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Pig Farming Practices in the Urban and Peri-urban Areas of N'Djamena, Chad

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Abstract: The study aimed to determine pig farming practices in urban and peri-urban areas of N'Djamena. The research was conducted through retrospective and cross-sectional surveys involving 110 pig farmers and 2206 pigs. Data collected focused on the profiles of the farmers, herd origin and structure, farm management, reproductive performance of sows, constraints faced by farmers, and their perspectives on improvement. Data collected were analyzed using XL-STAT software (version 6.1.9). The study showed that most pig farmers were men, around 40 years old, married, and had secondary-level education. The majority of pigs reared were purchased (90.91%). The pigs were either allowed to divagation (45.45%) or kept in a combination of confinement and divagation (54.55%), using traditional habitats (93.64%). Breeding was conducted randomly (without selecting specific breeding animals). The average herd size was 20.03 ± 0.91 pigs, with sows being the most populated. The most prevalent challenges were related to feeding and neighborhood issues. Most breeders (77.27%) conduct health monitoring of their animals, while (22.73%) do not. Breeders in urban areas use veterinary products or consult a veterinarian more than other caregivers. Live pigs were sold to local customers in their homes. Most of the income generated from these sales was used to support the breeders' families, while a small portion was used to purchase other animals. Expanding farming operations was the most expressed perspective among respondents. However, monitoring reproductive performances is necessary to determine actual performance and to conclude this study.

Keywords: Farming Practices, Pig, Urban Area, Peri-Urban Area, N'Djamena, Chad

1. Introduction

As the population explodes, traditional animal protein sources have become insufficient. To deal with this sensitive issue, it seems reasonable to develop short-cycle livestock species. Consequently, short-cycle livestock farming has experienced significant growth since the early 1960s. The growth is due to many factors, like genetics, better management, nutrition and health progress, and easier production. Traditional farming has several advantages: It is less restrictive, acquiring pigs is affordable, and the breeding cycle is short with high prolificity [1]. Sows can have 8-15 piglets per litter, and their reproductive efficiency depends on the breed, breeding practices and parity [2]. In addition, the pigs are good at using cheap local waste like brewery waste, bran, and cake. This helps save money on production. Low-income farmers in tropical zones and Africa traditionally raise pork in family-run operations [3].

The livestock sector in Chad plays a vital role in the economy, accounting for 53% of the Gross Domestic Product (GDP) [4]. Chad is an agropastoral country with a large livestock population of 93,803,192 animals. This includes 1,664,346 pigs, which comprise 1.77% of the total herd [4]. Although pig populations in most tropical countries are relatively small, there is an increasing trend in pig farming in urban and peri-urban areas of Sub-Saharan Africa, where

pork consumption is not prohibited. This trend is aimed at meeting the growing demand for animal protein among the population [5]. In Chad, N'Djamena and its surroundings are recognized as the second most significant pig production zone after the Sudanese zone [6]. Breeding can help reduce poverty for vulnerable groups, like women and young people in southern Chad [1]. In addition, Tellah et al. [7] reported that in Moundou City (in southern Chad), the average litter size was 7.8 ± 0.14. The weaning process occurred when they were 11.08 ± 0.14 weeks of age. Interval weaning-fertilizing service was 4.63 ± 1.04 weeks with 1.99 ± 0.01 farrowing per year. The age at first farrowing was 10.88± 0.12 months with an age of the first fertilizing service of 6.88 months. Pig production in Chad has not been studied much since 2010. The few existing studies focused on research and development, livestock enumeration, and herd demographics [8]. The current surge in pork production and consumption in N'Djamena necessitates not only the enumeration of pig farmers and herds but also a comprehensive investigation into zootechnical and economic aspects related to basic farming practices. The growing number of pig farms in N'Djamena, particularly in the 1st, 7th, and 9th arrondissements among the city's 10 districts and in peri-urban areas due to high consumer demand, requires special attention to address the zootechnical and economic constraints associated with its development. Despite facing significant management challenges over the decades, professional and well-managed pig farming can yield favorable results, effectively catering to the ever-increasing needs of the population for protein. This study was conducted to highlight the management practices and pig production in the urban and peri-urban areas of N'Djamena. The general objective of this research is to determine pig farming practices and the reproductive performance of sows in the study area.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted in N'Djamena, the capital city of Chad. As of 2020, N'Djamena had an estimated population of 1,418,854 inhabitants, with over 40% of the urban population of Chad residing there [9]. The city experiences a Sahelian-Sudanian tropical dry climate, characterized by a dry season from November to May and a rainy season from June to October. The climate is influenced by fluctuations between the dry northward airflow known as "harmattan" and the humid southwest maritime airflow known as "monsoon." The average annual rainfall is approximately 452 mm/year, and the average annual temperature is 28.9°C. N'Djamena's geographical coordinates, measured using the Global Positioning System (GPS), are 12° 11' 30" latitude North and 15° 04' 91" longitude East. The study sites included the three arrondissements (1st, 7th, and 9th) within the city of N'Djamena and the Koundoul sub-prefecture (located in the peri-urban area of N'Djamena).

