Intra-urban livestock breeding in the Sahel zone and the living environment of city dwellers in Maroua-Extrême-Nord Cameroon

Abstract

Sahelian cities, in their overall designs, evolve over time, and are characterized by a complex urban livestock system which overturns certain components of the environment more quickly and has a negative impact on the human health of city dwellers. This study was conducted in the intra-urban environment of the city of Maroua. The objective is to contribute to understanding the impacts of intra-urban livestock farming on the biophysical environment and on the health of the population in order to propose solutions that will reduce its harmful effects. A survey of 211 households was conducted to acquire data on the practice of this activity. Through the survey sheets, the interview guide, the defecation monitoring sheets of cattle, goats and sheep, the breeding inventory sheets and observations, the study reveals that: this breeding is characterized by a poor condition but the breeding of cattle (13.3%), goats (35.1%) and sheep (22.3%) are represented in the study area. This activity is influenced by natural and human factors. The main livestock stakeholders are dominated by men (83.41%) and women (16.59%). Poor breeding practices lead to air pollution, soil degradation and water pollution through methane emissions (421,443.6 kg of CH4/year in cattle and 37,676.76 kg of CH4/year in sheep and goats) and carbon dioxide emissions (579484.94 Kg of CO2/year in cattle and 51805.54 Kg of CO2/year in sheep and goats). The activity harms human health and social ties between neighbors gradually deteriorate. Given these impacts, waste recovery techniques from this activity such as compost would be one of the preferred means for the protection, preservation and conservation of the biophysical environment and human health in this city.

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Sahelian cities, in their overall designs, evolve, and are characterized by a complex urban livestock system that overturns certain environmental components more quickly and negatively impacts the human health of city dwellers. This study was conducted in the intra-urban environment of the city of Maroua. The objective is to contribute to understanding the impacts of intra-urban livestock farming on the biophysical environment and the health of the population to propose solutions that will reduce its harmful effects. A survey of 211 households was conducted to acquire data on the practice of this activity. Through the survey sheets, the interview guide, the defecation monitoring sheets of cattle, goats, and sheep, the breeding inventory sheets, and observations, the study reveals that: this breeding is characterized by a poor condition but the breeding of cattle (13.3%), goats (35.1%) and sheep (22.3%) are represented in the study area. Natural and human factors influence this activity. The main livestock stakeholders are dominated by men (83.41%) and women (16.59%). Poor breeding practices lead to air pollution, soil degradation and water pollution through methane emissions (421,443.6 kg of CH4/year in cattle and 37,676.76 kg of CH4/year in sheep and goats) and carbon dioxide emissions (579484.94 Kg of CO2/year in cattle and 51805.54 Kg of CO2/year in sheep and goats). The activity harms human health and social ties between

neighbors gradually deteriorate. Given these impacts, waste recovery techniques from this activity such as compost would be one of the preferred means for protecting, preserving, and conserving the biophysical environment and human health in this city.

Keywords: Intra-urban livestock breeding, Techniques, socio-environmental impact, Sahelian cities, environmental components, Maroua.

INTRODUCTION

The current demographics, which have about 7.6 billion inhabitants, impose a growing demand for food production. To properly satisfy food needs, humans exploit natural resources as much as possible, at the same time producing a disproportionate quantity of waste which is toxic, in majority of the cases; this produces a reduction in the quality of life on earth (CALLICOTT, 2018). Thus, in developing countries, the production of food will have to double, and that of waste and effluents will be multiplied by four in cities (SMITH et al, 2004). Interest in intra-urban agriculture has increased over the past decade. Two phenomena partly explain this situation: the speed of urban growth, on the one hand, and the renewal of public policies, on the other. The rate of urban growth in Africa has been 4% per year since 1960 (SMITH et al, 2004).

In the same context, to satisfy the demand for meat or protein, urban areas are involved in livestock farming. These, in urban areas in general, form a significant component of a complex system of food and financial security. This is how in developing countries, livestock farming plays a key role in agricultural development in terms of supplying meat and livestock products. Livestock farming thus contributes to meeting the protein and high biological value needs of populations in these countries.

In Cameroon, livestock farming plays a role in the socio-economic life of the population. Socially, meat is used as a food ingredient and economically, it is seen as a way to make money. Today, livestock breeding is no longer only the concern of rural producers but also that of producers in urban areas. Indeed, the production of poultry and pigs is an important source of income for a large part of the urban population (DONGMO et al, 2005). Cameroon in its urban environments is experiencing a livestock dynamic which is taking place through the multiplication of livestock farms and consumption points.

This breeding in urban Maroua is today becoming important given the increase in demand for food products from it. In fact, the population of Maroua is already galloping. Thus, to meet the food needs of the population, intra-urban livestock farming is appearing. The population itself becomes an actor in this breeding. By practicing this breeding in the town of Maroua, many consequences, mainly negative rather than positive, emerge and harm environmental components and human health.

