Profitability of sheep farming in Benin

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Abstract

Sheep farming is gaining more and more importance in many households in northern Benin given its contribution to their income. This study aims to analyze the economic performance of 102 sheep farms distributed in 5 municipalities of the Borgou department in Benin. Descriptive statistics were used to describe the socio-economic characteristics of the farms. The results showed that the sheep farmers were predominantly male (75.4%), married (87.2%), predominantly Muslim (90.2%). Only a minority has reached university (1.96%). The sheep breeds encountered on the farms were made up either of Djallonké (33.3%), or Djallonké, Sahelian and crossbreds (31.3%), Sahelian (25.4%) or weakly of Djallonké and crossbreds (9.80%). The most common type of feeding was a combination of natural pasture, hay and concentrate (59.8%). Sheep farmers combined traditional medicine and veterinary medicine much more (72.5%) and very few of them (12.7%) used agricultural credits linked to sheep farming. The sheep flocks consisted of 20.6 ± 11.5 heads with larger numbers of ewes (8.2 ± 6.4) and rams (5.2 ± 7.3). The economic analysis revealed that sheeps were acquired at a price of 28450.9 ± 12458.9 FCFA (~ 47.1\$ ± 20.6) and resold at 58591.6 ± 18937.8 FCFA (~ 97.0\$ ± 31.3), generating a net margin of 9902.1 ± 11192.0 FCFA (~ 16.4\$ ± 18.5) per sheep. Overall, almost 90% of sheep farms presented a positive balance. This study shows that the sheep farming sector can be better exploited to increase meat production in Benin and further increase household income.

Key words: Farming; sheep; product; profitability; Benin.

Introduction

Ruminant farming plays a large role in the daily lives of households and families around the world and in Africa in particular (Wodajo et al., 2020; Worogo et al., 2022) . The sheep husbandry is source of earning to small and marginal farmers across the world in both developed and developing countries (Martinez et al 2012; Milchevskiy et al 2020; Bhateshwar et al 2024). Studies have sought to demonstrate the importance of sheep farming as an alternative livestock production in different contexts around the world and this activity has the potential to address the global challenge of dramatically increasing food production in rural areas poor in a socio-economically sustainable way. Given the accentuated urbanization in the West African area closely associated with demographic growth, the supply of products of animal origin is struggling to cover the needs of the populations. This implies that production linked to agriculture and livestock breeding must benefit from more interest to meet this challenge and, in turn, contribute to the food security of populations.

In Benin, the contribution of the animal sector to the agricultural Gross Domestic Product (GDP) is estimated at around 13% with a value of livestock of around 242 billion FCFA and a value of total animal production of live animals around 67 billion FCFA (DSA, 2020) . This activity is generally practiced by both men and women in many localities to the extent that it contributes to the security of families, the capitalization of resources, the diversification of activities while playing an indirect economic role through soil fertilization (Lesse et al., 2015; Worogo et al., 2020). Furthermore, although the weight of the livestock sector in agricultural GDP is significant, with annual production of meat and milk estimated respectively at 78,208 and 128,389 tons in 2020 (DSA, 2020), Benin continues to import on average 60,000 tons of meat per year, equivalent to around 21 billion FCFA. Milk imports are estimated at nearly 10,000 tons of milk, or around 10 billion FCFA. In the category of ruminants in Benin, the small ruminant farming is perceived as an important means for improving the contribution of animal production to the national GDP (Vissoh et al., 2021) . These animals are raised by the vast majority of the population. In addition to the functions of prestige and savings, they contribute to farmers' income through the sale of animals and their by-products and at the same time, they provide manure to be used as organic fertilizer (Houessou et al., 2021). In fact, agriculture-livestock integration makes ruminant farming more practicable given the advantage offered by crop residues as well as agro-industrial by-products (Afouda et al., 2020; Dimon et al., 2022a, 2022b). Sheep farming has seen very little scientific interest compared to other ruminant species present in Benin despite its strong potential to increase protein production in Benin (Idrissou et al., 2017; Montcho et al., 2016; Dimon et al., 2020) . In addition, the assessment of the economic value of a given type of livestock constitutes an important lever for guiding political and scientific decisions oriented towards the development of the animal sector (Sounon et al., 2019; Jemberu et al., 2022) . Therefore, it would be important to optimize production, first of all by evaluating production costs and revenues obtained at the level of farmers. Thus, they will be able to better manage their farms by acting upstream on certain production parameters. Controlling production costs as well as their relationship with the products obtained therefore remains a great challenge and a key indicator for not only analyzing but also effectively managing a farm. The observation is that the technical-economic analyzes carried out by management consulting groups remain difficult to access to breeders in the sheep farming sector due to their high cost and the fact that breeders are unaware of the positive effects of such an analysis on their business. It is in this context that this study aims to contribute to the improvement of animal production in Benin through an evaluation of some economic performances of sheep farms in northern Benin. This will specifically involve determining production costs, the cost price of live sheep as well as the profitability indicators of these farms.