2.2. Experimental Animals, Sampling Size and Area

The study involved 2206 pigs of the local breed, consisting of 798 males and 1408 females. N'Djamena is a cosmopolitan city with a predominantly Muslim population. Residents in a neighborhood often choose to live among people with similar ethnic, regional, and religious affiliations. Before collecting field data, a retrospective survey was conducted, identifying three districts. Not all neighborhoods within these districts practice pig farming. The pig farming activities were predominantly in neighborhoods where the majority of the population was Christian, particularly originating from the southern regions of the country. Christians were the primary producers and consumers of pork meat in these areas.

Regarding the selection of households for the survey, information was obtained through inquiries made to residents and, notably, among the pig breeders themselves, who were acquainted with each other. This approach involved a snowball sampling technique. Within the selected households, any breeder who owned four or more pigs within the study site was included in the survey, while those with fewer pigs were excluded.

2.3. Survey Method and Duration

The study was conducted from November 2, 2021, to February 28, 2022, through a combined retrospective and cross-sectional survey, along with direct observations of animals. A structured questionnaire was administered to 110 pig farmers. Data were collected three times a week, from morning to evening, with breaks during the hot hours of the day. In many cases, especially for working breeders, appointments were scheduled early in the morning or in the evening. For breeders living far away, appointments were made on weekends.

The counting of animals (piglets, gilts, and others) was done together with the owners. However, some breeders were cautious about strangers. The fear of pig farming restrictions in certain neighborhoods led to the categorical refusal to collaborate or withhold information despite presenting a research authorization issued by the Faculty of Sciences Dean at the University of N'Djamena. On the other hand, some educated breeders eventually cooperated with the survey and provided all possible information.

The questionnaire requested information that primarily included the breeder's profile (age, gender, occupation, marital status, education level, experience, ethnicity, regional origin), total herd size, number of sows, gilts, boars, and piglets, farming practices, feeding methods, care, sow reproductive performance and challenges and prospects for improvement.

2.4. Other Technical Supports

Data recording and reproductive monitoring during the survey were carried out using questionnaires. For visual documentation of animals, their habitats, and animal feed, a Samsung J2 mobile phone camera was used.

3. Statistical Analysis

The collected data were analyzed using XLSTAT software (version 6.1.9). Descriptive statistics provided measures of dispersion (mean, standard deviation, extremes, and frequency), and analysis of variance (ANOVA) was conducted to compare the various means. Post-hoc analysis was performed using the Newman-Keuls multiple comparison test at a significance level of 5%.

Table 1. *Profile of respondents in the urban and peri-urban areas of N'Djamena.*

Parameter	Number (n)	Proportion (%)
Sex of Respondents		
Women	24	21.82
Men	86	78.18
Marital Status		
Single	4	3.64
Married	98	89.09
Widowed	8	7.27
Religion: Christian	110	100.00
Education Levels		
No	6	5.45
Yes	104	94.55
Educational Level (%)		
Primary	10	9.62
Secondary	72	69.23
High School	22	21.15
Origin of Breeders Province		
Logone Occidental	21	19.09
Logone Oriental	5	4.55
Mandoul	26	23.64
Mayo Kebbi	31	28.18
Moyen Chari	6	5.45
Tandjile	21	19.09
Occupation		
Agriculture	5	4.55
Trade	21	19.09
Breeding	20	18.18
Student	3	2.73
Masonry	11	10.00
Civil Service	50	45.45

4. Results and Discussion

4.1. Results

4.1.1. Characteristics of Pig Breeders

Table 1 describes breeders' socio-professional characteristics. Pig farming in the study area is practiced by men (78.18 %, n = 86) and by women (21.82 %, n = 24). Breeders were mostly men ($p < 0.05$), exclusively married, and Christians. Most of them had a secondary education and hailed from the provinces of Mayo Kebbi, Mandoul, Tandjile, and Logone Occidental. Breeders were mostly civil servants (45%) followed by traders (19.09%) and farmers (18.18%).

