding were the leading reproductive management declared by the respondents. The average age for breeding heifers was 24 months. Accurate heat detection was challenging, as females could have silent heat. Respondents reported bleating of cows, passive overlapping of other cows and acceptance of the male, as the major signs of heat detection. In the case of natural breeding, after detection of signs of heat, the operator selected the sire of his cowshed or borrows from other operators. The most sires used were those of the Azawak (80%) and Goudali (20%) breed. For farms that used artificial insemination, a team of inseminators came first to trigger estrus in cows in a synchronized manner. After two weeks, the insemination is done artificially with the seeds of exotic breeds (Holstein). However, insemination may not be successful for the first time. The gestation report is based exclusively on the observation of the non-return of heat.

3.6. Typology of farms

Following the interpretation criteria adopted (contribution and quality of projection), the first two components of the AMC explain only less than 50% of the total inertia (Fig 7), with 11 quantitative variables out of 13 interpretable on the factorial plane. These components, synthesizing complete information through these 11 variables, were therefore sufficient to guarantee a precise interpretation of the results. Besides, the test values indicate that all the additional qualitative variables were well interpretable on the first two components, at least for one modality (Table 4).

Table 4. Test values of the additional variables on the two axes of the PCA

Variables	Modalities	Dim1	Dim2
Constraints	Financiers	-0.977	-0.040
	Housing	-0.492	-0.887
	Pathological	0.957	0.720
	Performing breed	0.557	-0.238
	Any	-0.122	-2.243
Parent	Azawak and goudali	-0.556	0.031
	Azawak	2.141	0.401
	Holstein Crusader	-1.731	2.155
	Goudali	-0.315	-0.289
Cut	Big	2.312	1.777
	Average	-1.374	0.407
	Small	-1.065	-2.220

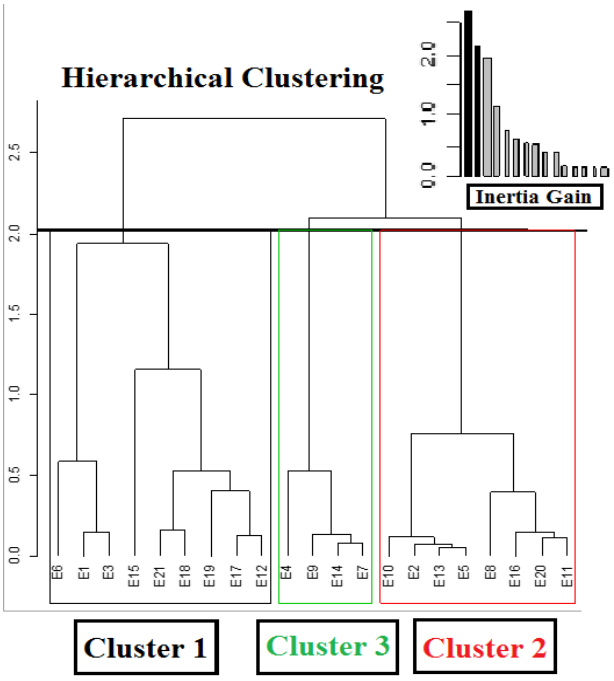

Fig. 8. Typology of farms of the KDC

The first component of the PCA was an axis of the farm description according to the breed structure, the dairy performances and the size of the herds (Fig 7). This axis opposed, on the positive side, the first group of farms (Cluster 3, Fig. 8) dominated by Azawak females, of dairy cow and larger size (100% of farms), with the second group of farms with crossbred females (3.0 ± 2.0 heads on average) and with dairy performances (3.6 ± 0.7 litres day^{-1} cow^{-1}) very characteristic. In the first group, the larger herd size (16 ± 3.7 heads) and the dairy underperformance of the cows are associated with a high number of breeding females (8 ± 2.2 heads on average) and lactating females (5.3 ± 2.1 heads). Also, the test values indicated a selection rather oriented towards the choice of a male Azawak breed. Finally, the average rate of calving calculated on the scale of this subgroup was 48.3% or slightly less than one calf every two years.

