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Factors favoring the infestation of *Boophilus microplus* and the consequences on cattle breeding in the communes of Parakou and Tchaourou in Bénin

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Abstract
Animal health is an essential element for improving livestock performances. Cattle breeding is confronted with several pathologies, especially parasitic. The general objective of this study is to determine the factors favoring the infestation of *Boophilus microplus* and their consequences on cattle farms in the communes of Parakou and Tchaourou.
This biological material is constituted of a total of one thousand three hundred and thirty-seven (1337) large ruminants, of which we have Borgou, Yakana, Azawack, Goudali, Half-breed and Girolondo breeds. Sixteen (16) farms per commune were chosen and surveyed, in total thirty-two (32) farms of large ruminants. Ticks were collected on 08 (eight) farms per commune with a rate of 10%. The samples collected were analyzed at the Veterinary Diagnostic and Sero-surveillance Laboratory and then precisely in the parasitology section. The technique used was to recognize and classify ticks in their genus by using a USB microscope and a computer.
Farms surveyed are equitably divided into two districts, including one district per commune or 50% in each of the communes of Parakou and Tchaourou.
The total number of large ruminants involved was 1337 with an average of 39.44 and a standard deviation of 28.424. Our investigators revealed that 100% of our sample, 32 farms were affected by this tick. This allowed us to identify six factors that could be causing its appearance. We can therefore mention among others: Lack of cleaning, exotic breeds, fodder, rain, high humidity, humidity and exotic breeds. Two of these factors are highly representative: humidity rate and exotic breeds. We have observed two kinds of ticks namely: Boophilus and Amblyomma.
This study on the typology of cattle breeding and consequences of infestations to *Boophilus microplus* in the communes of Parakou and Tchaourou, allowed us initially to develop a typology of these farms. In a second step, we identified the factors favoring infestation by *Boophilus microplus* in the communes of Parakou and Tchaourou. It also allowed us to identify the consequences of diseases caused by *Boophilus microplus* in the two communes.

Keywords: Breeding management, breeding typology, Infestation, *Boophilus microplus*, cattle

Introduction
Cattle breeding provide a large part of the human diet through milk and meat production [9, 3, 10] or reflect the social status of agriculture [4]. Animals are also integrated in nutrient transfers and can have a positive effect on the environment as they limit the spread of insects and weeds, produce manure for fertilization and soil improvement [16]. Despite its importance in the economy, cattle breeding face several pathologies, especially parasitic. Indeed, the introduction of a new strain of potentially chemical resistant ticks currently used to control native tick population is a significant threat to the livelihoods of livestock farmers in the area. There are no reliable estimations of the costs of tick infestation in the area, although the loss of weight could be as high as 55-76 g per tick clogged, with cattle infestation rates as high as 1000 ticks over an annual infestation period [5]. *Boophilus microplus* (*Bm*), an invasive tick, has recently been introduced in Bénin [8]. There are concerns that this newly introduced tick specie may be resistant to chemicals rendering them insensitive to current tick control strategies. The distribution and epidemiology of *Boophilus microplus* in West and Central Africa is currently unknown. The absence of this information is currently hampering the development of an integrated tick control program. They suck the blood of their hosts and are often the cause of severe anemia in animals [12]. Moreover, they have the ability to transmit a broad spectrum of pathogenic organisms such as viruses, rickettsia and spirochetes [11],

responsible for serious diseases in animals such as babesiosis, anaplasmosis etc. Ticks are hematophagous ectoparasites of several vertebrates. They have a severe impact on health and animal production because of their direct action on parasitized animals: blood spoliation, skin lesions, toxic action, but especially because of their role as vectors of many pathogens such as protozoa, rickettsiae, bacteria and viruses, which cause serious diseases in animals. Hard ticks spend more than 90% of their lives without being parasitic to animals. They are most often exophilous living in open biotopes such as forests, pastures, savannas, grasslands and steppes [15]. *Boophilus microplus* is considered the most important parasite tick of breeding in the world. It is a hard tick found on many hosts especially cattle, buffalo, horses, donkeys, goats, sheep, deer, pigs, dogs and some wild animals. Heavy burdens of tick on animals can decrease leather production and lead to further damage. *Boophilus microplus* can also transmit babesiosis caused by *Babesia bigemina* and *B. bovis*, and anaplasmosis caused by *Anaplasma marginale*. Under experimental conditions, this tick can transmit equine piroplasmosis caused by *Babesia equi*. *Boophilus microplus* requires a high humidity and an ambient temperature of at least 15-20 °C. This tick is therefore particularly present in the tropical and subtropical zones, particularly in Asia, Africa, Central and South America, southern Europe, and parts of Australia [6]. Previously absent in West Africa, the presence of *Boophilus microplus* was demonstrated for the first time in Côte d'Ivoire following the import of Girolondo cattle from Brazil [14].Another study in the same area has highlighted its invasive character [13]. In the same year, the presence of the tick was revealed in Bénin thanks to a sampling carried out on the implantation site of the imported cattle and on the nearby sites. They live in an environment where their cycle of development is influenced by vegetation, climatic conditions and their relationships with other living beings, parasitic animals and microorganisms. All of these elements form a particular ecosystem. Thus, any change in the time and space of one of the elements of the ecosystem has varying degrees of impact on their lives and even their survival. It is with this in mind that this study aims to determine the factors favoring the infestation of *Boophilus microplus* and their consequences on cattle farms in the communes of Parakou and Tchaourou.

