



(RESEARCH ARTICLE)



## Evaluation of the practice and contribution of sheep breeding and camel milk to the income of camel drivers in the peri-urban area of N'Djamena (Tchad)

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### Abstract

Camel drivers living in the peri-urban area of Sahelian cities carry out several economic activities. These activities can have an impact on techno-economic practice of livestock. A cross-sectional survey was conducted in 2018 to assess the practice and contribution of sheep breeding and camel milk to the income of camel drivers in the peri-urban area of N'Djamena. It affected 42 sedentary camel drivers (27.6%). Young camel drivers ( $31.52 \pm 9.3$  years old) raise a mixed herd. Arab sheep is exploited for the subsistence. Its productivity is improved by monitoring reproduction, breeding selection (format) and supplementation. A family workforce and salaried shepherds ensure manage and sell. Camels walk during the day under the control of a young camel driver. Camel is milked manually by a woman and/or a man. The demand for sheep on the market is higher than that of goats and camels. The contribution rate of the average annual income of sheep sold (ScoreAISSm) is  $51.2 \pm 23.6\%$  of the total average annual income from breeding (ScoreTAIBm) ( $1960187 \pm 1028966$  CFA francs). This rate is high in Group A households not selling camel milk compared to Group 2 ( $p < 0.01$ ). Average annual income from the sale of camel milk (ScoreCMm) provides the daily expenses of the household in Group B. The correlations between the number of women–ScoreTAIB and the number of women–ScoreCMm are positive ( $p < 0.01$ ). Depending on opportunities offered by the place of sedentarisation, camel drivers develop strategies to better meet the urban market demand while maintaining a pastoral way of life.

**Keywords:** Sheep breeding; Camel milk; Income livestock; Peri-urban area; N'Djamena

### 1. Introduction

Like other Sahelo-Saharan countries, camel breeding in Chad is undergoing a profound change. The national camel herd consists of 6,413,522 heads [1]. The camel or the "desert vessel", emblematic means of transport of the trans-Saharan tracks in Africa and the Silk Road in Asia, continues to provide varied services to the population by offering them milk and meat. The economy of camel breeding is based essentially on the transport and sale of animals. In Chadian pastoral culture, camel milk is self-consumed by the family or offered free of charge to passing guests and poor people raw or fermented. The evolution of the production system, the climate, the social hope of nomadic pastoralists (education, health and economy), the growing urbanization of the rural population, the renewed interest in camel milk and meat by urban dwellers and especially access to the urban market have supported the emergence of camels and facilitated the

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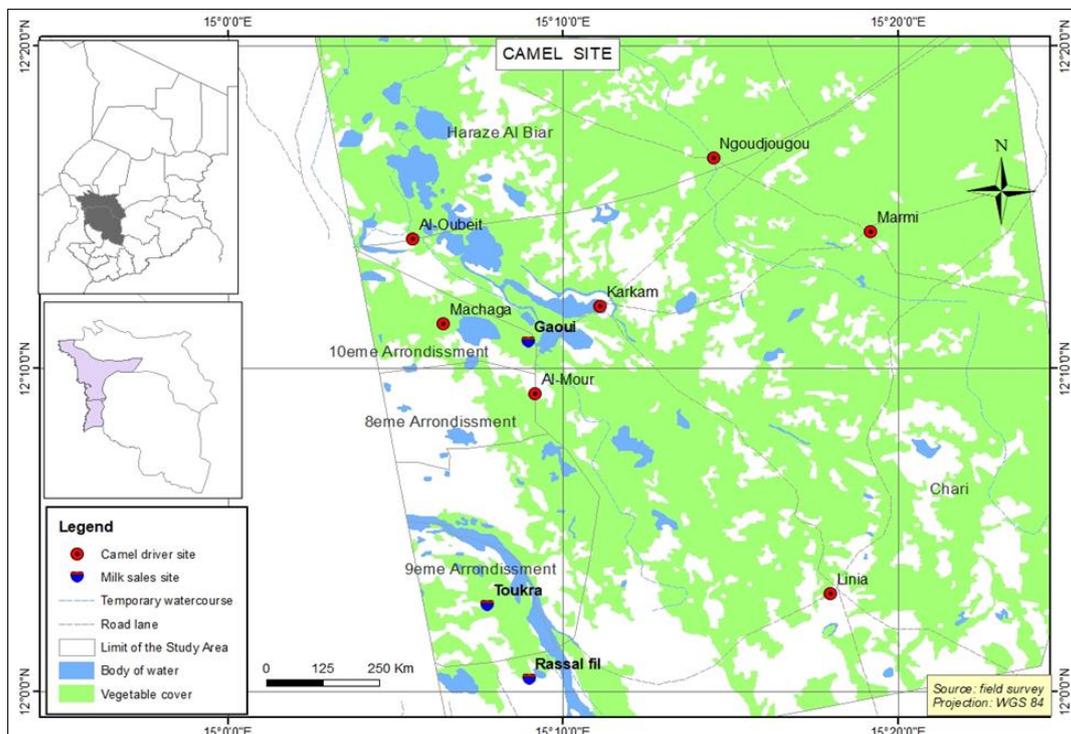
establishment of camel drivers around large cities [2-5]. The way of life of camel drivers (urbanization, sedentarisation) and the practice of their breeding activities have also gradually undergone transformations [2, 5-7].