Materials and methods

Study environment

This study was carried out in the Borgou department. Five (05) municipalities were the subject of investigation. These are the municipalities of Parakou, Nikki, Pèrèrè, Tchaourou and Ndali. The choice of these municipalities was guided by the fact that they are areas with a strong dominance of ruminant farming contained in the Agricultural Development Center (PDA) promoting the breeding of small ruminants (sheep and goats) according to the new plan recovery of the country's agricultural sector (MAEP, 2017) . This choice also depends on the accessibility of these municipalities and the presence of small ruminant farms.

Data collection and sampling

In total, one hundred and two (102) sheep farmers distributed in the five municipalities of the Borgou department with 20 sheep farmers in the municipality of Ndali, 17 in that of Nikki, 22 in that of Parakou, 22 in that of Pèrèrè and 21 in Tchaourou participated in the present study (Fig 1). These sheep farmers were individually submitted to a pre-established questionnaire. Data collection was carried out from November 2023 to February 2024. The interview guide enabled to collect both socio-demographic and economic data from farms linked to sheep farming. The sociodemographic data concerned the age of the farmer, gender, ethnicity, religion, marital status, level of education, geographical location, number of years of experience in sheep farming. and the
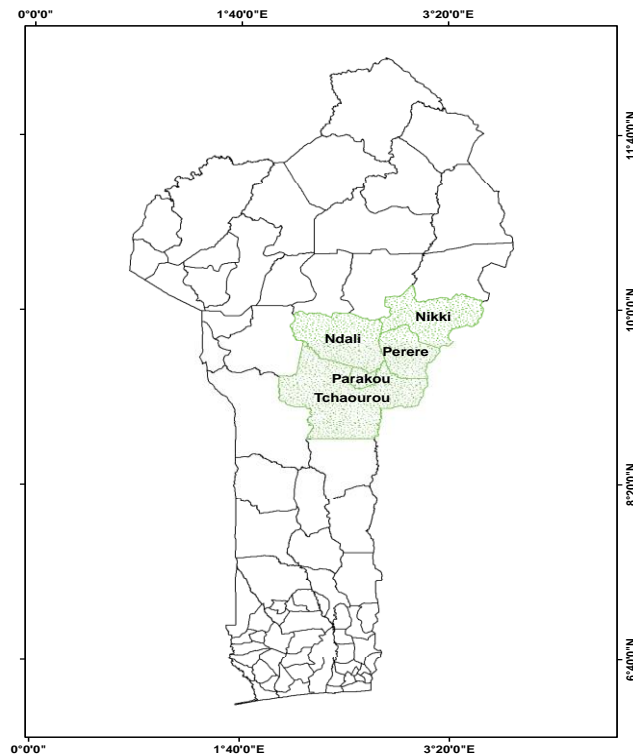
Figure 1: Location map of study municipalities

area of cultivated land. Data relating to the composition of the herds according to the categories of sheep (male and female lambs, young rams, young ewes, rams and ewes) were also collected. The economic data were about the estimation of all fixed costs, variable costs as well as income relating to sheep farming. Due to the lack of recording of financial movements in most of the farms surveyed, certain financial expenses were grouped under the same designation in this study. Thus, the costs linked to the installation of enclosures and specific equipment (making feeders, drinkers, rakes, etc.) for the breeding of small ruminants have been grouped together in "Sheepfold and equipment". "Maintenance" here includes the estimate of depreciation of the various equipment, repairs of the sheepfold, etc.); "Reimbursements and taxes" provides information on financial outflows solely linked to sheep farming in the event of a loan from banking structures or from other individuals or when the breeder has the obligation to pay taxes to the town hall or any other structure during sales or occupation of land for sheep production.

