

Technico-Economical Diagnosis of Traditional Goats Farms Based on Zootechnical Performances in the Locality of Wakwa (Adamawa Region-Cameroon)

Nicolas BAYANG HOULI¹, Wuld Daniel Paddy MVENG^{2*}, Elysée DJEDOUBOUYOM NAMÉ¹,
NDODE Herman OKAH-NNANE¹, Elias ABLADAM DARAHALAYE¹, Mélanie LASSANGO
GASSIDA³, Iya Souley BAGARI¹, Clemence Aggy NJEHOYA⁴.

¹Institute of Agricultural Research for Development - Wakwa Centre; PO Box: 65 Ngaoundere, Cameroon.

²Institute of Agricultural Research for Development - Station of Dschang; PO Box: 44 Dschang, Cameroon.

³Department of Biological Sciences - Faculty of Sciences - University of Ngaoundere; PO Box: 454 Ngaoundere, Cameroon.

⁴Institute of Agricultural Research for Development - Animal Production Division; PO Box: 2123 Yaounde, Cameroon.



Abstract – A survey was carried out in the locality of Wakwa, region of Adamawa-Cameroon during the month of April 2021. The purpose of this study was to determine the elements of calculation of the gross product, intermediate consumption, and the method of calculation of the added value of traditional farms in the area with the zootechnical parameters of the goat as elements of economic production through the administration of a previously established questionnaire. The questions asked concerned: the socio-economic profile of the breeders, the farming or breeding system practiced the zootechnical parameters and the price and cost elements of inputs. It was noticed from this survey that the gender profile of the farmers is made up mostly of men (80%), most of who were above twenty years (92%), with agriculture (56%) as principal activity, trade (20%), handicrafts, pottery, sewing and other side activities (24%). They were mostly persons having received no formal education (68%). Regarding zootechnical parameters, the size of the herd did not exceed 10 animals for the majority of farms (76%). The selling price of the animals varied between 15,000 FCFA and 60,000 FCFA. The Litter of birth goat obeyed the principle of twinning with less than two litters per year or five cubs for a goat. The mortality of neonates and kids was less than 30%, which brings the number of adult goats to between 3 and 4 per year. *Grosso modo*, the goat breeding activity provides breeders with an estimated annual income of around 64,251.709 CFA, with a total cost of intermediate consumption over the mother's career of 7,904.9922 FCFA for a Gross Added Value of a mother over the duration of her career estimated at 143,300.698 FCFA.

Keywords – Gross product, Intermediate consumption, Added value, Zootechnical parameters, Goats, Traditional farms, Wakwa.

I. INTRODUCTION

The development of goat farming in Cameroon is an important activity driven by strengthened sector policies and constantly improving breeding practices (Seignobos, 2008) [1]. In the arid environments of the country (Sudano-Sahelian zones and high Guinean savannah), this type of breeding is generally located in the rural areas of the plateaux and mountains. It is a

traditional farming system with mild modernisation, generally extensive, with species well adapted to the environment (Pamo Tedonkeng et al, 2010) [2]. In everyday life, goats are used for consumption, also as a main source of income, or for customary rites. Goats are also a source of several valuable products: meat, which is widely consumed, manure, milk, and skin for leather. The revenues from this sector provide significant income and social benefits to breeders, enabling them to meet their health, education and various investment needs (trade, construction, etc.) [1]. Goats then constitute a cash reserve and are a lifesaving.

However, the sector has benefited very little from the results of research on the development of breeding systems and projects to improve the performance of the goat sector. Despite the progress made in understanding traditional goat farming in the Sudano-Sahelian zone of Cameroon, there are still limits in its technico-economic diagnosis. These limits can be explained, among other things, by the multiannual nature of the farms and by the fact that the breeders build up stocks. Also, goats remain difficult to assess economically because of the type of farming practiced, mainly focused on straying, and because their trade is mostly done through informal channels (Awa et al, 2004) [3]. This situation contributes to underestimating the economic importance of goats, especially for the most disadvantaged populations.