In Chad, the vast majority of camel drivers associate camel breeding with that of small ruminants. However, the camel herd in the peri-urban area of large cities consists mainly of producing camels and small ruminants [7, 8]. It has made it possible to set up a marketing circuit for its products (sale of animals and milk) during their stay (dry season) in the peri-urban area of N'Djamena. The sale of the camel is slow with an irregular income [5, 8]. The irregularity of the income from the sale of camels often does not ensure household food security [4]. Thus, the diversification of income from complementary socio-economic activities through the exploitation of small ruminants and the sale of milk could ensure greater fluidity in household cash flow and allow livestock to be self-financing. Sheep breeding allows for much more regular sources of income than with camel breeding [5]. It can thus generate an additional real income securing the multi-activities and social life of camel drivers. However, the exploitation of sheep among camel drivers and the contribution of the sale of camel milk to household income has not been the subject of any study, hence the interest of this work. The objective of this study is to assess the practice and contribution of sheep breeding and camel milk to the income of camel drivers in the peri-urban area of N'Djamena.

## 2. Material and methods

### 2.1. Study area

The study was conducted in urban and peri-urban areas of the city of N'Djamena. N'Djamena has a dry tropical climate with two seasons: a long dry season (8 months) and a short rainy season (4 months). The average temperature is around 37°C, with a minimum of 18°C in January and February and a maximum of 45°C between April and May. The area benefited from two permanent streams, which are the Logone and Chari rivers. The shrub vegetation consisted mainly of *Acacia sp.* (Figure 1)



**Figure 1** Location of the study area

### 2.2. Sampling and data collection

The study was conducted by cross-sectional survey at two passages in March 2018 among 42 camel drivers. A pre-survey phase was used to identify the sedentary camel drivers who exploit the Arab sheep and to test the survey form in order to adapt its content to the survey itself. These breeders represent 26.3% of the camel drivers in the surveyed area. Part of the household and herd go into transhumance during the rainy season. The survey itself made it possible

to collect data from camel drivers in their camp through a direct individual interview with the head of household. This survey was guided by a survey form created for this purpose. Camel prices in the markets of N'Djamena were recorded. The data collected concerned:

- the socio-professional and educational characteristics of the head of the household (sex, age, level of education, year of responsibility, main activity) and the members of the household (number of persons in the household, number of active people, employees);
- breeding practices: this part provides information on the composition of the herd, milking technique and the technical management of sheep;
- Sources of household income: sale of camels, camel milk, sheep, and others.

### 2.2.1. Analysis

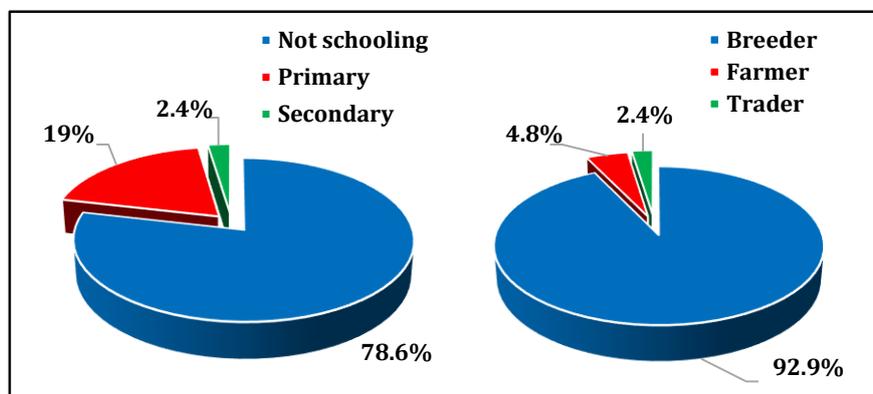
Statistical data processing was carried out using the Statistical Package for the Social Science (SPSS version 25) software. Descriptive statistics were used to calculate the percentage of qualitative variables and the mean with standard deviation of the different quantitative parameters subjected to analysis of variance (ANOVA) with the significance level of 5%. The Pearson correlation between the variables was calculated. The Principal Component Analysis (PCA) concerned variables relating to the economics of sheep farming.