MATERIAL AND METHOD

1. Location of the study area

The spatial framework of this study corresponds to the northern lowlands, more precisely in the plain which is a topographic entity of Diamaré (figure 1). Indeed, according to the coordinates indicated in the global coordinate system WGS84, the study area is located

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between 10°34.33' N and 10°38.00' N of northern latitude and between 14°16.48' E and 14°21.36' E of east longitude. This study area includes 9 selected neighborhoods, three of which per municipality in the city of Maroua.

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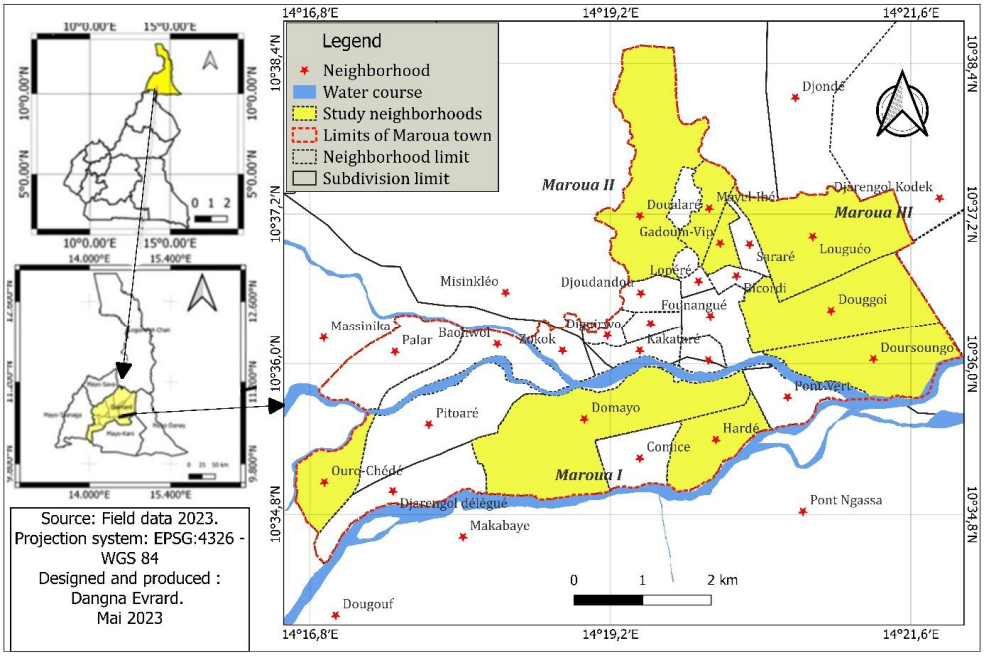

Figure 1. Location of intra-urban Maroua

2. Data collection

Data were collected through livestock inventory, defecation monitoring, maintenance and a cross-sectional survey conducted in the three communes of Maroua I, II and III. It affected 9 neighborhoods out of the 27 in the urban area of Maroua. At the level of each commune, three neighborhoods were chosen at random and at the level of each neighborhood, the breeders were surveyed randomly using a snowball method. The information sought in this study relates to the factors, actors and socio-environmental impacts of livestock farming in the city of Maroua. In total, 211 breeders were surveyed.

3. Statistical analysis of data

The data collected was codified and entered into the SPSS version 20 software and the software

Excel. This software made it possible to produce descriptive statistics, cross tables and make estimates of environmental degradation due to intra-urban livestock farming using this formula:$\boldsymbol{Qp = (Rn \times f)365}$,(**Qp:** Quantity of proliferation, Rn: Number of individuals, f: quantity of gas proliferated per day). Some data was exported to the Excel spreadsheet to create tables and figures.

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RESULTS

1. Livestock factors in the town of Maroua

1.1. A landscape characterized by traditional and modern breeding

The landscape is a territory as perceived by the population whose character results from human and natural action and also from their interactions. It is the spatial support for human activities. Therefore, the urban livestock landscape in Maroua is characterized by traditional and modern livestock farming. Traditional urban livestock farming (Photo 1) generally results in unsophisticated shelters and animals such as goats and sheep wandering around all day. The breeders here spend almost nothing on food, because it is the animal that manages to have food in the city's trash cans. Regarding modern urban livestock farming (Photo 2), the shelters and animal farms are well built and generally this breeding is much more applied among large ruminants, namely cattle employment.