To deal with this, the Wakwa Agricultural Research Centre (CRA-Wakwa), the main research laboratory in the semi-arid zone of Cameroon, has a series of research programs aimed at analyzing and improving livestock management. To this effect, the Centre coordinates studies on livestock systems using various techniques and analytical methods. These methods have not only make it possible to assess the technical and economic performance of farms, but above all they allow us to understand the reasons why farmers practice them. And among these, the technico-economic diagnosis based on zootechnical performance (Sissao et al, 2019) [4] has the advantage of analyzing livestock as a system, that is to say a set of causal loops that contribute to overall performance. These zootechnical performances concern among others: age at reproduction, age at cull, number of litters per year, kid mortality rate, adult mortality rate (between the young stage and sale), the age at sale, the selling price of the animals, the purchase price of the goat at the start of their career, the sale price of the goat at the end of their career, etc.

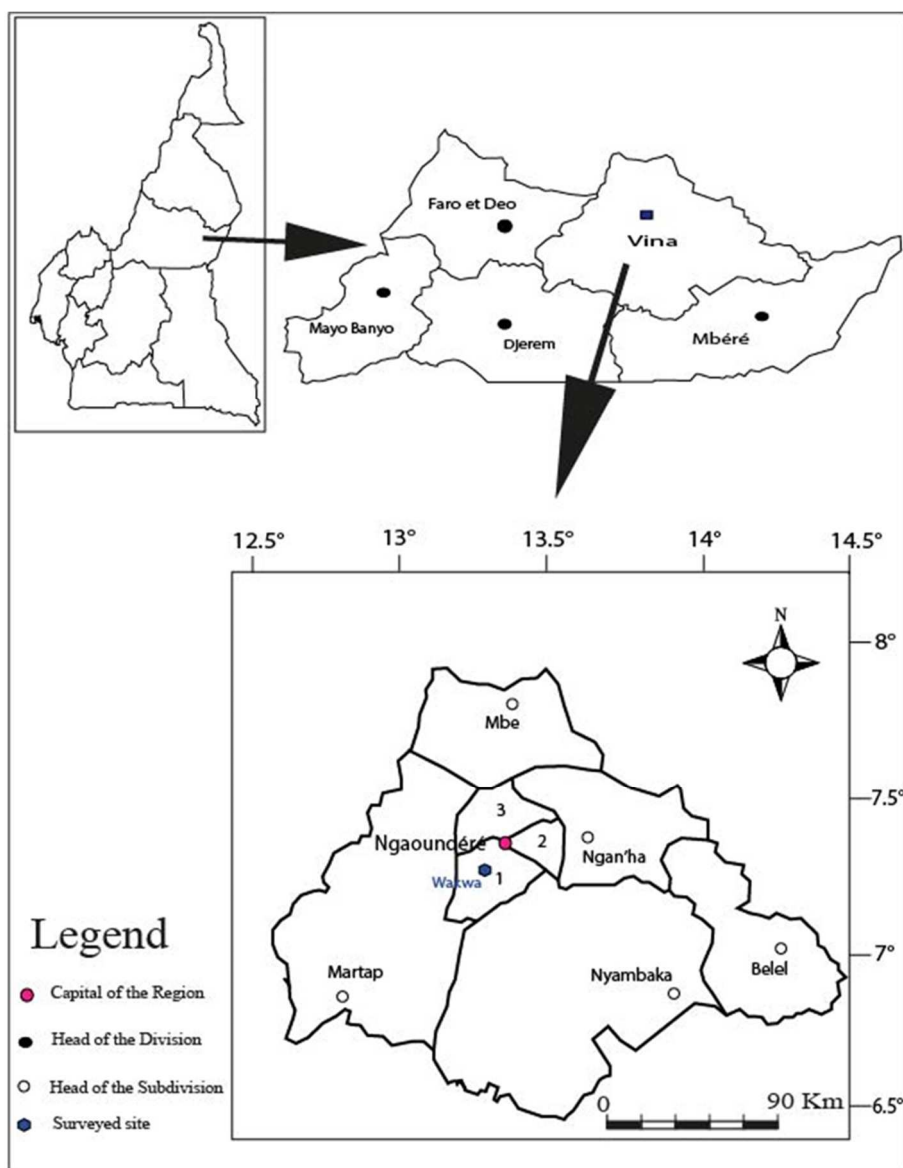
Thus, to have an idea of the wealth creation provided by a breeding, it is therefore necessary to estimate the increase in the value of the herd from the zootechnical performances (Ngongang, 2007) [5]. The challenge for CRA-Wakwa is therefore to determine the scope and interest of such a method in the characterization of traditional goat farming in the Sudano-Sahelian zone of Cameroon, taking as a practical case a rural area such as the locality of Wakwa for example. The basic assumption is that the goat rearing systems in the area are fattening-fattening and that they are valued by the local market (Iniguez, 2011) [6].