In group 2, on average, 83.3% of the farms surveyed had a sire crossbreeding stock in their herd. The average calving rate was highest at 52.3%, just over one calf every two years. The second component of the PCA described small herds of course (Cluster 1, Fig 8), but, beyond the constraints typical to all farms (Financial constraints, minimal availability of inputs on the market, lack of plot none of the limitations studied seemed to affect the herds on these farms. The main characteristics of these herds reside in their straw-based feeding practices, the duration of which (6.3 ± 0.9 months on average) was the longest compared to the remains of the farms, as much for the basic food (Rice straw and *Echinochloa stagnina*) only for the complementary ration, namely bran (Fig 7). Beyond these practices, a high proportion of calves of domestic breeds is observed (76% versus 24% crossbred), fewer breeding females (3.5 ± 1.9 heads on average) and fewer dairy mixed breeds (0.3 ± 0.4 heads on average) (Fig 7). The test values indicated, on the other hand, that the operators of this group have more limited availability (8.3%) of a Métis sire from crosses between domestic breeds and the exotic breed (Holstein) in their herd. The absence of sires is also observed in 41.7% of the herds in this group, with the lowest average calving rate (33.9%).

There were three types of farm profile at the KDC (Fig 8). Seven (7) variables among thirteen (13) selected for the study; significantly characterize the score as a whole. Individuals belonging to different standard profiles, therefore, take, overall, significantly distant values for these variables. The most critical variables, that best characterized the typology of farms (classes) were the number of females of the Azawak breed, cross-type cows and total breeding females, the number of domestic and crossed calves, and the size of the herd.

4. Discussion

The strong involvement of the Zarma ethnic group in peri-urban dairy cattle farming has already been described in other studies which have shown, as in this work that 40% of breeders in the peri-urban area of Niamey are Zarma (Chaibou et al., 2011). Young people and adults (20 to 50 years old) were primarily the owners of farms at KDC level (65% of the sample). These results were similar to those reported by Assaini, (2013) in a study on productivity Goudali zebus in the far north of Benin, where the age of breeders varies from 25 to 60 years.

In terms of activity diversification, the operators of the studied area were dominated by civil servants (65%), and they were able to mobilize their financial resources for the promotion of intensive farming. This strong involvement of civil servants in dairy cattle breeding was also noted by Meyer and Denis, (1999). So at this cooperative, buying was the primary mode of acquisition of animals for 95% of respondents. These results corroborated those of Chaibou et al. (2011) in peri-urban areas where the purchase represented 85% of the mode of entry of animals on farms. At the same time, it is noted that sale is the main route of exit for animals (70%),

followed by slaughter and mortality. This same observation was reported by (Mounkailla, 2005).

The basic diet for cattle at KDC was mainly rice straw and *Echinochloa stagnina*. Supplementation is practised periodically by all respondents in the area because food supplements for animals were not always available on the market. The survey revealed that at KDC level, the coverage of energy and protein nutrient requirements of animals remains very limited to favour milk production, which daily average is around 1.32 ± 0.07 litres in Azawak cows and 1.4 ± 0.4 litres in the Goudali cow. Indeed, dairy performance is intrinsically linked to food (Dioffo, 2004; Abdou, 2007; Cuvelier et al., 2010; Croisier et al., 2012). These results were much lower than those obtained by Abdou (2007) for the same centre (KDC) with a variation in the daily milk average between 2.3 ± 0.4 litres to 5.1 ± 0.4 litres per cow. Overall, the daily production of these cows at the KDC was far below their potential (Marichatou et al., 2005b). The results of this study also highlighted operators preference for health.

Two annual vaccination campaigns were organized at CLT level, one against symptomatic anthrax (CS) and the other against contagious bovine pleuropneumonia (CBPP). Thus, animals were regularly vaccinated against these pathologies. Also, deworming (internal and external) is practiced by all respondents every three months. Health management is necessarily based on rapid disease treatment, indicating improved veterinary care facilities in the peri-urban areas benefits the farms. Vigilance on epidemiological surveillance was increased at the level of this Dairy Cooperative. However, the lack of hygiene observed in the stables could lead to the appearance of diseases such as diarrhoea (69% of respondents) and mastitis in dairy cows because from a health standpoint. Floor cleaning was emphasized considering the importance of feet hygiene (Schreiner and Ruegga, 2003; Sraîri et al., 2005; Saidi et al., 2011; Belkheir et al., 2015).