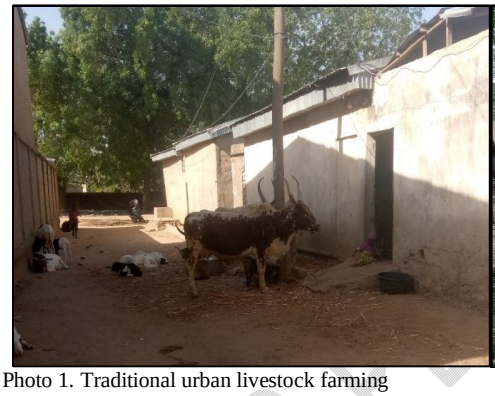

Photo 1. Traditional urban livestock farming

Photo 2. Modern urban livestock farming

1.2. Diversified breeding in the town of Maroua

Surveys in urban Maroua revealed that some households raise goats, sheep and cattle (table 1) separately and others use the mixed type. Of the 211 households surveyed, 35.1% of households, or 74, only raise goats. 62 households or 29.4% practice mixed breeding, 47 households or 22.3% raise sheep and finally 28 or 13.3% raise cattle.

Table 1. Type of breeding

Breeding type	Household number	**Percentage**
Cattle breeding	28	13,3
Sheep breeding	47	22,3
Goat breeding	74	35,1
Mixed animal breeding	62	29,4
Total	211	100,0

Source: Field survey, January 2023

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1.3. The presence of natural grazing and grasses in urban and peri-urban areas

1.3.1. Abundant grazing

In the town of Maroua, the livestock system is mostly semi-extensive. The majority of food consists of pasture. The quantity and quality of grass available to animals is greatest at the end of the rainy season and the beginning of the dry season. They then gradually decrease until the appearance of new rains. This resource conditions the movement of animals in the town of Maroua. In the rainy season, cattle breeding is much more stable due to the abundance of grazing in uninhabited spaces and in city garbage bins. The places where herds are kept in the town of Maroua are illustrated in (Figure 2).

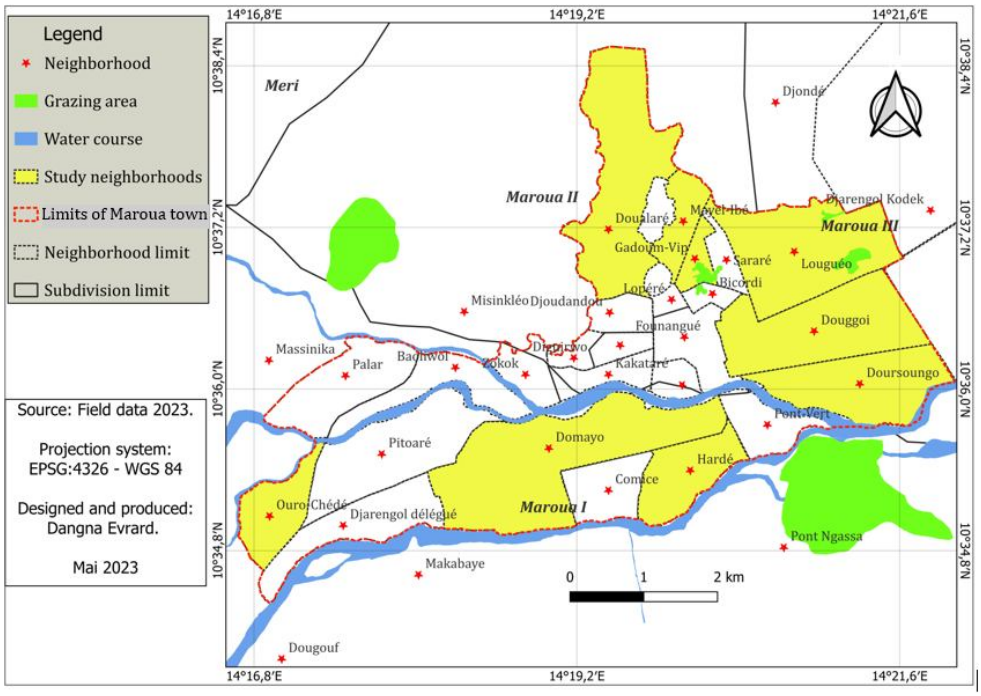


Figure 2. Animal paddocks /parking area in the town of Maroua

1.3.2. The sale of grasses in town

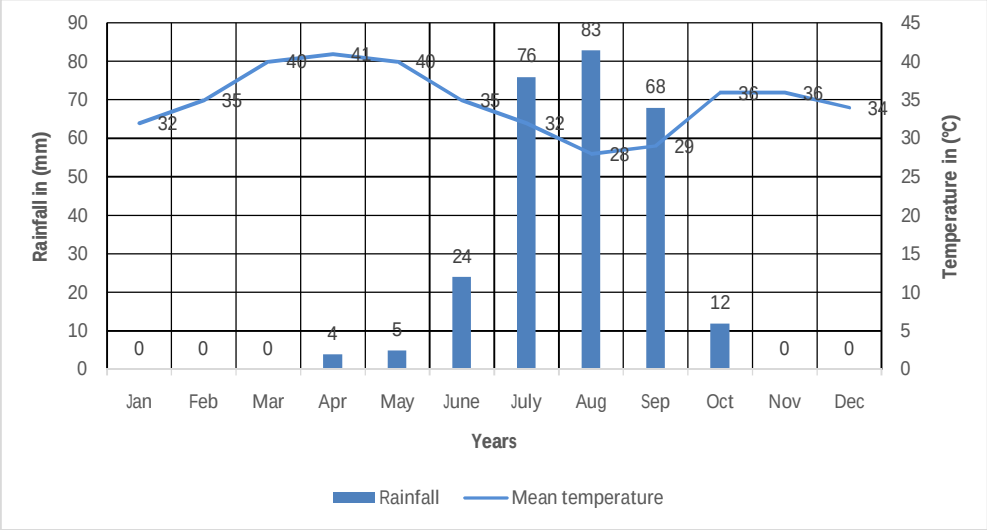
In the city of Maroua, grasses are present in urban wastelands. They constitute the place of grazing in the rainy season in the city. Outside of urban wastelands, the population or young city dwellers in search of money (photo 3) go to peripheral or rural areas to cut grasses in