## 3. Results

### 3.1. Status of the breeder

The survey was conducted among camel drivers in the urban and peri-urban area of N'Djamena (52.4%: Al-mour, Gaoui, Machaga and Koukra) affecting the provinces of Chari-Baguirmi (26.2%: Linia and Rassal fil) and Hadjar-Lamis (26.2%: Al-Oubeit, Karkam, Marmi and Ngoudjougou). A part of the camel driver's family consisting of  $8.3 \pm 3.2$  persons ( $6.5 \pm 2.4$  man and  $2.4 \pm 1.0$  women) per household was settled in the surveyed area. The average number of women per household by province is significantly different ( $p < 0.001$ ). A head of household has been appointed by the family to lead and manage the income of the breeding installed in peri-urban areas. These heads of peri-urban households who have been settled for  $13.26 \pm 9.2$  years are  $31.52 \pm 9.3$  years old. They have little schooling (figure 2). Camel drivers own their animals (92.2%). Their main activities are the camel breeding (66.7%), the small ruminants breeding (31%) and agriculture (2.4%) (Figure 1). Family members involved in sheep breeding represent  $1.7 \pm 1$  people. In addition to this staff from the family, 40.5% of the breeders employed  $1.4 \pm 0.8$  employees. Salaried shepherds were paid monthly at  $21411 \pm 4912$  CFA francs (15,000 to 30,000 CFA francs). The size of the sheep herd was significantly correlated with the number of employees (0.568) ( $p < 0.01$ ).

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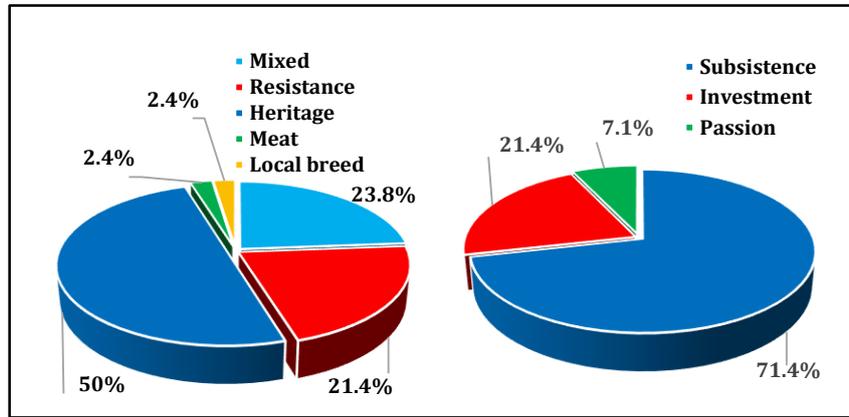
**Figure 2** The level of training and the main function of camel driver

### 3.2. Herd management

All the herd surveyed consisted of camel, sheep and Sahelian goats. Sheep breeding has been associated with camel breeding for several generations in all breeders. The sheep herd of the breeding comes from the inheritance in 95.2% of camel driver and the remaining 4.8% had bought it with their own funds. Their mode of travel is dominated by seasonal transhumance (95.2%). A nomad and a sedentary one was recorded among the herders surveyed. The

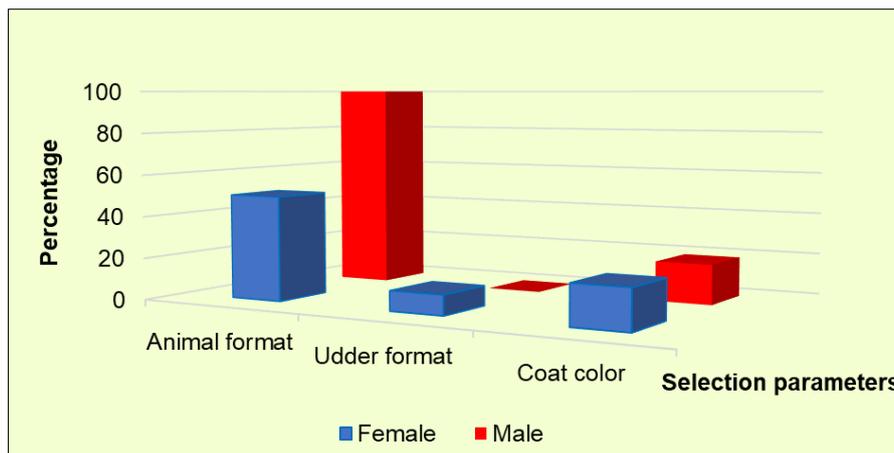
operating system is the traditional system (92.9%) and the semi-extensive system (7.1%) with a free stall. The camels are wandering during the day under the control of a young camel driver.

The Arab sheep of the herd surveyed is inherited in 50% of camel drivers. The other camel drivers themselves chose this breed for its mixed production (milk/meat), its resistance, its meat or simply because it is the local breed (Figure 3). The Arab sheep herd consists of  $113.6 \pm 68.5$  heads. The purpose of exploiting the Arab race is dominated by subsistence (Figure 3). The camel drivers surveyed also have a small nucleus of Fulani sheep (35.7%) and Kababich sheep (7.1%).



**Figure 3** Choice of breed and purpose of breeding Arab sheep

All breeders monitor the reproduction of sheep. The calving-to-calving was interval was  $7.15 \pm 0.62$  months and the calving-to-first service interval was  $1.47 \pm 0.56$  months. The breeding ewe and ram are selected on the basis of coat color, animal format and udder format (Figure 4).