Animal reproduction was mainly (75%) carried out by AI with the seeds of bulls of improved Azawak breeds. The use of this new technique could be explained by the desire of farmers to have rustic domestic breeds with high milk production. According to the testimonies collected from the respondents, the reproduction parameters (age at first calving, the interval between calving, duration of gestation and fertility) of the Azawak and Goudali breeds were excellent compared to the others. Indeed, it is reported from the work of Johnson et al. (1984), on the Sokoto Goudali breed, at the Shika station in Nigeria, age at first calving of 40 months. The calving interval and calving rates were 378.4 ± 23.6 days and 54.0 ± 3.6%, respectively (Johnson et al., 1984). However, this method of reproduction also had limitations (Betayeb et al., 2017). Indeed, the use of pure breeds promotes consanguinity within the herd but also the loss of cycles (Assani, 2013) and the appearance of tares following an intense depression of consanguinity (Ebangi et al., 2002; Ceriotti et al., 2003).

The age pyramid is an essential diagnostic tool (Lhoste et al., 1993). The profile of the age pyramid of KDC herds presented an unstable demographic regime (sawtooth) with a narrowed base and a very broad top in this case for the breeding females. These reflect a decline in the herd (Lhoste et al., 1993), maintaining a large proportion of young males and even bulls, beyond the sex ratio, rules out the hypotheses of a herd with breeder or dairy function (Lhoste, 2001). The high rate of female individuals could well explain a rebuilding strategy by the purchase of cows and breeding heifers, to reinforce milk production. Indeed, the profile of the general evolution of the herds and the reduction of animals of both sexes in the age group of 2 to 3 years is evidence of a significant episode in the past such as high mortality of the young or even a catastrophic decline in fertility (Lhoste et al., 1993). In this case, the high proportion of older females could aim to rebuild the herd (Hourcade, 2010).

The establishment of the typologies of production systems was a precious element for the orientation of agricultural development (Perrot and Landais, 1993). The typological analysis of the KDC herds led to three subgroups. For group 1, the operators favoured exotic breeds for the genetic improvement of animals, which made it possible to improve the milk productivity of herds. Crossing with hardy females allowed them to alleviate the constraints of environmental adaptation and to have in their herd, a male crossbred and to be less dependent on inseminators. In contrast, in group 2 farmers, the selection was more oriented towards domestic breeds (choice of a male Azawak breeder). In fact, in a semi-arid environment like in sub-Sahelian Africa, the domestic breeds were particularly well adapted to local environmental stresses (Moyo et al., 1996). Choosing a breed well suited to the specific environment improves the efficiency of animal production (Moyo et al., 1996). The choice of the Azawak breed was not surprising; the Azawak cattle

breed was known to be the best dairy in the sub-regions (Kassa et al., 2016) with good fertility (Achard and Chanono, 1997).

4. Conclusion

At the end of this study, it is noted that the majority of the operators are civil servants; breeding is only a secondary economic activity. The animals were bred in free housing. The study found that the farming system at the Kirkissoye dairy cooperative is not efficient. The animals were mainly fed with *Echinochloa stagnina* and rice straw. Although supplemented, this diet did not cover the energy and protein nutrient requirements of animals, which results in lower performance of the herd, particularly for milk production, a production far below the potential of KDC dairy farmers. Furthermore, the age pyramid of the KDC herds suggests a fattening and non-dairy herd. In short, milk production at KDC level remains low despite the semi-intensive nature of the farming system in place. What invites reflections towards a complementary zootechnical analysis to understand with more precision the poor performance of the dairy farmers and boost the production of this cooperative.

List of Abbreviations: AI, Artificial Insemination; CBPP: Contagious Bovine Pleuropneumonia; DGPIA/ME: Direction Générale de la Production et des Industries Animales; KDC, Kirkissoye Dairy Cooperative; PCA, Principal Component Analysis; UCN, Urban Community of Niamey.

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References

Abdou, H. 2007. Influence de la complémentation sur la production laitière chez la vache zébu Azawak de la coopérative laitière de kirkissoye au Niger : cas de deux concentres « son de blé et drèche de brasserie ». Mémoire de DEA, Ecole Inter-états des Sciences et Médecine Vétérinaires de Dakar/Université Cheik Anta Diop de Dakar, Sénégal. 54p.

Achard, E et M. Chanono. 1997. Mortalité et performances de reproduction chez le zébu Azaouak à la station de Toukounous, Niger (1986-1992). Revue Élev. Méd. vét. Pays Trop. 50 (4): 325- 333.