order to sell to breeders. These grasses are of capital importance in intra-urban livestock activity.

Photo 3.

1.4. Animal breeding subject to the sahelian climate

Urban Maroua is in the tropical domain with a long dry season (8-9 months) and a short rainy season (3-4 months). The heaviest rainy months in Maroua are July (76 mm), August (83 mm) and September (68 mm) with a minimum temperature of 28°C and maximum of 41°C according to ONACC in 2022 (Figure 3). This rainfall favors the herbaceous formations which constitute the grazing of livestock and the supply of water ponds for watering the animals.



Source: ONACC, 2022

Figure 3. Monthly evolution of rainfall and temperature in Maroua

1.5. Presence of natural and artificial watering places in urban areas.

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Animal watering in the town of Maroua is done through natural and artificial sources. Artificial watering (Photo 4) and natural watering (Photo 5) are favored by the flatness of the city, which in certain places refuses rapid infiltration. The water therefore stagnates and constitutes natural drinking troughs. The presence of these places in the city ensures that urban livestock activity maintains its pace throughout the year. During the dry season, animals drink from man-made watering places. The breeders here organize themselves in such a way that each herd can drink in a circuit and each herd must spend around fifteen minutes in the watering site.

Photo 4. Artificial watering places Photo 5. Natural watering places

1.6. Abundance of sorghum stalks, peanut leaves and cottonseed meal

1.6.1. Sorghum stalks and peanut leaves

The presence of sorghum stalks and peanut leaves in the town of Maroua constitutes a factor in the proliferation of intra-urban livestock farming. These stems and leaves constitute the food of livestock, especially those which are not mobile. They are sold to breeders (Photo 7) who are in the city and generally those who are hiring.

Photo 6. Marketing of fodder for livestock Photo 7. Bag of meal for livestock feed

2. Organization of stakeholders around breeding and their techniques

2.1. Main players dominated by men, older and less educated

Breeders in the town of Maroua identify themselves according to socio-demographic characteristics (Table 2) and which determines the type of breeding. Livestock breeding is dominated by male breeders 83.41% compared to 16.59% for female breeders. This low

involvement of women in this activity can be explained by the religious and cultural way of life in the northern zone of Cameroon. So breeding requires a certain experience to be practiced. This is why they are largely represented by people belonging to the age group over 30 years old (58.77%) whether it is cattle, goat, sheep or mixed breeding. Despite experiences in this area, these breeders remain less educated, 33.6% have completed primary school and 33.6% have not gone to school.

Table 2. Sociodemographic parameter of Maroua breeders

Sociodémographic Parameters		Rearing or breeding type				Total	Frequency (%)
		Cattle rearing	Sheep rearing	Goat rearing	Mixed rearing		
Sex	Female	6	11	14	4	35	16,59
	Male	22	36	60	58	176	83,41
	Total	28	47	74	62	211	100
Ages	15-20 years	6	2	1	6	15	07,1
	20-25 years	5	4	2	4	15	07,1
	25-30 years	5	8	20	24	57	27,02
	Plus de 30 years	12	33	51	28	124	58,78
	Total	28	47	74	62		100
Level ofeducation	Never been to school	9	20	19	23	71	33,6
	Primary	7	10	33	21	71	33,6
	Secondary	11	11	21	13	56	26,5
	High school	1	6	1	5	13	6,3
	Total	28	47	74	62	211	100

Source: 2023 field survey

2.2. Associations, organizations, training centers, the State and its decentralized services support and supervise breeders

Associations and NGOs are considered the indirect players in livestock farming in this city with more or less diversified areas of intervention. This is how the NGO CARE carries out projects to support local populations and help them fight against the food crisis affecting the urban population of Maroua. Training and research structures are present. The Institute of Agricultural Research for Development (IRAD), being present in the three northern regions of Cameroon, has a program totally dedicated to animal and fish production. The Maroua Agricultural Technicians School (ETA) trains livestock technicians and veterinary nurses who are at the service of breeders.