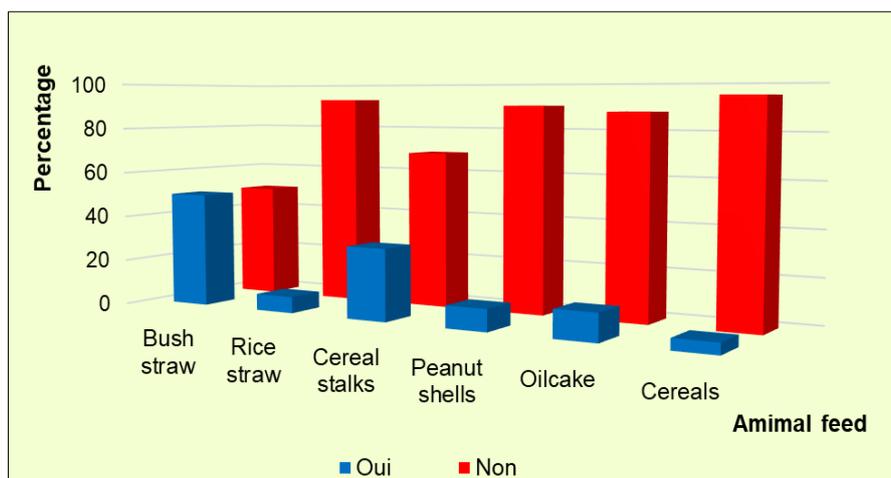
**Figure 4** Choice of breeders

The main method of breeding selection is based on the animal format (Table 1).

**Table 1** Method of selection of breeding ewes and ram

|            | Female (%) | Male (%) |
|------------|------------|----------|
| Format     | 59.5       | 45.2     |
| Precocity  | 7.1        | 2.4      |
| Ancestry   | 28.6       | 28.6     |
| Resistance | 4.8        | 0        |
| Vigour     | 0          | 23.8     |

The animals are taken too natural grazing and then supplemented by 90.5% of breeders. The feed used in camel feeding is shown to Figure 5. The feed used for supplementation consists mainly of bush straw and cereal stems. All camel drivers supplemented their herds with natron (natural sodium bicarbonate) and salt (76.2%), natron (21.4%) and salt (2.4%). Food is stored in bulk (78.6%) or in bot form (21.4%) on the roof (61.9%), on the ground (26.2%) or under a protected shed (11.9%). Only 7.1% of breeders prepare a feed ration for their animals. The animals drink from the river, the pond and the borehole. Manual milking is carried out by women in goats and sheep. In camels, it was provided by the man or the woman according to their availability. Most breeders complain about food (76.2%) and health (52.4%) constraints.



**Figure 5** Feed used in animal supplementation

### 3.2.1. Economics of the camel drivers surveyed

The camel drivers' families surveyed in the peri-urban area of N'Djamena live from the sale of animals (100%), the marketing of camel milk (40.5%) and that of small ruminants (54.8%). The Income from the sale of camel is managed under the discretion of the head of household. It was not included in the total average annual income from breeding (ScoreTAIB) in this study. Table 2 shows the different prices of the camel sold on the N'Djamena markets.

**Table 2** Price of camels sold on the N'Djamena markets

|                     | Sex         | Age (year) | Price (x1000 CFA Francs) |
|---------------------|-------------|------------|--------------------------|
| 1. For breeding     |             |            |                          |
| - Young             | Female      | 2-3        | 175 - 300                |
| - Primiparous       |             | -          | 450 - 500                |
| - Pregnant adult    |             | -          | 400- 450                 |
| 2. For the butchery |             |            |                          |
|                     | Female      | 2-3        | 175 - 200                |
|                     |             | 3-4        | 275 - 300                |
|                     |             | 5-6        | 400 - 450                |
|                     | Male        | 2-3        | 125 - 150                |
|                     |             | 3-4        | 225 - 250                |
|                     |             | 5-6        | 300 - 350                |
|                     | Male/Female | 7-9        | 450 - 500                |

The average number of sheep sold per breeding per year was  $37.5 \pm 6.6$  head with an average unit price of  $23,595 \pm 4,241$  CFA francs (15,000 to 30,000 CFA francs), i.e. an average annual income of sheep sold per breeding (ScoreAISm) of  $885,250 \pm 216,048$  CFA francs (400,000 to 1,620,000 CFA francs).

3.2.2. Principal Component Analysis

Principal Component Analysis (PCA) of the economic variables of the sheep holding (price of sheep (PriceS), annual income of sheep sold (ScoreAISS), total annual income of sheep sold (ScoreTAISS), salary amount (Salary), number of employees (ScoreNE) and annual salary expenditure (ScoreASE)) made it possible to trace the components in space (Figure 6). Component 1 (55.1%) and Component 2 (34.7%) explain 89.8% of the information. Axis 1 represents the salary expenses of the breeding and Axis 2 represents the income from the sale of sheep.