Assani, S.A. 2013. Typologie et productivité des élevages de Zébu Goudali situés dans les communes de Malanville et de Karimama à l'extrême Nord du Bénin. Thèse d'Ingénieur Agronome, Université de Parakou, Benin, 103p.

Belkheir, B., F. Ghozlane, M. Benidir, A. Bousbia, N. Benahmed, et S. Agguini. 2015. Production laitière, pratiques d'élevage et caractéristiques du lait en exploitations bovines laitières en montagne de Kabylie, Algérie. Livestock Research for Rural Development. DOI: http://lrrd.cipav.org.co/lrrd27/8/belk27145.html

Bettayeb, A. 2017. Conduite d'élevage bovin laitier dans la région d'Ourgla. Mémoire de Memoire de Fin d'études en vue de l'obtention du Diplôme d'Ingénieur d'Etat, Université Kasdi Merbah., Ourgla, Algérie. 47p.

Ceriotti, G., A. Caroli, R. Rizzi et C. Crimella. 2003. Genetic relations between the taurine (Bos taurus) and of the zebus (Bos indicus), the populations as revealed by the blood groups and proteins of blood. J. Anim, Breed. Genet. 120 (1) : 57-67.

Chaibou, M., A. Illia et H. Marichatou. 2011. Pratique de gestion et performance de production dans les élevages bovins laitiers urbains et péri-urbains de Niamey. Revu de bio-ressource. Université Abdou Moumouni de Niamey, Niger, AM, Ministère de l'Elevage et des Industries Animales, Niger.12p.

Croisier, M et Y. Croisier. 2012. Alimentation animale: raisonnement de l'alimentation des animaux d'elevage. ed. Educ agri. 232p.

Cuvelier, C.H., J-L. Hornick, Y. Beckers, E. Froidmont, E. Knapp, L. Istasse et I. Dufrasne. 2010. L'Alimentation de la vache laitière: physiologie et besoins. Université de Liège, Centre Wallon de recherches Agronomiques. Belgique. 67p.

Dioffo, O. 2004. Contribution à l'étude de la dynamique de la production laitière chez la vache Zébu Azawak à la station sahélienne expérimentale de Toukounous au Niger. Thèse de Doctorat d'Etat en Sciences et Médecine Vétérinaire, Ecole Inter-états des Sciences et Médecine Vétérinaires de Dakar/Université Cheik Anta Diop de Dakar, Sénégal. 18p.

Direction Générale de la Production et des Industries Animales, Ministère de l'Elevage (DGPIA/ME), République du Niger 2011 Programme de travail et budget annuel (démarrage). 34p.

Ebangi, AL, G.J. Erasmus, D.A. Mbah, C.L. Tawahand and O. Messine. 2002. Factors Affecting Growth Performance in Purebred Gudali and Two-Breed Synthetic Wakwa Beef Cattle in a Tropical Environment. Revue Élev. Méd. vét. Pays trop., 55 (2): 149-157.

FAO, 2009. Base de données sur les activités rurales génératrices de revenus [En ligne : [Adresse URL : www.fao.org/fr/ESA/riga/french/index_en.htm]. Consulté le 2/4/2019.

FAO, 2013. Caractérisation phénotypique des ressources génétiques animales. Directives FAO sur la production et la santé animales n° 11. FAO, Rome, Italie, 151 p.

Hourcade, M. 2010. Estimation des paramètres démographiques des systèmes d'élevage bovins et analyse de la filière viande bovine, dans le *Southeast Lowveld* (Zimbabwe). Mémoire de Master, Université Montpellier II, CIRAD – Zimbabwe, 129 p.

INS-Niger, 2015. Annuaire statistique régional de Niamey 2010-2014. 82p.

INS-Niger, 2018. Annuaire Statistique Du Niger, 2013 – 2017. 260p.

Johnson, A.O., V. Buvanendran, et B.A. Oyejola. 1984. Dairy potential of Bunaji (WhiteFulani) and Bôkoloji (Sokoto Gudali) breeds. Trop. Agric. (Trinidad), **61** (4): 267-268.