4.1.2. Pig Farming Practices in N'Djamena

Table 2 describes the various farming practices in the N'Djamena locality. The majority of surveyed breeders acquired their pigs primarily through purchases (90.91%). The pigs were either allowed to roam freely (45.45%) or kept in a combination of divagation and cloistering (54.55%), using traditional habitats (93.64%). Breeding was mainly conducted randomly (without selecting specific breeding animals), and regular health monitoring (77.27%) included preventive treatments and deworming (56.18%). The average feeding frequency was 2.45 ± 0.05 times per day (ranging from 1 to 4 times), and the average building cleaning frequency per month was 4.28 ± 0.20 times (ranging from 0 to 10 times).

Table 2. *Various farming practices in N'Djamena locality.*

Parameters	Number (n)	Percentage %
Proprietary		
No	9	8.18
Yes	101	91.82
Mode of acquisition		
Purchase	100	90.91
Trust	7	6.36
Gift	3	2.73
Breeding management		

Parameters	Number (n)	Percentage %
Divagation and cloistering	60	54.55
Cloistering	50	45.45
Type of feed used		
Cereals and artisanal distillers' grains	34	35.05
artisanal distillers' grains	62	63.92
Feed and agro-industrial by-products	1	1.03
Type of habitat		
Modern	7	6.36
Traditional	103	93.64
Mode of reproduction		
Controlled reproduction	4	3.64
Hazard	106	96.36
Health monitoring		
No	25	22.73
Yes	85	77.27
Type of treatment		
Deworming practice	28	32.94
Deworming and curative treatment	6	7.01
Preventive treatment and deworming practice	48	56.18
Vaccination, curative treatment and deworming practice	3	3.53

4.1.3. Breeds of Pigs

Several breeds of pig were identified in pig farms in the urban and peri-urban areas of N'Djamena (Figure 1). The results presented in Figure 1 clearly show that the number and proportion of local breeds were higher ($p < 0.05$) than those of exotic and crossbreeds.

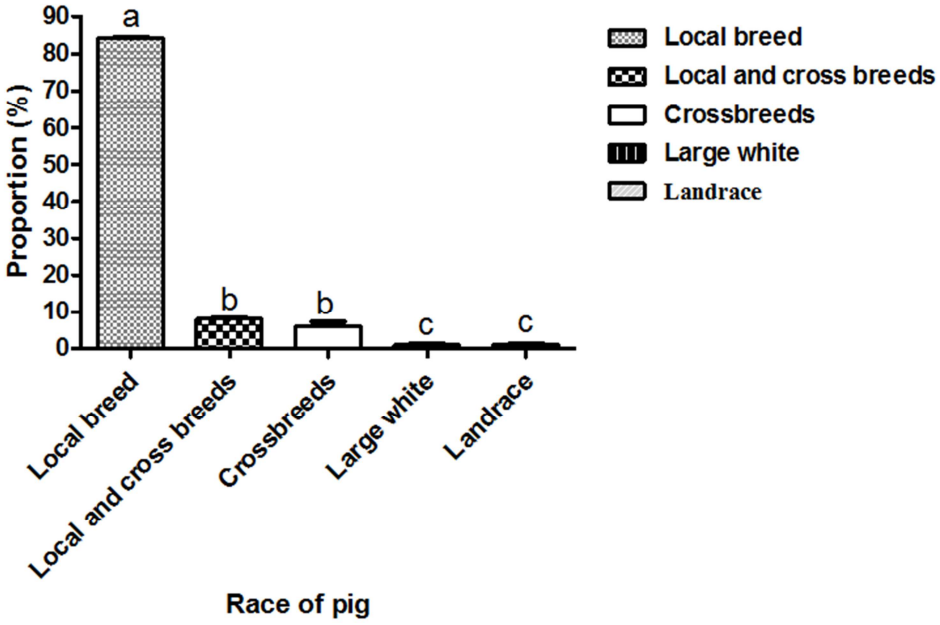

Figure 1. *Proportion of pig race in the farms.*

Data sharing no common letter are different.

4.1.4. Objective of Pig Farming and Utilization of Income from Pig Sales

The results on breeding objectives showed that 73.64% of the surveyed farmers raised pigs, firstly for sale and then for self-consumption. The results showed that all pigs were sold live to local customers in their homes. The income generated from these sales was used to meet the daily needs of the breeders' families (87.27%) while a small part (12.73%) was reserved for their daily needs and purchasing other animals.