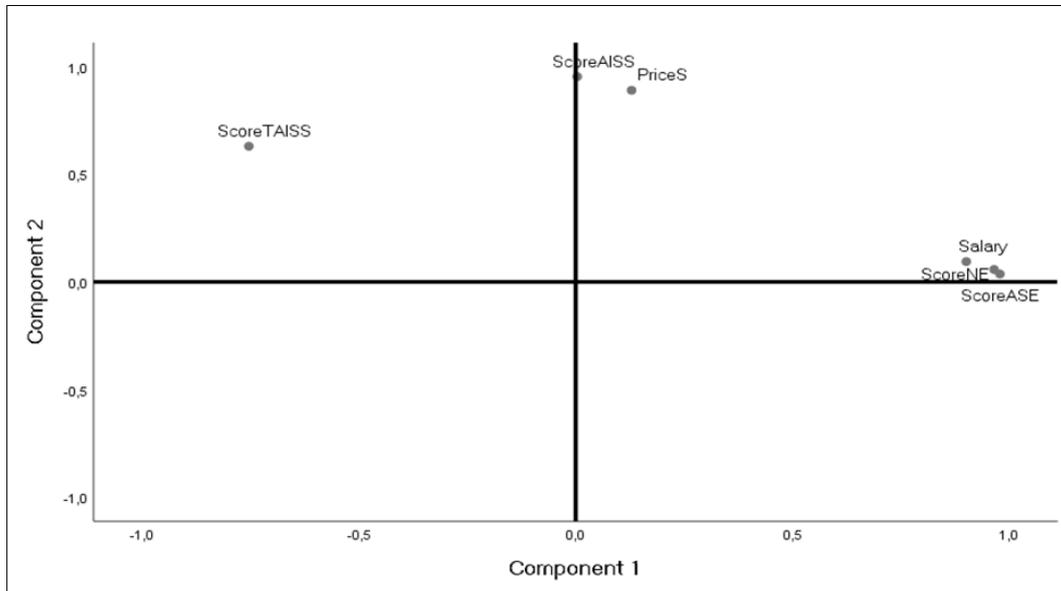


Figure 6 Plotting components in space

Figure 7 is a projection of the different breeding surveyed on the PCA's FI\*F2 factorial plan.

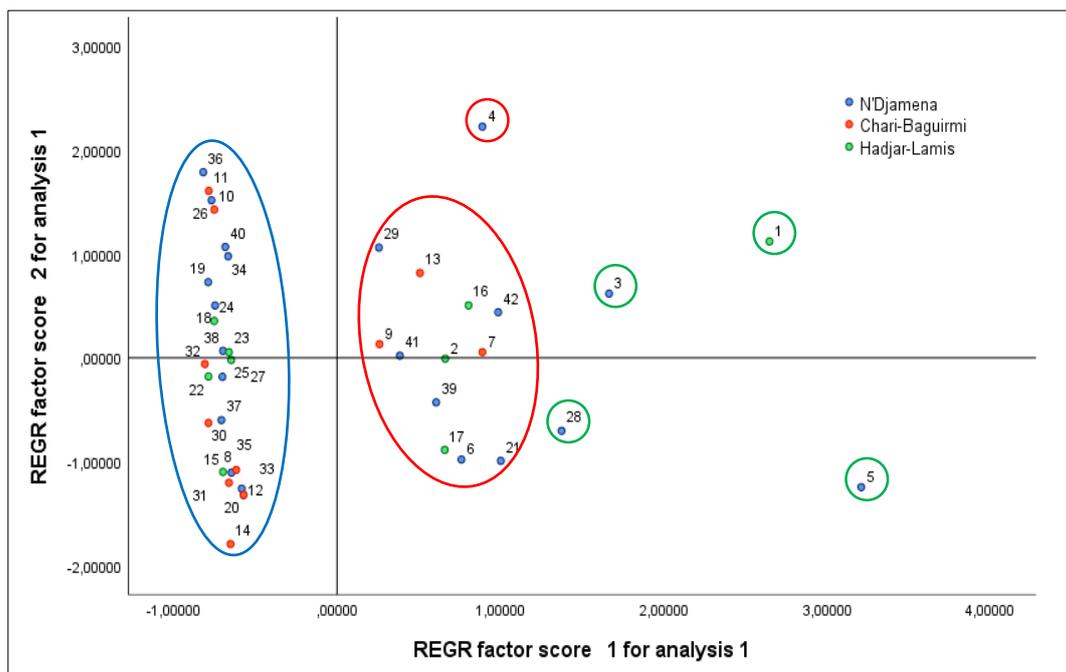


Figure 7 Principal Components Analysis (PCA) by Province

The breeding of the blue circle has no employees. Those in the red circles have one employee and those in green have several employees. Breeding number (No.) 28 has two (2) employees (18,000 CFA francs/month/person) and breeding No.1; No.3 and No.5 have three (3) employees paid monthly respectively at 25,000; 15,000 and 30,000 CFA francs.