Statistical analysis

The data collected was entered into an Excel spreadsheet and then imported into R software (R Core Team, 2021) for statistical analyses. The values of quantitative variables are presented as Mean ± Standard Deviation). The quantitative data were subjected to an analysis of variance (ANOVA) and then compared (between municipalities) using the Tukey test in case of significance ($P<0.05$). As for qualitative variables, they are presented as percentages and subjected to the Chi-square test. The percentage of negative profit margin farms was determined by making the ratio between the number of farms having presented a negative balance over the total number of farms. The same principle was applied to determine the percentage of farms with a positive balance.

Results

Socio-demographic profile of the breeders surveyed and animal management

The results showed that the average age of the people surveyed was 45.14 ± 13.60 years with older individuals in the municipality of Nikki and younger individuals in the communes of Parakou and Tchaourou ($p<0.05$) (Table 1). The majority of the surveyed farmers were married and were male. They mainly practiced Islam as a religion. The number of employees presented significant differences between the municipalities studied and this was higher in the municipality of Ndali ($p<0.05$). The people surveyed had an average of 18.1 ± 0.7 years of experience in sheep farming with more experienced individuals in the municipalities of Nikki and Tchaourou compared to those in other municipalities ($p<0.001$). The people surveyed were largely represented

Table 1: Socio-demographic characteristics of the breeders surveyed and animal management

Features		Overall	Ndali	Nikki	Parakou	Pèrèrè	Tchaourou	P-value
Age		45.1 ± 1.3	$47.2 \pm 3.6ab$	$56.0 \pm 2.7a$	$38.4 \pm 1.5b$	$45.2 \pm 3.0ab$	$41.2 \pm 2.5b$	P<0.001
Nb_empl		0.7 ± 0.1	$1.9 \pm 0.3a$	$0.7 \pm 0.2b$	$0.2 \pm 0.1b$	$0.3 \pm 0.1b$	$0.5 \pm 0.1b$	P<0.001
Nb_yr_exp		18.1 ± 0.7	$16.6 \pm 1.1ab$	$22.6 \pm 2.0a$	$14.4 \pm 0.9b$	$15.6 \pm 1.2b$	$22.4 \pm 2.0a$	P<0.001
Household size		9.4 ± 0.5	$12.7 \pm 1.8a$	$8.7 \pm 0.7ab$	$9.3 \pm 0.9ab$	$9.1 \pm 0.9ab$	$7.0 \pm 1.0b$	P<0.05
Sex	Male	75.4	95.0	58.8	77.3	63.6	81.0	$X^2 = 8.7$
	Female	24.5	5.0	41.2	22.7	36.6	19.0	P>0.05
Ethnic group	Bariba	42.1	35	47.1	68.2	59.1	0	$X^2 = 36.8$
	Fon	2.9	10	0	0	0	4.8	P<0.001
	Gando	2.9	5	0	0	0	9.5	
	Nagot	10.7	20	0	9.1	4.5	19	
	Peulh	41.1	30	52.9	22.7	36.4	66.7	
Marital status	Married	87.2	80	100	81.8	77.3	100	$X^2 = 9.0$
	Single	12.7	20	0	18.2	22.2	0	P>0.05
Religion	Muslim	90.2	90	0	95.5	95.5	71.4	P<0.05
	Christian	09.8	10.0	0	4.5	4.50	28.6	$X^2 = 11,5$
Educational level	None	22.5	10.0	17.6	22.7	9.10	52.4	$X^2 = 23.7$
	Primary	26.4	45.0	29.4	27.3	18.2	14.3	P<0.05
	Secondary	49.0	40.0	52.9	50.0	72.7	28.6	
	University	1.9	5.0	0	0	0	4.8	
Mod_acq	Purchase	91.1	80	70.6	100	100	100	$X^2 = 18.3$
	Heritage	8.8	20	29.4	0	0	0	P<0.001
Memb_assoc	Yes	40.1	45.0	47.1	18.2	36.4	57.1	$X^2 = 7.6$
	No	59.8	55.0	52.9	81.8	63.6	42.9	P = 0.10
UseAgrCredit	Yes	12.7	25.0	5.9	9.1	4.5	19.0	$X^2 = 5.7$
	No	87.2	75.0	94.1	90.9	95.5	81.0	P>0.05
Sheep breeds	Djal	33.3	25	41.2	31.8	27.3	42.9	
	Djal_Crossb	9.8	0	5.9	4.5	27.3	9.5	$X^2 = 25.3$ P<0.05
	Djal_Sah_Crossb	31.3	35	29.4	18.2	27.3	47.6	$X^2 = 91.6$ P<0.001
	Sah	25.4	40	23.5	45.5	18.2	0	
Feed	Hay_Conc	11.7	20	0	18.2	18.2	0	
	NaPa	5.8	0	11.8	4.5	0	14.3	
	NaPa_Conc	15.6	0	82.4	0	0	9.5	
	NaPa_Hay	6.8	5	5.9	4.5	0	19.0	
	NaPa_Hay_Conc	59.8	75	0	72.7	81.8	57.1	
Care	Traditional	0	0	0	0	0	0	$X^2 = 11.71$ P<0.05
	Veterinarian	27.4	40	52.9	22.7	18.2	9.5	
	Veto+Tradi	72.5	60	47.1	77.3	81.8	90.5	