Kassa, K.S., S. Ahounou, G-K. Dayo, C. Salifou, M.T. Issifou, I. Dotché, P.S. Gandonou, V. Vapi-Gnaoré, B. Koutinhouin, G.A. Mensah et I.A.K. Youssao. 2016. Performances de production laitière des races bovines de l'Afrique de l'ouest. Int. J. Biol. Chem. Sci.**10** (5): 2316-2330.

Lesnoff, M., R. Lancelot et C.H. Moulin. 2007. Calcul des taux démographiques dans les cheptels domestiques tropicaux-Approche en temps discret. Edition Quae.74p.

Lhoste, P. 2001. L'étude et le diagnostic des systèmes d'élevage. Atelier de Formation des agronomes SCV Madagascar, 13-23 mars 2001. [En ligne] Adresse URL : http://agroecologie.cirad.fr. Consulté le 28 janvier 2020.

Lhoste, P.**,** V. Dollé, J. Rousseauet et D. Soltner**.** 1993. Manuel de zootechnie des régions chaudes. Les systèmes d'élevage. Paris : Ministère de la coopération, 288 p. (Manuels et précis d'élevage : IEMVT) ISBN 2-11-087335-3.

Marichatou, H., H. Koré, H.K. Motcho et G. Vias. 2005a. Synthèse bibliographique sur les filières laitières au Niger. Document de travail n° 4. Réseau de recherche et d'échanges sur les politiques laitières. Coordination ISRA-BAME. 40 p.

Marichatou, H., S.G. Abdoulaye et A.B Kanwe. 2005b. Production laitière de la race Gudhali et croissance des jeunes purs et croisés, en zone périurbaine de Bobo-Dioulasso (Burkina Faso). Cah. Agric., 14 (3) : 291-296.

Meyer, C., et J.P. Denis. 1999. Élevage de la vache laitière en zone tropicale. Montpellier (France) : CIRAD-EMVT, 314p.

Ministère de l'Elevage, République du Niger, 2014. Atlas sur l'élevage au Niger : L'élevage au Niger, une richesse sans fin. Direction des statistiques, 133p.

Ministère du Plan, République du Niger, 2017. Plan de Développement Economique et Social 2017-2021 : Un Niger renaissant pour un peuple prospère. Ministère du Plan, 198 p.

Mounkaila, M. 2005. Caractérisation préliminaire des élevages laitiers périurbains de la communauté urbaine de Niamey. Niamey (Niger). Faculté d'Agronomie /Université Abdou Moumouni de Niamey, Niger. 64p.

Moyo, S., F.J.C. Swanepoel and J.E.O. Rege. 1996. Evaluation of indigenous, exotic and crossbred cattle for beef production in a semi-arid environment: reproductive performance and cow productivity. Proc. Aust. Soc. Anim. Pro. 21: 204-206.

ONU, 2004. Halving hunger by 2015: a framework for action. Rapport intérimaire. Équipe spéciale du Projet du Millénaire chargée des problèmes de la faim. New York, États-Unis d'Amérique, Projet du Millénaire.

Perrot, C. et E. Landais. 1993. Exploitations agricoles : pourquoi poursuivre la recherche sur les méthodes typologiques. Les cahiers de la Recherche-Développement. 33 : 13-23.

R Core Team, 2013. A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Réseau National des Chambres d'Agriculture du Niger (RECA). 2011. Programme National d'Amélioration Génétique/Bovins locaux (PNAG/BL) Présentation d'extraits du programme.Note d'information / Actualités Niger n°24, 4p.

Rhissa Z., 2010. Revue du secteur de l'élevage, rapport provisoire, FAO/SFW, 115 p.

Saidi, R., D. Khelef et R. Kaidi. 2011. Evaluation d'un test de dépistage précoce des mammites subcliniques des vaches. Pratique Vétérinaire, Revue bimestrielle 11 (Septembre-Octobre), p18-26.

Schreiner, D.A. and P.L, Ruegga. 2003. Relationship between udder and leg hygiene scores and subclinical mastitis. Journal of Dairy Science. 86: 3460-3465.

Sraîri, M.T., I. Hasni Alaoui, A. Hamama et B. Faye. 2005. Relations entre pratiques d'élevage et qualité globale du lait de vache en étables suburbaines au Maroc. Revue de Médecine Vétérinaire. 156 (3) : 155-162.

Vias, G., M. Goni et S. Ousseini. 2010. Perspectives de la production laitière au Niger. 8p.