In this perspective, the objective of this study is to carry out a technical and economic characterization of traditional goat farms in Wakwa based on the diagnostic method. This article then describes the elements for calculating the gross product, intermediate consumption, and the method of calculating the added value of traditional farms in the area with the zootechnical parameters of the goat as elements of economic production (Mergeai, 2017) [7].

II. MATERIALS AND METHODS

2.1. Study framework

CRRA-Wakwa conducted this experiment during the month of April 2021 in its immediate concentric area. Wakwa is a peri-urban area, located 10 km south of the city of Ngaoundéré with geographic coordinates: 7 ° 15'908 'North and 13 ° 32'912'' East Altitude 1143 m (Figure 1). Its predominantly rural population is estimated at 485 inhabitants (BUCREP, 2010) [8]. It is exercised primarily in livestock, agriculture, crafts and small businesses (CRA-Wakwa, 2020) [9] thus benefiting from the institutional and technical supervision of a zootechnical station in addition to that provided by the CRA- Wakwa.



Source: CRRA-Wakwa, 2021

Figure 1: Location of Wakwa

Geomorphically, the area is a plateau with the presence of a few mountain ranges. Its humid Sudanese tropical climate with high variability dominated by a long dry season and a shortened rainy season. These conditions favour savannah vegetation with some shrub forests. Also, the presence of some rivers and lakes such as "Lake Tyson" and "Lake Piau" shapes the sparse landscape of this locality.

All these factors contribute to characterize the livestock farming in the area as well as those in semi-desert and mountainous areas.

2.2. Sample and data collection

As an updated database of goat breeders in the area did not exist with research and support organizations in the sector, the difficulty was to constitute a population sufficiently representative of the study. Thus, the snowball sampling strategy was used to sample the existing farmers. This type of sampling constitutes an inventory of the next breeder (s) to be surveyed from one who has been surveyed previously. The data collected was obtained by interviewing a sample of 58 breeders who were selected on the

basis of their availability. The questions asked concerned: the socio-economic profile of the breeders, the type of breeding practiced, the zootechnical parameters, and the price and cost elements of inputs. All these data were recorded and processed in the Excel 2016 spreadsheet through the construction of calculation matrices. These elements made it possible to assess: the gross product, intermediate consumption and the gross added value of livestock.

2.3. Statistical analysis and calculation method

The statistical analysis method is descriptive and focuses on estimating the frequencies and averages of socio-demographic variables observed in breeders. Also, the calculation of the technico-economic performance of traditional goat farms is inspired by study carried out by Mergeai (2017) other similar studies (Benkahla et al 2003 [10]; Lategan and Williams, 1993 [11]). This determining the overall wealth created over the course of a year.

The software used for data entry and analysis was the Excel 2016 spreadsheet.

Thus, the unit of economic production taken into account here was the mother, that is to say the goat. Several fundamental questions guided this step: How many times a year does a goat give birth? How many kids does she have? How many die?

For the gross product (PB), the calculation is given by the formula:

$$PB = \frac{[\delta + \theta]}{n}$$

With δ = the difference between the sale price and the purchase price of the goat

φ = value of all products sold during a mother's career

n = length of a goat's career (expressed in months)

Intermediate consumption (IC) is calculated by the formula:

$$CI = C_1 + C_2 + C_3 + C_4$$

With C_1 = Reproduction loads

C_2 = Power loads

C_3 = health charges

C_4 = Maintenance costs (building and equipment)

The gross added value (GAV) is given by the difference between the value of the gross product and the intermediate consumption per goat and per year.

$$GAV = PB - CI$$

III. RESULTS

The results of this study relate to: the socio-economic profile of traditional goat breeders in Wakwa, the type of farming system practiced, the breeds present in the area, the size of the workforce, and economic calculations.