PriceS and sheep number sold per year had a very significant influence on ScoreAISS ( $p < 0.01$ ). Also, ScoreAISS was influenced very negatively by ScoreASE ( $p < 0.01$ ). The economic data for sheep breeding showed no significant difference between the provinces surveyed ( $p > 0.5$ ). ScoreAISSm contributes  $51.2 \pm 23.6\%$  of ScoreTAIBm. This contribution was significantly higher in the provinces of Chari-Baguirmi ( $61.1 \pm 21.8\%$ ) and Hadjar-Lamis ( $66.9 \pm 16.9\%$ ) compared to that of N'Djamena ( $30.9 \pm 21.5\%$ ) ( $p < 0.01$ ).

The sale of camel milk and small ruminants is managed by women at the camp and/or at the market. Regarding the sale of camel milk, two (2) groups have been identified: Group A prohibits its sale and Group B markets it. Group B camel drivers are located in Gaoui, Toukra and Rassal fil (Figure 1). The price of a liter of camel milk varies between 750 to 1,000 CFA francs and that of small ruminants between 600 to 1,000 CFA francs. The average annual income from the sale of camel milk (ScoreCMm) of Chari-Baguirmi province was significantly lower than that of N'Djamena ( $p < 0.001$ ). The average annual income from the sale of milk from small ruminants and goats (ScoreMSGm) is  $614,972 \pm 417,743$  CFA francs (Table 3).

**Table 3** The different incomes (CFA francs) of livestock farms according to province

|                | Score AISSm           | Score CMm               | Score MSGm            | Score TAIBm               |
|----------------|-----------------------|-------------------------|-----------------------|---------------------------|
| N'Djamena      | $889,318 \pm 238,015$ | $1,641,964 \pm 575,149$ | $716,481 \pm 425,390$ | $2,464,345 \pm 1,102,398$ |
| Chari-Baguirmi | $875,818 \pm 236,845$ | $865,000 \pm 190,525$   | $514,751 \pm 381,068$ | $1,561,636 \pm 690,050$   |
| Hadjar-Lamis   | $886,833 \pm 142,193$ | -                       | $485,772 \pm 425,390$ | $1,214,917 \pm 314,056$   |
| Average        | $885,250 \pm 216,048$ | $1,504,852 \pm 605,412$ | $614,972 \pm 417,743$ | $1,960,187 \pm 1,028,966$ |

ScoreAISSm: average annual income of sheep sold; ScoreCMm: average annual income from the sale of camel milk; ScoreMSGm: average annual income from the sale of milk from small ruminants and goats; ScoreTAIBm: total average annual income from breeding.

The recorded data allowed a correlation between: number of women in the household and annual income from the sale of camel milk (ScoreCM); number of women in the household and ScoreTAIB; number of persons in the household and ScoreTAIB ( $p < 0.01$ ) (Table 4).

**Table 4** Person Correlation

|           | NP      | NF      | Score CM | Score TAIB |
|-----------|---------|---------|----------|------------|
| NP        | 1       |         |          |            |
| NF        | 0.464** | 1       |          |            |
| ScoreLC   | 0.555** | 0.737** | 1        |            |
| ScoreRATE | 0.701** | 0.804** | 0.875**  | 1          |

\*. Correlation in significant at the 0.01 level (two-tailed)

\*. Correlation in significant at the 0.05 level (two-tailed)

NP: number of people in the household; NF: number of women in the household

## 4. Discussions

### 4.1. Status of the breeder

Camel drivers during their seasonal transhumant in the dry season camp for a few months around the N'Djamena city. They tend to extend their stay according to the opportunities offered by the place of sedentary settlement (urban and peri-urban area) sometimes leaving part of their family and herd on the spot. The rate of sedentary camel driver's remains low (27.6%). Camel drivers divide their families into two (2) [8]. The large herd returns to their breeding area (home region). A head of household was chosen to manage the household and herd remaining in the camp. These heads of household installed for about ten years are young and operate a mixed herd consisting mainly Arab sheep breed. They enjoy sheep breeding. According to these camel drivers, its management is easier than camel breeding [5]. Also, the limited productivity of camel breeding and the high price of the camel do not encourage young pastoralists to opt for the exploitation of this animal [4, 9]. The purpose of subsistence-dominated sheep breeding was different from that of a camel. Sheep served as a permanent cash reserve for household spending. The survey data identified three (3)

profiles with different main activities: camel breeding, small ruminant breeding and agriculture. Ben Semaoune [9] also reported three (3) main activities in the Ghardaïa region, i.e. 32.14% camel operator, 44.64% farmer and 8.93% trader. Multi-activity is a principle widely used among camel drivers [4, 10]. These main activities have led pastoralists to develop new economic activities such as farmer, the trade in small ruminants and milk. Some pastoralists have even changed their function (4.8% of farmer and 2.4% of trader). On the other hand, camel drivers continue to protect their nomadic way of life.