Table 3. *Different actors involved in the sale and utilization of pig sales revenue.*

Breeding objectives	Number	Percentage (%)
For sale	81	73.64
Consumption and for sale	29	26.36
Pig product sold		
Pig live	108	99.08

Breeding objectives	Number	Percentage (%)
Pig live and pig carcass	1	0.92
Customer: local market	110	100
Place of sale: Home	110	100
Utilization of pig sales revenue		
Daily needs of families	96	87.27
Daily needs of families and purchase of other pig	14	12.73

4.1.5. Constraints and Improvement Prospects for Pig Farming

Figure 2 presents the different constraints of family pig farming. The main constraints were feed availability coupled with disease (43,63%) ($p<0.05$) and feed problem addition by nuisance created in the neighborhood (33,42%).

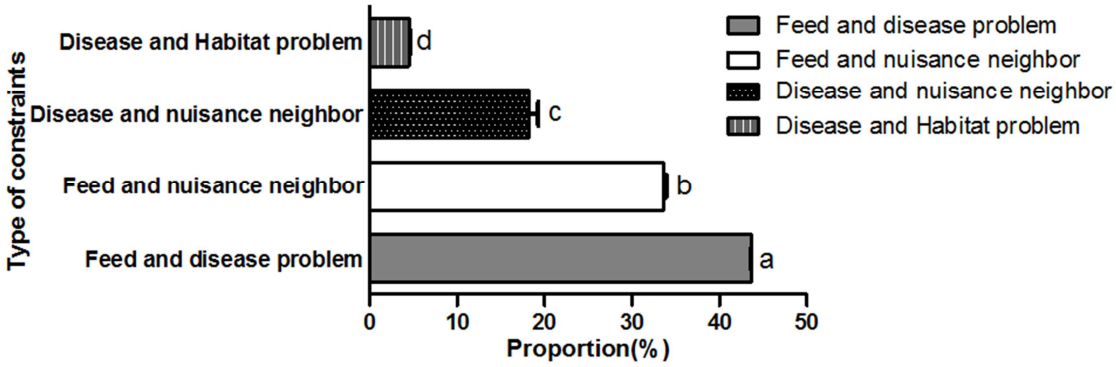

Figure 2. *Main constraints of pig farms.*

Data sharing: no common letter is different

Figure 3 presents improvement prospects for pig farming. Breeders sought higher financial support (42.3%) ($p<0.05$) for improvement prospects. Next is also a quest for support for industrial pig feed (29.2%). Technical support (12%) for pig farming was the least solicited improvement prospect among breeding techniques. These results show that financial support is the most significant factor in improving pig farming. This suggests that more investment should be made in the sector to increase profitability.

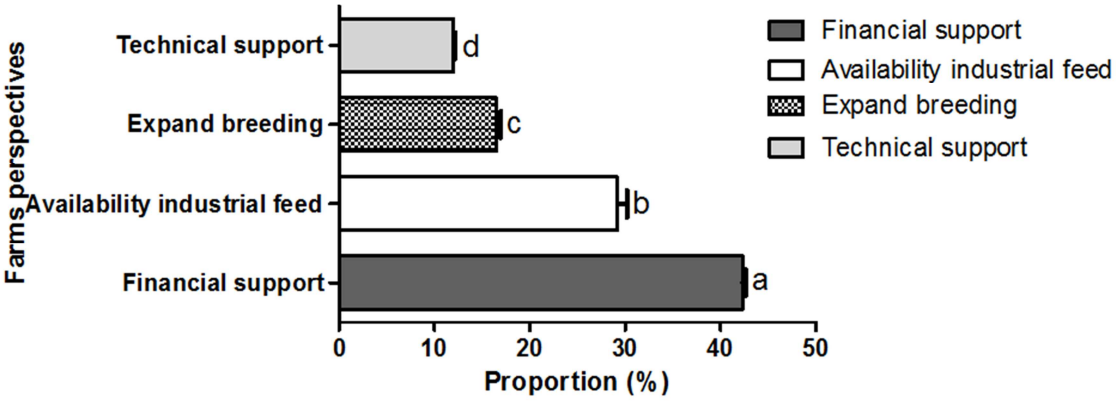

Figure 3. *Perspectives for improving pig farms.*

Data sharing: no common letters are different

4.2. Discussion

4.2.1. Characteristics of Breeders

The results of this study show that pig farming is predominantly carried out by men (78.18%) in N'Djamena city and its borders. However, a notable portion of women (21.82%) also engage in this activity, indicating that pig farming is not exclusively male-dominated. This result is consistent with findings from Benin, where 79% and 81.6% of pig farmers were men, respectively reported by Djimenou David et.al and Kiki Pascal et.al [10, 11]. The predominance of men in pig farming has also been observed in Moundou city (Chad) [7]. However, the percentage of male breeders in N'Djamena, Chad [8], is lower at 73%. Similarly, in Benin [8] the percentage of male breeders was 74.4%.