Nbr_empl: number of people active in sheep farming; Nb_yr_exp: number of years of experience in sheep farming; Mod_acq: Mode of acquisition of sheep; Memb_assoc: membership in an Assocition; UseAgrCredit: use of agricultural credit in sheep farming; Djal: Djallonké; Djal_Crossb: Djallonké and Crossbreds; Djal_Sah_Crossb: Djallonké, Sahelian and Crossbreds; Sah: Sahelian; Hay_Conc: Hay and Concentrate; NaPa: Natural pasture; NaPa_Conc: Natural pasture and Concentrate; NaPa_Hay: Natural pasture and hay; NaPa_Hay_Conc: Natural pasture, Hay and Concentrate; Véto+Tradi: Veterinary and Traditional.

Table 2: Composition of herds in the study areas

Categories	Overall	Municipalities					p -value and S
		Ndali	Nikki	Parakou	Pèrèrè	Tchaourou	
Male lamb	2.1 ± 0.2	1.8 ± 0.2 a	$1.3 \pm 0.9a$	$3.1 \pm 0.9a$	$2.0 \pm 0.3a$	$2.1 \pm 0.3a$	0.2; NS
Female lamb	1.6 ± 0.1	$1.3 \pm 0.3a$	$1.9 \pm 0.1a$	0.8 ± 0.3 a	$1.9 \pm 0.4a$	$2.2 \pm 0.5a$	0.07; NS
Young ram	1.2 ± 0.2	0.8 ± 0.2	1.1 ± 0.5	1.9 ± 0.5	0.8 ± 0.2	$1.5 \pm 0,7$	0.4; NS
Young ewe	2.1 ± 1.5	$1.4 \pm 0.3a$	2.6 ± 0.2 ab	1.7 ± 1.2 ab	$2.0 \pm 0.3ab$	$2.8 \pm 0.4b$	0.01; *
Ram	5.2 ± 0.7	$8.4 \pm 2.8a$	3.0 ± 0.3 ab	$2.1 \pm 0.2b$	$8.9 \pm 1.6a$	$3.1 \pm 0.5ab$	0.001; *
Ewe	8.2 ± 0.6	$5.0 \pm 3.9a$	8.2 ± 4.8 ab	8.1 ± 1.1 ab	$7.5 \pm 1.4ab$	$12.0 \pm 2.0b$	0.01; *
Total	20.6 ± 1.1	$18.8 \pm 2.0a$	$18.3 \pm 2.1a$	$18.0 \pm 2.1a$	$23.4 \pm 2.4a$	$24.0 \pm 3.4a$	0.2; NS

Sig: Significance; NS: Not significant; *: p<0.05; **: p<0.01

by individuals from the Bariba and Fulani ethnic groups (42.1 % and 41.1% respectively). The average household size varied from 7.1 ± 1.0 (Tchaourou) to 12.7 ± 1.8 people (Ndali). Nearly 50% of respondents had reached secondary level and almost a third of them had not gone beyond primary level. Nearly 23% of the people surveyed were not educated at all and the least represented individuals were those who had reached university level (1.9%). The method of acquiring sheep was purchase (80%) and less than half of the breeders belonged to a livestock farmers' association (40.2%). Among the people surveyed, very few used agricultural credit. For all the farms studied, the sheep breeds raised are composed of Djallonké (33.3%) followed by a combination of Djallonké, Sahelian and crossbreds (31.3%), Sahelians (25.4%). Farms raising Djallonké breed associated with crossbreds were in a smaller proportion.