3.1. Socio-demographic characteristics of the farmers surveyed

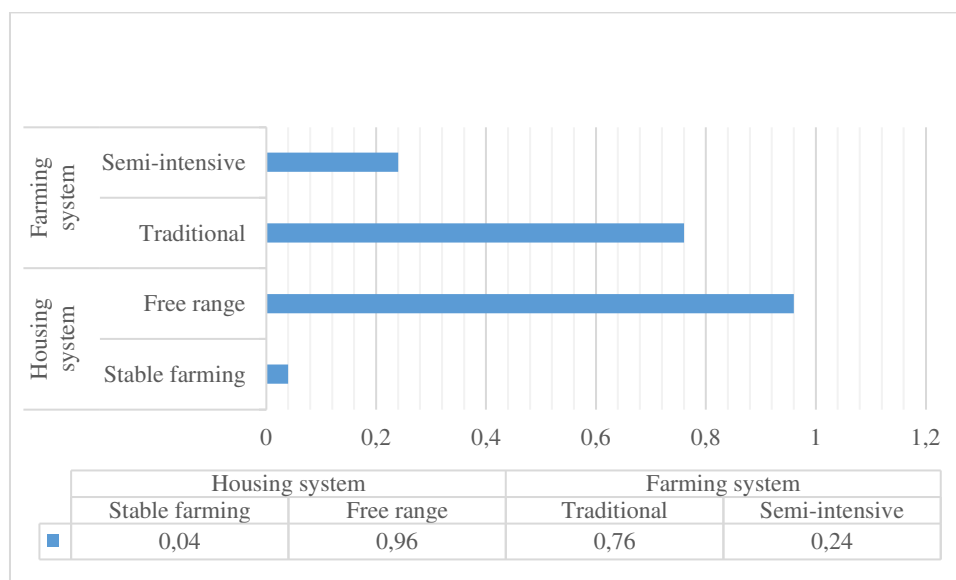
Table 1: Socioeconomic profile of traditional goat farming in the locality of Wakwa (Adamawa Region-Cameroon). $n = 58$

Parameters	Modalities	Frequencies
Age group	Under 20 years	0.08
	20-29 years	0.32

	30 – 39 years	0.32
	40 years and over	0.28
Respondent's sex	Male	0.8
	Female	0.2
Source of income	Farmer	0.56
	Trader	0.2
	Others	0.24
Education level	No formal education	0.68
	Primary school	0.12
	Secondary school	0.16
	Higher education	0.04
Training/ Supervision	Yes	0.04
	No	0.96

Table 1 presents the profile of the people surveyed. This table shows that goat farming is an activity practiced largely by men (80%). Middle breeders are mostly over their twenties (92%) with respectively 32% in their twenties, 32% in their thirties, and 28% over the age of forty. They practiced mostly agriculture (56%), petty trading (20%), crafts, pottery, sewing and other breeding activities (24%). However, they are predominantly illiterate and do not have formal education (68%). Also, it was observed that a proportion of the breeders had undertaken primary (12%) and secondary (16%) education, and very few with university education (4%). This situation made it difficult for them to access knowledge on modern farming techniques and practices from which they are excluded (96%).