The state is represented here by MINEPIA and the three municipalities of the city. Planning of activities and national livestock policy is the responsibility of MINEPIA. At the institutional level, other ministries carry out activities related to that of MINEPIA. We can mention MINADER, MINMEE, MINEF, MINPLANDAT and MINFI. Local authorities have autonomous power at the local level. They are in fact holders of power or political

management authority distinct from the State. Their traditional power gives them the right to plan and even coordinate activities. The *Lamidos*, the *Lawan* and the *Jaoros*[1] master this area in the different municipalities of the city. Because they resolve most conflicts between breeders and their neighbors.

2.3. The city's breeders use well-identified techniques

Breeding techniques were identified during field surveys. Households involved in livestock farming are unable to feed their livestock and are often forced to let them wander around the city. For this, we distinguished the techniques of breeding by enclosure (26.54%), breeding by farm (0.94%), guarding (17.53%) and the wandering of animals in the streets of the city (47 .86%). Leaving the animals wandering in the streets is the image of livestock farming in Maroua.

Table 3. Breeding techniques in Maroua town

Quartier	Breeding or rearing Techniques					Total
	Rearing in a fence	Rearing in a ranche	Leave animals to wonder in the streets	By shephards	Mix Technique	
Doursoungo	14	0	8	7	3	32
Douggoi	6	0	18	4	1	29
Lougueo	4	1	15	8	8	36
Hardé	4	0	6	1	5	16
Domayo	0	0	9	7	4	20
Ouro-Chèdé	7	1	15	4	1	28
Doualaré	4	0	10	5	3	22
Mayel-Ibe	4	0	4	3	0	11
Gadouma VIP	3	0	10	4	0	17
Total	56	2	101	37	15	211
Frequency (%)	26,54	0,94	47,86	17,53	7,10	100

Source: Field survey

3. Socio-environmental effects of intra-urban livestock farming in Maroua

Livestock production worldwide is responsible for 14.5% to 51% of global greenhouse gas emissions according to estimates from WORLDWATCH, and FAO 2016. Livestock production is generally responsible for 65% of nitrous oxide (N_2O) and 37% of methane (CH_4) from human activities. Nitrous oxide emissions are linked to fodder production, and especially to the discharge of manure. The livestock sector therefore appears here as one of the two biggest culprits for the main environmental problems, whether at the local or global

[1]Traditional leaders in their respective rank

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level, livestock should be at the heart of the policies put in place to deal with the problems of soil degradation, climate change, air pollution, lack of water resources or their pollution and erosion of biodiversity (STEINFELD *et al*., 2006).

3.1. Quantity of proliferation of cattle, goats and sheep dung in the study area

The dung (Table 4) of cattle, goats and sheep is rich in water and organic matter. Based on the monitoring of 3 oxen, 2 goats and 2 adult sheep in the town of Maroua for a week. The observation is that an adult ox can produce an average of 10 excrements per day, or approximately 0.6 kg each. In one day an ox can produce around 7 kg. As for adult goats and sheep, they can produce an average of 17 excrements per day of around 0.14 kg each. In one day, a goat or a sheep can produce around 2.5 kg of dung.

Table 4. Quantity of beef, goat and sheep dung

Animal	Number of excrement per week	Number of excrement per day	Quantity of dung per week	Number of dung per day
Sample Cow 1	67	9,57	48,35	6,90
Sample cow 2	63	9	46,5	6,64
Sample cow 3	78	11,14	55,3	7,90
Sample goat 1	120	17,14	17,85	2,55
Sample goat 2	116	16,57	17	2,42
Sample sheep 1	116	16,57	15,54	2,2
Sample sheep 2	117	16,71	16,65	2, 37

Source: Field measurements

3.2. Estimation of carbon dioxide and methane released by cattle, sheep and goats

The most recognized greenhouse gas is carbon dioxide (CO2). This greenhouse gas has caused global warming of the earth in recent years. Livestock farming is thus one of the activities that facilitate the proliferation of CO2. But it remains mostly unguarded. Methane (CH4) follows the most abundant greenhouse gas (carbon dioxide). According to *Groupe Parlons Science* (2020), even though CO2 is more abundant in nature than methane, methane traps approximately 30 times more heat than carbon dioxide. Methane is therefore the gas to watch closely[2].

After the analyzes carried out with existing MINEPIA data on the breeding of cattle, goats and sheep through the formula $\boldsymbol{Qp = (Rn \times f)365}$, we estimated the amount of carbon dioxide and methane proliferation per year from this breeding in the town of Maroua. Starting from the basis that an ox can produce 120 Kg of CO2 and 90 Kg of CH4 in 365 days according to CHOUINARD (2010) and knowing that goats pollute 10 times less than cattle we obtained the results as illustrated in table 5.