Regarding feeding practices, the use of natural pasture combined with hay and concentrates were more dominant, with the exception of farmers in the municipalities of Nikki whose dominant feeding method was the use of natural pasture and concentrates (82.4%). Regarding the health management of sheep, none of the farmers surveyed applied health care based solely on traditional medicine. On the other hand, the use of veterinary medicine associated with ethno-veterinary practices was more common in all municipalities with the exception of the commune of Nikki where the dominant form was modern veterinary medicine (52.9%).

Herd composition

In the study area, all age categories of the sheep species were represented (Table 2). For all the farms, the number of sheep varied from 1.2 ± 2.2 (young rams) to 8.2 ± 6.4 heads (ewes). No significant difference was observed between the numbers of lambs, ewe lambs, ewe lambs as well as the total numbers of sheep in the four municipalities studied ($p > 0.05$). On the other hand, significant differences were observed between the numbers of sheep, rams and ewes ($p < 0.05$; $p < 0.01$ and $p < 0.05$ respectively). The number of residents was lower in the commune of Ndali and higher in the commune of Tchaourou. The numbers of rams were similar between the communes of Ndali and Pèrèrè ($p > 0.05$) but higher compared to those of Parakou ($p < 0.01$). Furthermore, the largest numbers of sheep were recorded in the commune of Tchaourou while the lowest numbers were recorded in the commune of Ndali ($p < 0.05$).

Economic performance of farms

Raising the sheep species in the areas studied involves various operating expenses leading to total operating costs varying from 82,500 FCFA to 3,076,000 FCFA with an average of 483964.7 ± 50779.3 FCFA (table 3). The values recorded for the profit margin indicated that this activity was profitable for the farms studied with an average of 115617.6 ± 17477.7 FCFA per year and extremes of -53,000 and 1,064,000 FCFA. Parameters such as the purchase price of sheep, the costs linked to the acquisition of fodder and the costs linked to animal health care were the only parameters that presented significant differences between the municipalities taken into account (table 3). The average costs of acquiring sheep were lower in the municipalities of Ndali and Tchaourou and higher in the municipality of Pèrèrè ($p < 0.01$). As for the costs linked to the acquisition of fodder for sheep, the highest costs were observed in the municipalities of Ndali and Parakou while the lowest costs were recorded in the municipality of Nikki ($p < 0.001$). Furthermore, expenses related to health care were significantly higher in the municipalities of Parakou and Tchaourou and lower in the municipalities of Nikki and Pèrèrè ($p < 0.01$).

Table 3: Overall values (FCFA) of the farm balance sheets of the sheep farms studied

Operational charges	Number	Minimum	Mean	Standard Deviation	Maximum
Sheepfold and equipment	102	30000	76142.1	4824.2	320000
Maintenance	102	2000	7774.5	276.5	15000
Refunds and taxes	102	0	29949.0	10630.5	650000
Purchase price	102	0	28450.9	1233.6	60000
Fodder	102	1000	2778.4	101.2	5000
Feed_suppl	102	0	2199.0	98.4	7000
Mineral_block	102	500	1416.6	73.2	3500
Health care	102	500	1326.4	73.2	2500
Total charges	102	82500	483964.7	50779.3	3076000
Number of sheep sold	102	3	9.4	0.7	46
Sell price	102	30000	58591.6	1875.1	115000
Revenues	102	105000	599582.3	66377.7	41400000
Total profit margins (FCFA)	102	-53000	115617.6	174777.8	1064000
% Negative profit margins	12.7				
% Positive profit margins	87.2				