3.2. Type of livestock systems practiced in the area

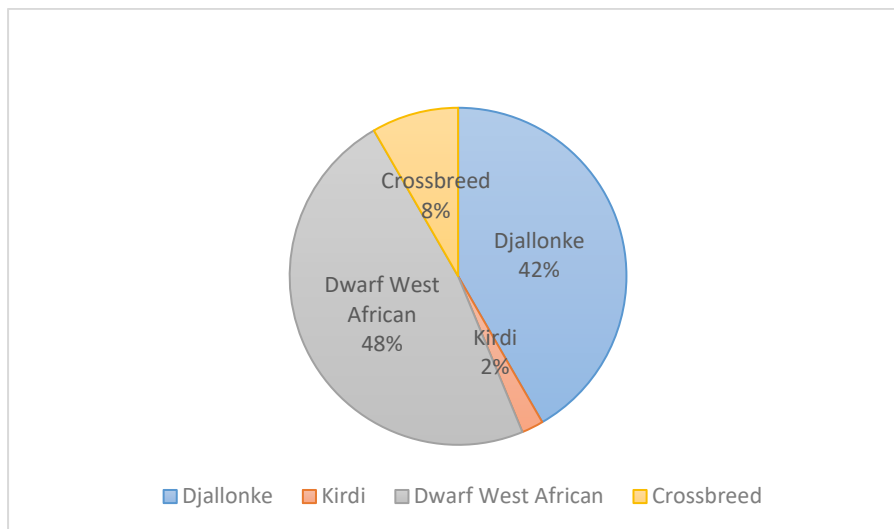


Graph 1: Livestock systems represented in the Wakwa area (n= 58)

From the following graph, it is observed that most of the animals are reared in the open air following the traditional model specific to Sudano-Sahelian spaces, and only return to enclosures at night fall. The animals feed on grass shoots and household food scraps. They receive little care and the young males are however castrated upon weaning.

However, the semi-intensive model which concerns farms of more than 10 heads is starting to develop according to the lifestyle of the breeders and socio-economic developments. In this model, the animals are instead kept in enclosures or tied to sticks. This necessarily implies care for the animals and their feeding is controlled. This confinement is seasonal and corresponds to the rainy season.

3.3. Breeds of goats present in the area

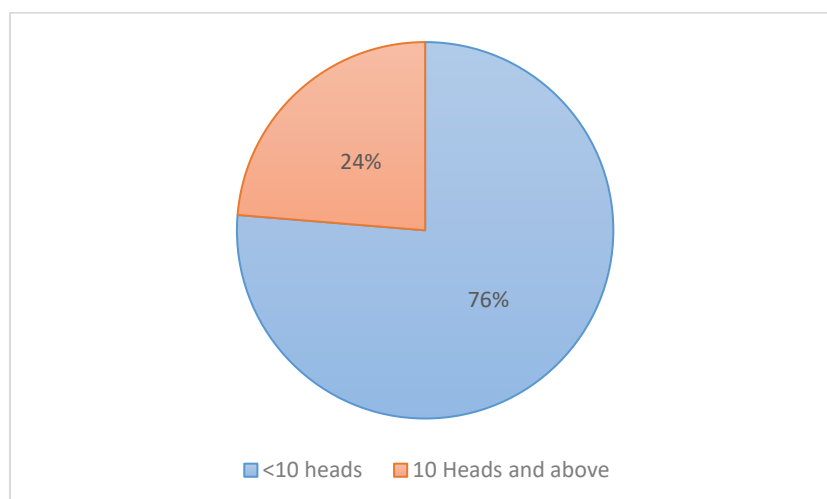


Graph 2: Goat breeds

This study allows the Wakwa goats to be grouped into four Sahelian and Guinean type breeds. These are the races: Djallonke, Kirdi, Dwarf West African, and Crossbreed. The dominant breed is the Guinea Dwarf breed (48%) followed by the Dwarf West African goat commonly referred to as the Djallonke breed (42%).

They are mainly goats with a great variety of coats, some more slender than others and perfectly adapted to the area. They are mainly animals for slaughter, raised for their meat and their skin.

3.4. Average size of goat farms in the area



Graph 3: Herd size of goat farms surveyed

The average herd size is very small and rarely exceeds more than 10 heads. Among the breeders 76% have a goat population of less than 10 heads and 24% have a minimum number of 10 heads. However, there is an increasing decline in numbers due to diseases, insufficient feeding of animals, sales, or even cases of theft.

3.4. Calculation of the Added Value of traditional goat farming systems in the Wakwa zone (Adamawa, Cameroon)

The calculation of the added value of the traditional systems of goat farming in the Wakwa zone relates to cow-type farms intended for sale, the main destination of these farms. Parameters make it possible to obtain results in this direction by calculating the gross product and intermediate consumption.