The surveyed breeders were all from Chad's southern regions. This result could be attributed to the absence of religious prohibitions against pig farming and pork consumption in the southern part of the country. Among the regions of origin, the Mayo Kebbi region (28.18%) had a higher number of experienced pig breeders. This suggests that pig farming was introduced in this region

long ago, resulting in a deeper understanding and wider adoption of this activity. The availability of feed and a favorable environment for pig breeding also contributed to adaptation in this region. In a study reported Djimenou David et al [10], the Mayo Kebbi Provinces were found to be the main producers of pigs in N'Djamena city. They accounted for 59% of the total and had more experience in pig farming.

All pig breeders in the surveyed area were Christians. The prevalence of Christians in pig breeding could be attributed to the absence of Christian religious prohibitions against pig farming and pork consumption. In Chad, pig farming is subject to religious prohibitions by the Muslim population. This finding is consistent with a previous study conducted by Ossebi Walter et al [14] in Senegal, where pig farming practices were affected by religious prohibitions by the Muslim population.

Breeders were mainly married (89.09%) people, while a small part was single (3.64%) or widowed (7.27%). This result, of a farmer marriage rate, is lower than that obtained in Moundou City of Chad at 92% [7]. Pig farming is an activity that can be pursued by individuals of various marital statuses, as it requires minimal investment (low labor input) and is highly profitable, providing an additional source of income for families. As a result, families can diversify their income sources to meet their needs. Regarding education, the majority of surveyed breeders (94.55%) had received some level of education, with 69.23% completing secondary education, 21.15% higher education, and 9.62% primary education. Breeders surveyed are generally more educated based on this data. This result illustrates that the breeder's occupation (Civil Service), pig breeders were mainly Civil service. Through this, pig farming techniques can be better implemented, pig feed can be rationed properly, and inputs can be managed effectively. Additionally, it assists livestock technicians in developing and promoting this activity. It is consistent with the findings of Ohouko Okri et al [15] in Benin where 34.29% and 40%, respectively, had primary education. However, it differs from the findings of Kiki Pascal et al [11] in another area of Benin, where most breeders were illiterate.

Regarding occupation, the surveyed breeders had diverse professions, with workers (45.45%) being the largest group, followed by traders (19.09%), masons (10%), agricultural producers (4.55%), students, and pupils (2.73%), and those exclusively involved in pig farming (18.18%). Pig farming remains a secondary activity for most breeders, driven by the need for income diversification and the profitability of pig farming with relatively low investment. This finding aligns with previous reports from Benin by [10], Cameroon by [16, 17], and Burkina Faso by [18]. These studies also highlight that pig farming is often a secondary activity practiced by various socio-professional groups and is considered an additional resource for these breeders.

4.2.2. Mode of Acquisition and Herd Composition

The herds of pigs in the study area were mostly obtained through purchases (90.91%), with some breeders receiving pigs as gifts (2.73%) or being entrusted with their care (6.36%). The majority of beginners in pig farming or those who restarted after herd decimation acquired their animals through purchases. This result aligns with a study in Ivory Coast by [19], where pigs were mainly acquired through purchases (94.2%). However, it is higher than the results obtained in Benin [20], which reported a purchase rate of 76%. The average number of pigs in the surveyed herd was 20.03 ± 0.91, including 7.23 ± 0.38 males and 12.80 ± 0.69 females. The herd structure consisted of an average of 1.24 ± 0.05 sows, 1.24 ± 0.05 boars, and 5.10 ± 0.37 gilts. These results are similar to those reported by Mopté Youssouf et al [8].