#### 4.2. Herd management

The management of the breeding mobilizes a family workforce, sometimes with well-defined tasks. Camel breeding and sheep breeding were carried out in two different areas. This requires a sufficient workforce to manage and monitor both herds [5]. The change in the socio-professional profile of urban and peri-urban camel drivers (the main activity of 31% of camel drivers has been the exploitation of small ruminants) and the increase in the workload justify the recruitment of a salary workforce to optimize sheep productivity, prevent their penetration into gardens and / or cultivated plots and avoid damage (sources of conflict between breeders and herders). The recorded results show a significantly positive correlation between the number of salaried shepherds and the sheep number ( $p < 0.01$ ). Sedentary pastoralists in Tahoua using salaries shepherd to take care of the sheep's management range from 52 to 68 percent [11]. The monthly salary in N'Djamena was more expensive ( $24,522 \pm 3,920$  CFA francs) than those of Chari-Baguirmi ( $21,818 \pm 4,991$  CFA francs) and Hadjar-Lamis ( $23,500 \pm 3,741$  CFA francs). Maman Lawal [12] Recorded a salary of  $20,406 \pm 18,988$  CFA francs among 48.39% of peri-urban breeders in Niamey with salaried shepherds.

The camel herd was exploited in traditional transhumant mode. The combination of these hardy animals (camels and small ruminants) allows pastoralists to permanently dispose of resources (milk/meat) and various incomes for current expenses, household needs and herd maintenance [5, 10-12]. According to Alexis [13] the association between small ruminants and cattle allows a distribution of epidemiological risks, access to resources and sensitivity to climatic hazards between species. The small ruminant herd also contributes to the reconstitution of large livestock (camels and cattle) after a long period of drought. The Arab sheep herd exploited for its resistance and productivity has a similar size to the sheep herd of Ghardaïa camel drivers in Algeria recorded by Ben Semaoune [10]. The management of reproduction and the choice of future reproducer based on the format of the animal make it possible to have large offspring size for a better market value. Format selection yields good results in the process of improving a herd's productivity [14]. Supplementation is practiced by the majority of camel drivers. Straws, cereal stalks and minerals (salt and natron) were used for all the household herd according to their availability. Bush straw is the most used in the peri-urban area throughout the year [12]. But the other complementary feeds have been reserved for small ruminants. The sources of minerals used were natron and salt [11]. The feed preservation techniques used are authentic and do not add value the feed. Rationing is rare and unbalanced.

The milking of the camel is done indifferently by a man or a woman unlike that of the cow, the sheep or the goat which are milked only by a woman [6]. Among Tuaregs camel drivers, milking is generally done by women and children, rarely by men [8]. It has been difficult to assess productivity of the camel and the daily self-consumption of the household. The large quantity of milk is for self-consumption by households not selling milk [8]. Pastoralists consider camel milk to be a complete food and the one who drinker this milk therefore does not need any other food, neither solid nor even liquid and can dispense with drinking water [6]. The milk productivity of the camel competes with that of the cow. Because, in some well-fed camels, it is higher than that of dairy cattle raised under the same conditions [9]. Camel drivers drink the small ruminants' milk in the absence of camel milk. The small ruminants' milk is intended for self-consumption by children under one year. Baroin [6] report that sheep's milk, similar to that of woman, is reserved for orphans and children. At about a year of age this milk can be substituted by camel milk. The availability and accessibility of food resources and sanitary products limit the productivity of the herd. The low purchasing power of sanitary products and the absence of specialized veterinarians explained the low expenditure and rare health interventions [4].

#### 4.3. Economic activities

All camel drivers surveyed sell animals from their livestock. Butcher camels are generally sold in the urban markets of Diguel and Goudji [3]. The price of the future breeding camel is more expensive than the slaughter camel of the same age. Mbaïogaou [15] reported a price ranging from 52,500 to 120,000 CFA francs per camel in North-Western Chad. The weaned camel over one year old constitutes the bulk of the income of camel drivers in Morocco [4]. Camel meat not very popular with urban families. It is mainly used by restaurants and grilled meat outlets [3]. Grilled camel meat outlet was the driving force behind its consumption in N'Djamena. Despite their regularity of its sale, the camel remains important in the life of camel drivers. It should also be noted that the sheep trade has become the main activity for 31% of sedentary camel drivers. This activity has been economically profitable after the sale of milk in 88.23% of households that sell camel milk (Group B). This economic profitability has been confirmed by camel drivers in the Guelmim-Oued

Noun region of Morocco [5]. In this region, many camel drivers preferred to stop camel breeding and specialize only on sheep breeding. Because, they appreciate the speed at which they can generate economic income thanks to the rate of prolificacy of sheep. In addition, the sheep have a good market value with a still strong demand allowing to have regular incomes [5]. According to Faye [16]. Only 8% of camel breeders in the Horn of Africa were pure camel drivers. The presence of small ruminants is a factor in the easier mobilization of animal capital and a means of securing household cash flow [16].