Table 2: Parameters used to calculate the gross product

Age at reproduction (months)	5.36 ± 0.56862407 (0.44 year)
Age at reform (months)	33.6 ± 13.8564065 (2.8 years)
Number of litters per year	1.8 ± 0.5
Number of young per litter	2.8 ± 0.40824829
Youth mortality rate (%)	0.2696 ± 0.05086584
Adult mortality rate (early stage to sale) (%)	0.055 ± 0.046057545
Age at sale (months)	3.24 ± 0.5228129
Sale price of kids (FCFA)	16960 ± 1619.67075
Mother's purchase price at the start of her reproductive career	33480 ± 5781.57995
Mother's selling price to reform	45840 ± 13810.2619

The ages at breeding, culling and selling gave a precise indicator of the reproduction and growth cycle of goats. Likewise, the number of annual litters and the mortality rate made it possible to determine the number of live kids intended for sale. Finally, the price indicators gave an idea of the market value of the animals. The market is essentially local and the selling prices of the animals varied between 15,000 and 60,000 FCFA.

There is a principle of twinning with less than two litters per year or 5 kids per goat. The mortality of kids and young was less than 30%, which brings the number of adult goats to between 3 and 4 per year. The rapid reproduction of goats (early sexual maturity and high prolificacy) is an asset here. It makes it possible to compensate for high mortalities and thus ensures at least the self-renewal of the herds, even under the most difficult conditions.

Table 3: Parameters used to calculate intermediate consumption

Cost of mother's food (FCFA)	None
Cost of food for young people sold over the duration of the mother's career (FCFA)	None
Cost of maternal veterinary care (FCFA)	750
Cost of veterinary care per marketable young person (FCFA)	750

The feed consists of herbs available about 8 out of 12 months. With the cultivation of cereals, available in the area, it is possible to ensure sufficient food for the animals in stalls. In this light, there is no such thing as feed costs for goats, which significantly reduces operating costs in farms. On the other hand, Table 3 highlights the costs associated with veterinary care, even if their cost remains marginal in most cases.

Also, a dozen hours per day are observed from sunrise to sunset for the surveillance and care of the animals. This task is generally assigned to young people (children) or apprentices in the livestock profession.

Thus, the gross product is calculated as follows:

Table 4: Calculation of gross product

Number of young sold over the life of a goat = $(33.6 / 12 - 5.36 / 12) \times 2.8 \times 1.8 \times (1 - 0.2696) \times (1 - 0.055)$	8.2
Difference between the selling price and the purchase price of a goat (FCFA) = 45,840CFA - 33,480 CFA	12,360
Monetary value of 8.18665626 kids (FCFA) = 8.18665626 CFA $\times$ 16960 CFA	138,845.7
Gross proceeds from the quarry of a goat (FCFA) = 12,360 CFA + 138,845.69 CFA	151,205.7
Gross product / year on the reproductive career of a goat (FCFA) = 151,205.69 CFA $\times$ $(33.6 / 12 - 5.36 / 12)$	64,251.7

The gross proceeds from the goat breeding activity are based solely on the sale of young and end-of-career goats. This activity provides breeders with a significant annual average income of around 64, 251.709 CFA per breeder. This sum can be reinvested in the activity to increase the herd, or it can be used to meet socio-economic needs.

Table 5: Calculation of Intermediate Consumption

Mother's veterinary care (FCFA) = 750 CFA $\times$ $(33.6 / 12 - 5.36 / 12)$	1,765
Veterinary care for young products = 750 FCFA / head $\times$ 8.18665626 head	6,139.9922
Total cost of intermediate consumption over the mother's career (FCFA) = 1, 765CFA + 6, 139.9922CFA	7,904.9922
Total cost of intermediate consumption per year (FCFA) 7, 904.9922 CFA / $(33.6 / 12 - 5.36 / 12)$	3,359.06184

Intermediate consumption is relatively low and is limited to veterinary care.

Table 6: Calculation of Gross Added Value (GAV)

GAV of a mother over the duration of her career (FCFA) = 151,205.69 CFA - 7,904.9922 CFA	143,300.698
GAV of a mother per year (FCFA) = 143300.698 CFA / $(33.6 / 12 - 5.36 / 12)$	60,892.6479

GAV / hd (hour / day) (FCFA) =	5,074.38732
60892.6479 CFA / 12 hd	

The GAV shows a situation of high positive average productivity per goat. This allows the breeders to realise an economic surplus of more than 5,000 CFA per day.