Discussion

Sociodemographic profile of respondents and animal management

The present study revealed the dominance of men in sheep farming in the study areas. The average age recorded in the present study was 45.1 ± 13.6 yrs. This age is close to that reported (48.2±14 yrs) by Zanou et al. (2022) on small ruminant farmers distributed across the eight agroecological zones of Benin. This value is, on the other hand, slightly higher than the average of 42.0 ± 0.8 yrs reported by Dimon et al. (2022a) on female small ruminant farmers in Benin. The number of years of experience recorded for all the farmers in this study (18.1±7.5) is slightly higher than that reported by these same authors (14.3 ± 11.8). Furthermore, the proportion of people surveyed having received no formal education is much lower than that reported by these authors (71.1%). This proportion is also lower than that reported by Dimon et al. (2022a) who reported a value of 88.3%. However, the population considered by these authors consisted only of women. On the other hand, those of people who have reached primary, secondary and university level in the present study are higher than those reported by these authors (26.4 vs 16.8%; 49.0 vs 11.1% and 1.9 vs 1% respectively). The proportions of people belonging to a livestock farmers' association in the present study are also higher than those reported by Zanou et al. (2022) in their study (40.1% vs 20.4%). The feeding practices and types of health care recorded in this study are characteristic of the usual practices encountered in Benin in ruminant farming. In fact, these practices were mentioned in the studies carried out by Zanou et al. (2022), Dimon et al. (2022a) on small ruminant farming in Benin. They were also mentioned by Worogo et al. (2020) in cattle farms in Benin.

Herd composition

The sheep herds of the people surveyed had an average of 20.6 ± 1.1 heads. This average is higher than that reported by Dimon et al. (2022a) who recorded an average size of 12.0 ± 1.1 sheep per female small ruminant breeder. The significant differences observed between the numbers of sheep, rams and ewes in the flocks of the different survey areas may be attributable to the geographical location and production objectives. Furthermore, the numbers of ewes and rams (arithmetic mean) are higher than those of other categories in each municipality. This could be explained by the fact that the rams present during the survey had not yet reached the favorable sales period and that breeders prefer to keep the ewes for the multiplication of the herd. In this study, the numbers recorded for male lambs, female lambs, young rams and young ewes show that these categories individually represent only around 10% of the total number while rams represent up to 25% and ewes up to 40%; i.e. more females than males. These same observations are reported in the results obtained on the breeding systems ": Integration of crops and animals" and "Integration of crops, shrubs and animals" by Dimon et al. (2022a) on herds of small ruminants kept by women in Benin. Zanou et al. (2022) also made the same observations on small ruminant farms distributed in the eight agroecological zones of Benin.

The results of the study show that sheep farming remains a profitable activity in all study areas. The results were only negative in 12.7% of cases for all the people surveyed, with a higher proportion in the municipality of Nikki. These failure rates could be corrected by keeping monitoring documents and reducing operating costs by farmers. The variations observed in the costs induced by fodder may be attributable to the geographical position of the farmers. In fact, the highest costs are recorded in the municipalities of Parakou and Ndali. These localities being more urbanized than the others considered in this study, sheep farmers in these localities are likely to pay more for the acquisition of fodder.

Furthermore, in all the farms studied, the costs linked to feed could be considerably reduced by the reduction in costs linked to the acquisition of agro-industrial by-products and the increase in hay production on the farms. In fact, several studies (Raineri et al., 2015; Debortoli et al., 2021; Toro-Mujica et al., 2015) have highlighted the importance of self-production of animal feed on farms, in particular of roughage, in order to reduce production costs. The profit margins obtained per sheep at the level of the farms studied (2693.1 to 15699.5 FCFA) are lower than those obtained by Shivakumara and Kiran (2019) on sheep raised following three farming systems (extensive, semi-intensive and intensive) in the region of Karnataka in India (1217 rupees [8646.6 FCFA] to 4418 rupees [31389.3 FCFA]). These differences are linked to the non-similarity of the factors entering into the production process in the two regions; however, this demonstrates the profitable nature of this business. Furthermore, the sheep farmers surveyed as part of this study could achieve greater performance if they carried out more nutritional supplementation on their farms. On the other hand, we could understand that this is attributable to the very scattered studies on the performances induced by new forms of complementation in Benin (Montcho et al., 2016; Dimon et al., 2020).