4.2.3. Breed Types and Feeding Practices

The majority of pig breeds encountered in the study area were local breeds (83.64%), with some improved breeds such as Large White, Landrace, and crossbreeds. The prevalence of local breeds in the study area could be attributed to their exceptional adaptability, as they tolerate high temperatures and fluctuations in feed availability, and demonstrate good fertility. Additionally, local breeds are favored by farmers due to their relatively low purchase price. However, some breeders have chosen to raise exotic breeds for their larger size and higher productivity compared to local breeds. This finding is consistent with studies in Chad by Mopaté Youssouf et al [13], in Senegal by ossewi Walter et al [21], and in Burkina Faso by [18]. Pig breeders practice a mixed breeding method (scavenging and confinement) illustrating the traditional system of breeding. The majority of pig reproductive modes were uncontrolled. This result confirms the assertion of Mopaté Youssouf et al [13] reported that traditional pig breeding is exclusively uncontrolled with replacement stock produced through completely natural reproduction.

In both urban and peri-urban areas, pig feed was primarily composed of kitchen waste, cereal bran, artisanal distillers' grains, and artisanal oilseed cakes. The type of kitchen waste used varied over time and depended on the breeder's dietary habits. Artisanal distillers' grains were specific to the type of agri-food processing and raw materials used. These by-products were typically fed alone or in combination by breeders. This feeding practice was chosen by breeders due to its cost-effectiveness and benefits for pigs, as commercial feed can be expensive and beyond the means of many breeders. This feeding practice is also reported in the works of Mopate Youssouf et al [23] where cereal bran and artisanal distillers' grains were combined for pig feeding. Cereal bran is commonly used to feed pigs across Africa, especially maize, millet, sorghum, and rice bran. Similar results have been reported in Benin [24], Senegal [21] and Burkina Faso [25]. Large pig farms in the peri-urban areas of N'Djamena were observed using commercial feed and agro-industrial by-products. The commonly used feed in these large farms included maize and maize bran, cotton seed and cotton seed cake, brewery wet distillers' grains, and soybean

cake [20, 23, 26]. In peri-urban areas, some breeders also reported using specific plants, especially during the rainy season, to feed their pigs. Additionally, some breeders provide mineral supplements such as kitchen salt, oyster shells, and sodium carbonate, either mixed or separately with the feed. This observation is consistent with [14]. The main constraints in pig farms were related to feed availability, disease and nuisance to neighbors. These results confirm the findings of Tellah et al [7] which revealed that the dominant problem of traditional pig breeding was feed availability and nuisance to neighbors.

4.2.4. Health Status of Pigs

The survey results revealed that the majority (77.27%) of farmers practice preventive treatment and curative treatment to counter different pig pathologies, while a minority (22.73%) do not practice pig health monitoring. Among those who provide care, the use of veterinary products or consulting a veterinarian is more dominant among breeders in urban areas. These results could be attributed to the breeder's level of education, who knows the importance of implementing health measures for their pigs. Similar observations have been reported in Benin [15, 24] and Senegal [14, 5], where most pig breeders seek veterinary assistance, but few have a prophylactic calendar and follow it. In the study area, a significant portion of breeders (56.47%) practice deworming coupled with preventive treatment. Few breeders (5.88%) administer curative treatments because many are not well-informed about diseases that decimate their herds. Similar observations have been reported in Senegal [21], where vaccination was rarely practiced, and breeders were not aware of the diseases it aimed to prevent. Animal vaccination is practiced by a small group of breeders (3.53%).

4.2.5. Constraints and Improvement Prospects for Pig Farming

Breeders sought financial support to improve their herds, followed by increasing herd size and obtaining industrial pig feed. Technical support for pig farming was the least solicited improvement prospect among breeding techniques. These results show that financial support is the most significant factor in improving pig farming. This suggests that more investment should be made in the sector to increase profitability.

5. Conclusion and Perspectives

This study, which aimed to determine pig farming practices in urban and peri-urban areas of N'Djamena, revealed that pig farming in the study area is extensive and a secondary activity. Most actors (men) in this sector are government employees. Animals are fed locally available resources (e g., brewery waste) and their herds are primarily constituted through purchases. The indigenous breed is the most common among breeders, even though its zootechnical performance is low. Pathologies and damages caused by roaming pigs constitute the main constraints on pig farming in urban and peri-urban areas of N'Djamena. In light of the findings, it is essential to pay particular attention to the support and socio-professional organization of actors to better promote this sector. Further thematic analyses of the survey data and in-depth studies should be conducted to gain a better understanding and find solutions to the constraints for the development of the pig farming sector. Further studies should examine certain parameters, such as morpho-biometric characterization and techno-economic parameters of the local pig breed.

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