IV. DISCUSSION

From the results of this experiment, it is observed that the technical and economic performance of traditional goat farming in semi-arid zones in Cameroon remains low compared to the results from similar studies in more controlled environments (Guingouain, 2017) [12]. In this zone, the breeding conditions are often difficult, and the technical supervision is often too negligible in the traditional breeding system and this explains the weak performances. The main constraints were observed at the level of: food supplementation for goats, health monitoring, and housing which was generally insufficient or non-existent. Also, the economic potential of goats still remains largely untapped and resources from goats are limited to the sale of live animals and carcasses from slaughter.

Goats in the natural environment will eat a little of whatever they find, and generally their diet is made only from natural pasture and leafy branches that they weigh. But in semi-arid conditions such as in Wakwa, complementary feeding is necessary as good nutrition is the key to prolific goat rearing. The main difficulty arises during the rainy season when the animals must be tied up so as to avoid damage in the field. It is during this period that their feeding presents the most problems because animals tied up or in stalls depend entirely on the breeder. If the latter does not have enough fodder; these goats get malnourished, which results in reduced fertility. But the insufficient quantity of forage is not the only problem the breeder has to solve; there is also the quality of the forage which ideally should contain grasses and legumes (Missohou et al, 2016) [13]. The CRA-Wakwa therefore set out to produce improved fodder adapted to the climatic conditions of the region (such as *Stylosanthes spp.* Or *Bracharia spp.*) and to disseminate it among herders through extension services.

With regard to health monitoring, goats are particularly prone to certain animal diseases with a high rate of morbidity and mortality. This is the case with Peste des Petits Ruminants, which is the deadliest viral disease of small ruminants. It is caused by a virus of the Paramyxo-viridae family, close to the rinderpest virus. Transmission occurs through direct contact between animals, through aerosols, nasal discharge, sputum and all secretions or excretions from sick or convalescent and asymptomatic animals. Helminthiasis also occupies an important place in animal production with the direct losses (mortality of young) and indirect (weight loss, lengthening of the interval between two births, etc.) that they cause (Kosgey et al 2006) [14]. These two health constraints can be controlled by vaccination (Caprippestovax vaccine produced by National Veterinary Laboratory (LANAVET)) for the first and treatment (anthelmintics) for the second. However, the main herds of Wakwa do not remain poorly vaccinated against these diseases and the use of a veterinarian is not the norm.

Regarding animal habitat, in the traditional goat farms surveyed, the goats are left free and no shelter or accommodation structure, worthy of the name, exists. Usually breeders are content to put the goats, along with all the animals they own, in a straw shed for the night or for shelter. These stables are often too narrow, poorly ventilated and above all never cleaned. This has harmful consequences on the health (appearance of respiratory diseases) and the zootechnical performance of goats (weight loss, decrease in fertility, etc.) (Lebbie, 2004) [15].

Finally, there is an under-evaluation of products from goat farming in the area, mainly because of the lack of marketing networks for goat products and resources. Meat is currently the only truly exploited resource, and resources like milk and skin are still largely untapped (Archimède et al, 2011) [16]. This situation is partly explained by the eating habits of the local populations. In addition, the storage at room temperature of dairy products from goats is subject to the effects of environmental factors. This makes this natural preservation of milk difficult, thus requiring refrigerated storage means. Goatskin is used very little by traditional tanners. This does not allow this slaughtering by-product to be exploited in terms of its economic value and spread in the area.

V. CONCLUSION

This study allowed us to make a technico-economical characterization of traditional Wakwa goat farms based on the diagnostic method. From the zootechnical parameters of the goat in the locality of Wakwa, this diagnostic method made it possible to describe the elements for calculating the gross product, intermediate consumption, and the method of calculating the added value of traditional farms. These zootechnical parameters used in the calculation described above are subject to nutritional, health and managerial constraints. This does not make it possible to actually visualize and estimate the elements for calculating the gross product, intermediate consumption, and the method of calculating the added value of these farms. In perspectives, we plan to carry out a comparative study on two categories of traditional farms, one of which is a control and the other benefits from technically improved support (improved fodder, vaccination, treatment and training of the promoter on the management of his farm).

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