[2]Cow methane and climate change www.parlonsscience.ca 2020

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Table 5. Production of CO2 and CH4 by sheep, goats and cattle in the town of Maroua in 2023

Breeding Type	Number	Quantity of CO_2 per day (Kg)	Quantity of CO_2 per year (Kg)	Quantity of CH_4per day (Kg)	Quantity of CH_4 per year (Kg)
Cattle	4811	0,33	579484,94	0,24	421443,6
Goat/sheep	4301	0,033	51805,54	0,024	37676,78

Source: Field data

3.3. Water pollution from livestock farming in the city

The poor practice of livestock breeding in the town of Maroua contributes to the contamination of surface water and groundwater via the infiltration of bad substances (urea, ammonia, phosphorus, carbon) or pollutants from this breeding. The infiltration of animal urine (47.2%) near water points, the dumping of waste from livestock near surface water (37.9%) and the watering of animals (20.9 %) are the factors (Table 6) of water pollution according to the people surveyed in this city.

Thus, the quality of water used by the population near livestock areas is polluted. During surveys of breeders in the study area on water quality (Figure 4), 57% of those think that the water consumed by them and which comes from wells close to the breeding areas is moderately poor. 35.7% think that this water is of poor quality.

Table 6. Water pollution factors

Water pollution factors	Frequency	Valide percentage
Dumping of waste near wells	80	37,9
Infiltration of animal urine from enclosures near wells.	87	41,2
Animal watering	44	20,9
Total	211	100,0

Source: Field data

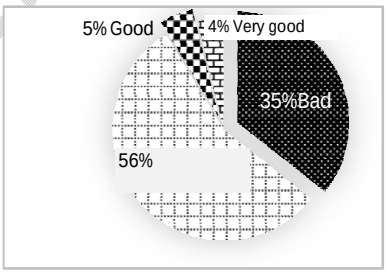

Figure 4: Distribution of water quality from boreholes close to animal enclosure

3.4. Presence of mud and impassable road

In the rainy season, roads and streets become impassable due to cattle encroachment (Photo 8). These impacts are directly linked to the presence of herds of cattle in the city in search of grazing or to their movement. In houses, especially in the rainy season, animals that have their shelters in the compound create mud. The areas of the yard for the most part are transformed into the animals' resting place and these concessions which shelter these animals are generally full of odors which leave nothing to be desired.

In all the districts of the city where we investigated, we encountered this type of situation, hence the question of sanitation and unsanitary conditions in this city. For the herds that go to the parking areas, they destroy the roads by creating mud on them and these roads

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become impassable, neither motorcycles nor cars can travel easily. In some cases, except pedestrians who can pass because they put stones or pieces of brick or even sandbags on the mud.

Photo 8. The mud resulting from the encroachment of cattle in the rainy season

3.5.Health impacts and accidents

Road accidents are recurrent in the city of Maroua, especially in neighborhoods where traffic is heavy. This is the example of the Douggoi, Domayo and Doursoungo district where cases of accidents are regular. These accidents linked to the movement of herds are generally identified from 8 a.m. onwards. Time for livestock to go out for grazing. And at 6 p.m., the hour that marks the return of the herds for those who wander around the city looking for something to eat. These animals cause accidents such as collisions between motorcycles and cars and have impacts on human health and even loss of human life. Thus, we recorded a large number of accident cases (Figure 5) in Douggoï (10 cases) and in Domayo (9 cases) during the investigation period.

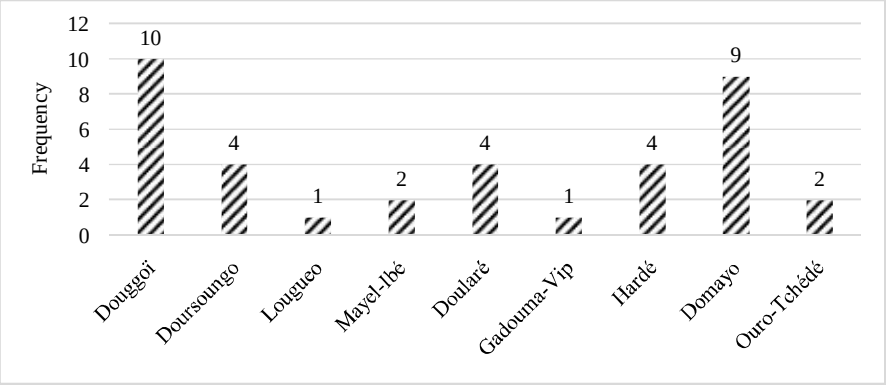

Figure 5. Distribution of accident cases by neighborhood

4. Technique for resilience and mitigation of the harmful effects of intra-urban livestock farming

4.1. Recycling of waste from intra-urban livestock farming

Any livestock activity produces waste which can represent “added value”, particularly in agriculture. Thus, due to the multiplicity and complexity of residual waste, there is a close link between the recovery of waste from an animal farm or a production unit and the management of this resource and its recovery at the level of the territory. However, from the micro to the macro scale, the recycling and risk research unit creates interactions between project leaders, communities and processing units.