Table 4: Operational report of sheep farms according to the municipalities studied

Designation	Ndali (n=20)	Nikki (n=17)	Parakou (n=22)	Pèrèrè (n=22)	Tchaourou (n=21)	p -value	Sig
Parameters related to operating costs							
Purchase price (FCFA)	24125.0 ± 3228.3a	30235.2 ± 1123.4ab	27454.5 ± 9007.8ab	36590.9 ± 11725.6b	23642.8 ± 5513.9a	0.0	**
Sheepfold and equipment (FCFA)	94875.0 ± 12264.5a	75117.6 ± 12353.9a	60272.7 ± 12279.2a	82409.0 ± 65994.7a	69190.4 ± 22575.6a	0.1	NS
Fodder (FCFA)	3140.0 ± 127.4a	2076.4 ± 98.1b	3300.0 ± 1116.5a	2977.2 ± 765.8ac	2247.6 ± 846.5bc	0.0	***
Feed_suppl	2350.0 ± 203.88	1605.8 ± 77.8	2390.9 ± 1191.2	2304.5 ± 536.7	2223.8 ± 909.3	0.1	NS
Mineral block (FCFA)	1300.0 ± 125.5	1217.6 ± 66.3	1613.6 ± 1034.3	1295.4 ± 570.2	1609.5 ± 801.8	0.2	NS
Health care (FCFA)	1275.0 ± 84.7ab	1088.2 ± 59.7a	1545.4 ± 532.4b	1145.4 ± 440.4a	1528.5 ± 528.3b	0.0	**
Maintenance (FCFA)	7550.0 ± 917.6	7470.5 ± 718.7	7500.0 ± 2907.2	9000.0 ± 3070.5	7238.0 ± 2547.6	0.2	NS
Ref_Taxes (FCFA)	60455.0 ± 8244.9a	4617.6 ± 794.7e	27545.4 ± 127860.3	11040.9 ± 1078.4d	43728.5 ± 9652.3b	0.4	NS
Total charges (FCFA)	611705.0 ± 160322.9a	338617.6 ± 42463.0b	348309.1 ± 435178.7	589963.6 ± 83707.9a	511038.1 ± 135745.2a	0.2	NS
Output related parameters							
Number of sheep sold	11.3 ± 2.4	7.0 ± 1.6	6.6 ± 1.1	10.5 ± 2.7	11.1 ± 2.0	0.0	NS
Selling price (FCFA)	61050.0 ± 7232.6 a	52205.8 ± 5903.1a	61931.8 ± 4785.5 a	65045.4 ± 2709.8a	51159.5 ± 2112.4a	0.0	NS
Revenue (FCFA)	789900.0 ± 42324.4a	362529.4 ± 23857.3b	431568.2 ± 36101.8b	729318.2 ± 51216.4a	650328.6 ± 47386.0a	0.1	NS
Total profit margins (FCFA)	94875.0 ± 11625.3a	75117.6 ± 8359.4a	60272.7 ± 9217.2a	82409.0 ± 10774.0a	69190.4 ± 8574.2aa	0.0	NS
Profit margins per sheep (FCFA)	15699.5 ± 2506.1a	2693.1 ± 562.9ab	10827.0 ± 915.7 ab	10079.2 ± 873.6 ab	9062.07 ± 619.4ab	0.01	*
% negative balance	5	35.2	9.0	13.6	9.5	-	-
% positive balance	95	64.7	90.9	86.3	90.4	-	-

Ref_Taxes: Refund and Taxes; Feed_suppl: Feed supplement *: p<0.05; **: p<0.01; Sig: Significance; NS: Not significant

Conclusion

The present study reveals that sheep farming is practiced by people with varied profiles depending on the municipality considered with equally varied management practices. The economic analysis shows that this activity has the potential to contribute to the improvement of livestock production in Benin given the generally satisfactory results. However, this potential can be further increased by improving the practices of sheep farmers by strengthening their capacities and establishing financing systems in the sheep sector in Benin.

Contribution of the authors

AD, OTLFO, HSSW participated in study design and planning. JSBSW, CDA, FS, and NA participated in field data collection and entry. HSSW, YI and performed the statistical analyses, interpreted and wrote the first version of the manuscript. YI and ASA participated in the critical revision of the manuscript. All authors have authorized publication of the final version of the manuscript.

Conflict of interest

The authors have declared no conflict of interest

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