Principal Component Analysis (PCA) of sheep economy data did not allow for the characterizing of farms by province. However, the results show that the sheep number sold and PriceS positively impacted ScoreAISS. ScoreASE also induces low ScoreAISS. For example, the breeding number (No.) 4 has a significantly higher ScoreRA compared to breeding No.5 It sold 47 heads of sheep at 30,000 CFA francs per animal and one employee paid 30,000 CFA francs a month. As for breeding No.5, it sold 36 heads of sheep at 30,000 CFA francs the animal and three (3) employees paid at 20,000 CFA francs the month (figure 7). His ScoreAISS was negatively affected by ScoreASE. The contribution of ScoreAISSm in ScoreTAIBm of the Chari-Baguirmi and Hadjar-Lamis provinces is greater compared to that of N'Djamena. Indeed, this contribution is higher among camel drivers in Group 1, who refrain from selling camel milk. Group 1 has a contribution rate ranging from 28 to 90%. It varies between 16 to 52% in Group 2 marketing this milk. The daily expenses of the household and herd of Group1 are covered by ScoreAISS and ScoreMSG. Those Group 2 are guaranteed by ScoreCM and supplemented by ScoreAISS. Goat's number sold was small. They have a lower market value than sheep. Therefore, the income from the sale of goats was added to that of the milk of small ruminants to better assess the ScoreTAIB.

More than half of the breeders (54.8%) market the milk of small ruminants only at the camp level. Traders travel to the various production sites of this milk (goat, sheep) to collect it and resell it to cheese producers and / or urban restaurants. The ScoreMSGm of N'Djamena is higher than that of the other provinces. But the difference was not significant.

The sale of camel milk is frowned upon by most camel pastoralist and remains little spread to pastoralists [4]. This taboo has been abandoned by some pastoralist of Gaoui, Rassal fil and Toukra. The integration of the camel milk marketing circuit on the urban market is recent. Self-consumption is often more important than marketed milk. Milk was previously sold on the main asphalt roads not far from the camps. Considered a substitute in the dry season, camel milk represents more than 14% of the volume of milk marketed in N'Djamena [17]. In Biltine (Chad), Mbaïogaou [15] recorded  $24.6 \pm 15.6\%$  of camel drivers marketing camel milk. In the peri-urban area of Agadez, more than half of the breeders surveyed (59%) come camel milk to the Azla dairy specializing in processing, to the traditional urban market and at home to regular customers [8]. Camel drivers' wives rarely leave the camp, especially married women. Around the 2000s, women left the camps in groups in the morning by renting a mini-bus to go to the urban markets of Mil and Diguel to sell their products. Large consumers and some amateurs knowing the nutritional and medical value buy this milk at the camps at a sometimes very high price (1,500 CFA francs per liter). Fresh milk sold at the camp is often milked in front of the customer to avoid counterfeiting. Women sometimes incorporate powdered milk, flour or diluted peanut paw into camel milk. Camel milk is more expensive compared to cow milk and small ruminants' milk, but its meat is cheaper [18]. On local markets in N'Djamena. The ScorCMm of N'Djamena was significantly higher than that of Chari-Baguirmi province ( $p < 0.001$ ). The high demand for this milk, the easy access to large markets by women and the proximity of the camps to consumers have favored the marketing of camel milk. The sale of milk has ensured various regular household costs, herd management, maintaining and growing the size of the herd by avoiding having to sell a few heads to meet the needs of the rest of the herd [5]. It also allows the livestock system to be self-financing and has a positive impact on household well-being [5, 11]. The economic valuation of peri-urban milk is indicative of a change in the exploitation of camel farming. However, when a self-consumption product a commodity status with increasing demand accompanied by incentive prices, it has implications for the management of financial resources and nutritional [11].

The impact of women's participation in household income is marginalized compared to that of men [11]. In general, she is not counted among the active members in household. Pastoral traditions attribute to her the function of housewife and guarantor of the household's food needs. Income management of milk sales is coordinated with the head of household [11]. However, the results of this study show that women contribute very significantly to ScoreTAIBm through milk marketing. Indeed, Group I households had fewer women. In addition, these women who are involved in milk marketing [8], cannot guarantee a permanent offer to their customers. The decision to replace the camel at the end of production with a new suckler or to introduce another camel into production is a matter for the head of household. Part of the herd joins the large family herd north wards during the rainy season.

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## 5. Conclusion

The Multi-activity and the diversity of economic incomes of peri-urban camel drivers has been a reality. The association of a camel and sheep herd (dominant) and the sedentarisation of young heads of household aim to secure the livelihoods of households in order to improve the living conditions of camel drivers and guarantee a financially autonomous breeding system in a world in full transformation. The camel drivers' herd of sheep enhances family work by procreating employees and profits. The improvement of the productivity of small ruminants and particularly that of sheep are sought through the supplementation, the management of reproduction and the sale of animals on the urban market. However, maximizing the productivity of camel milk to increase income from its sale is not the priority of all camel drivers, although it provides the household with a regular and expensive income. The technical and economic control of camel productivity and the milk marketing circuit were to have a positive impact on the organization of the milk sector, the integration of this milk into the national economy and the satisfaction of the strong demand for urban milk. Because, this milk knows a real revival of interest by the city dweller. In addition, the Chadian State with such a large herd (26,436,610 heads of sheep and 6,413,522 heads of camels) should consider this economic opportunity that can offer the commercial context of this type of breeding (camel-sheep association).

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

There is no conflict of interest.

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