Indeed, the recycling of waste (Photo 9) from this breeding will reduce the rate of proliferation of animal waste in the city. This urban environment is today confronted with this situation of characterized incivility of the population. So awareness for recycling waste or animal dung for other purposes can curb this pollution. So beef dung can be used for other purposes, even as cooking fuel.

Photo 9. Recycled and dried bovine dung for cooking

4.2. Using organic waste as compost

Composting waste from this breeding is very important for nature conservation. It is a process which consists of transforming waste in order to return to the soil as fertilizer. The processes for transforming waste from livestock farming today are solutions to reduce the rate of pollution emitted by livestock farming in cities. There are several types of compost (Table 7) with different components. Knowing these different types of compost will allow the breeder to choose what will allow them to better manage the waste resulting from their activity in order to give value to this waste.

Table 7. Type and Composition of Compost

Type of compost	N (Kg/t)	P2O2 (Kg/t)	K2O (Kg/t)
Mature composts (mainly cattle manure compost and commercial composts)	5,8	10,1	4,1
Mature composts (mainly cattle manure compost and commercial composts)	7,6	9,1	5,4
Straw dairy cattle composts under geotextile	8,4	6,3	12
Straw dairy cattle composts under geotextile	9,1	8	12,8

Source: (According to ROBITAILLE *et al*, 1996)

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Discussion

The problem examined in this study is part of the series of research studies on environmental and social impacts and is focused on the effects of intra-urban livestock farming. This study shows that intra-urban livestock farming in Maroua is characterized by the presence of cattle (13.3%), goats (35.1%) and sheep (22.3) and the mixed livestock system (29. 4%). It is also characterized by the poor state of livestock breeding in the city such as the wandering of animals, cattle tracks in the city, etc. MAGNE's studies (2017) also reveal this aspect of animal wandering in the town of Bafoussam. This activity, considered as a growing food production, is due to the demographics which are galloping. It also reveals that this proliferation of livestock farming is a function of natural and human factors. In the same sense DELFOSSE *et al*, (2018) reveal that livestock farming exists both as a nourishing activity in environmental forms in both urban and peri-urban spaces. The results are interesting and relevant, but cannot be interpolated across all Sahelian cities because each area has its own particular way of life.

The livestock farming stakeholders in the town of Maroua are distinguished: the main stakeholders (breeders) and the secondary stakeholders (States, NGOs, Associations, etc.). Field surveys using survey sheets made it possible to create a typology of actors and characterize them. The main actors are categorized by socio-demographic characteristics such as gender, function, age, etc. This study shows that men (83.41) are more involved in urban livestock farming than women (16.59), at least the owners of the animals. This observation has already been reported by NAÏMATOU (2017), YOUSSAO *et al*, (2008) and HOUNDONOUGBO *et al*, (2012) in Benin, by MOPATE (2008) in N'Djamena in Chad, and by OGNIKA et al, (2016) in Congo. According to HOUNDONOUGBO *et al*. (2012), the low rate of women in livestock farming is due to constraints linked to this activity and religion. On the other hand, MAGNE (2017) reveals that women (58.24%) are involved in urban livestock breeding than men (41.68%) in Western Cameroon. The breeding techniques practiced by these breeders as indicated in this study are diverse. The most representative techniques are that of animals wandering around the city (47.9%) and that of enclosures (26.5%).

The results reveal that the environmental and social impacts are enormous. Based on a scale and an animal defecation monitoring sheet, the study showed that an ox can produce around 7 kg of dung per day and a sheep or goat can produce 3 kg of dung per day. The study made it possible to make estimates per year on the release of carbon and methane. According to *Groupe Parlons Science* (2020), even though CO2 is more abundant in nature than methane, methane traps approximately 30 times more heat than carbon dioxide.

Methane is therefore the gas to watch closely. The production of methane (CH4) is thus due to fermentation and the result of the degradation of the ingested plant biomass by the microorganisms present in the digestive tract as indicated by CHOUINARD, (2010). This study also shows that the breeding of cattle, goats and sheep pollutes water and air, degrades the soil and creates unsanitary conditions in the city. The conclusions of MAGNE (2017), NAÏMATOU (2017) in Benin on urban pig farming are in the same vein. This study also

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showed the deterioration of social ties due to the poor practice of intra-urban breeding. MAGNE (2017) also has the same results. This deterioration of social ties is justified by the complaints submitted to the competent authorities.

The different adaptations of the population to the impacts of livestock farming are not insufficient. These strategies are based on complaints, on the laying of stones on roads destroyed by animals. All these adaptations have only helped to mitigate the effects of livestock farming on human health and the environment. The study showed that peasant adaptation strategies are spontaneous reactions to these environmental and social impacts which do not really integrate anticipation and management of waste. This leads us to propose solutions such as making manure compost. JOBIN (2004) also makes the same proposals. It is also necessary to set up corridors for livestock, treat contaminated water regularly and build signage for the passage of animals at a specific time or period.

Conclusion

This study aimed to contribute to understanding the impact of intra-urban livestock farming on the biophysical environment and on health in order to propose possible solutions that will reduce these harmful effects.

Thus, the introduction of animal breeding in urban centers must be made taking into account its significant impacts on the environment and populations. The proximity of livestock areas to city life imposes certain rules different from a traditional farm located in a rural environment (noise, smell); its location must therefore be discreet and perfectly adapted to the urban fabric. The competent authorities must establish a development model, a land use plan which integrates livestock activities in urban areas in the Sahel zone. Public health and environmental protection must be the major concerns of institutions and populations, hence the urgency of reframing and regulating this activity in urban areas of Cameroon.

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References

- CALLICOTT John Baird, 2018, “After the industrial paradigm”, in Id., Ethics of the Earth, op. cit., pp. 269-290.

- CHOUINARD Yvan, 2010, Production and emission of methane and carbon dioxide by ruminants, 65th congress of the Order of Agronomists of Quebec. Understanding climate change in order to act better. Laval University. 10 p.

- DELFOSSE Claire, DUMONT Bertrand, HOSTIOU Nathalie, 2016, “Cities and peri-urban spaces: places of new relationships between livestock farming and society”, For, pp. 193-202. DOI: 10.3917/for.231.0193. URL: https://www.cairn.info/revue-pour-2016-3-page-193.htm

- DONGMO Thomas., GOCKOWSKI Joseph and HERNANDEZ Samuel, 2005, “Peri-urban agriculture in Yaoundé: its relationship with poverty reduction, economic development, conservation of biodiversity and the environment”. Tropicultura, 23: pp.130-135

- FAO, 2011, Livestock in the world in 2011-Contribution of livestock to food security, FAO, Rome, 150 p.

- FAO, 2013, Urban livestock farming, food security or environmental danger? 2 p.

- Houndonougbo Mankpondji Frédéric, Chrysostome A. A.M and Houndonougbo Pascal Venan, 2012, bioeconomic performance of pullets fed with rations based on dried cassava leaves (Manihot esculenta), International journal of Biological and Chemical Sciences, pp. 1950-1959

- JOBIN Pierre and PETIT Jacques, 2004, organic fertilization of crops, FABD, 53 p.

- MAGNE Mouaffo Carole, 2017, Urban livestock breeding and socio-economic impact in Baffoussam II. Master's thesis, University of Dschang. 152 p.

- NAÏMATOU Abdoulaye, 2019, Environmental impacts of pig farming practices in urban and peri-urban areas of Benin. Master's thesis, University of Abomey-Calavi (EPAC). 45 p.

- OGNIKA Alex Jone, MOPOUNDZA Paul, OKANDZA Yves and AKOUANGO Parisse, 2016, Productive and reproductive adaptation of large white pigs raised in breed in Brazzaville (Republic of Congo) PP. 4727-4735

- ONACC, 2022, Bulletin of forecasts of climate parameters for the months of September, October and November 2022, Cameroon, 62 p.

- ROBITAILLE, ,.

- ,

- ROBITALLE Robert, RIOUX Romain, RÉGIS Simard, GAGNON Bernard and LALANDE Roger, 1996, Is my compost good, in Bio-bulle, 4p.

- SMITH Olanrewaju, MOUSTIER Paule, MOUGEOT Luc and FALL Abdou. 2004. Sustainable development of urban agriculture in French-speaking Africa: issues, concepts and methods. Montpellier: CIRAD-CRDI, 173 p.

- STEINFELD Henning, GERBER J. Pierre, WASSENAAR Tom, CASTEL Vincent, ROSALES Mauricio and DE HAAN Cornelis, 2006, Livestock's Long Shadow: Environmental Issues and Options. Food and Agriculture Organization of the United Nations. 416p. SN - 978-92-5-105571-7., VL-24,

- STEINFELD Henning and DE HAAN Cornelis, 1997, Livestock - Environment Interactions. Commission of the European Communities Food and Agriculture Organization of the United Nations World Bank. Denmark. 89 p.

- Worldwatch institute, 2016, study reassessing the share of livestock in greenhouse gas emissions, https://www.vegetarisme.fr/comprendre/planete/gaz-a-effect-de-serre- industrial-breeding/

UNDER PEER REVIEW

- YOUSSAO ABDOU KARIM Issaka, DAHOUDA Mahamadou, ATTAKPA E.Y., KOUTINHOUIN G.B., AHOUNOUG .S., TOLEBA S.S. and BALOGOUN B.S., 2008, Pig production and local genetic resources in the peri-urban area of Cotonou and Abomey-Calavi in Benin , Journal of Livestock and Veterinary Medicine of Tropical Countries, 235-24

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