Materials and Methods

Study area

The symptoms associated with the episodes and the consequences of these parasites are generally observed on cattle in the communes of Parakou and Tchaourou.

Case of Parakou

Geographic location

Parakou is located in the center of the Republic of Benin, 407 km from Cotonou. With an average altitude of 350 m, it covers an area of 441 km2. It is the regional capital of the North of the Republic of Benin. It is limited to the north by the commune of N'Dali; to the south, east and west by the commune of Tchaourou.

Case of Tchaourou

Geographic location

Located in the department of Borgou, the commune of Tchaourou covers an area of 7256 km^2 or 28% of the total area of this department and about 6.5% of the national territory. It is limited to the north by the commune of Parakou, Pèrèrè, and N'Dali, to the south by the commune of Ouèssè, to the east by the Federal Republic of Nigeria and to the west by the commune of Bassila and Djougou. This strategic geographical position is doubtless a major asset to be exploited by the municipal authorities for the promotion of the local economy.

Biological materials

The biological material is constituted of a total of one thousand three hundred and thirty-seven (1337) large ruminants, of which we have the Borgou, Yakana, Azawack, Goudali, Half-breed and Girolondo breeds.

Technical material

For the survey, a questionnaire was designed. The material used for the collection of ticks was composed, identification loops, markers to identify ticks collected, sterile bottle to collect ticks containing alcohol diluted to 70%, a cooler with cold accumulator to keep the ticks samples, a USB microscope. These ticks are collected from eight (08) farmers per district with a rate of 10%.

Method

Investigation phase

During this phase, there was essential data collection, on the typology of cattle farms and consequences of infestations to *Boophilus microplus* in the communes of Parakou and Tchaourou through structured interviews. Sixteen (16) breeders by commune are chosen and surveyed, in total thirty-two (32) farmers of large ruminants.

Choice of sampling units

The sampling unit is constituted by the breeding of large ruminants. A large ruminant farm is defined as any farm with at least three cattle including at least one breeding female. Thus, the defined population is all the large ruminant farms surveyed in a commune of Parakou and Tchaourou. Reasoned sampling was used.

The number of farms chosen per commune is sixteen, for a total of thirty-two (32) farms in the two communes. The number of large ruminants concerned for sampling is one thousand three hundred and thirty-seven (1337). Tick removal was done on 08 (eight) farmers per commune with a rate of 10%.

Tick sampling

The samples of this tick were collected from their flanks, shoulders, whalebone, belly, etc, large ruminants. Ticks are kept in tubes containing 70% alcohol. Each tube was identified by mentioning on the tube of the animal, the number and the commune in which the breeding was located.

Laboratory analysis

The samples collected were analyzed at the Veterinary Diagnostic and Sero-surveillance Laboratory and then precisely in the parasitology section. The technique used was to recognize and classify ticks in their genus using a USB microscope and a computer. This method allowed us to know the abundance of *Rhipcephalus (Boophilus) microplus* between these two communes.

Phase of data processing and analysis

The capture and verification of survey data were done using Microsoft ACCESS software (2010 release). The Microsoft ACCESS 2010 software is used to draw graphs.

Investigation data analysis was realized using Minitab software. A Factorial Analysis of Multiple Correspondences (FAMC) allowed us to obtain a representation of the farms in the form of projections on plans defined by the factorial axis. Then a classification Hierarchical Ascendance (CHA), allowed grouping of the farms according to their proximity to each other. Then it was to identify some factors favoring the infestation and to evaluate the consequences caused by *Boophilus micriplus* by using SPSS software.

Results

Characteristics of the farmers

Farmers surveyed are equitably divided into two districts, including one district per commune or 50% in each of the communes of Parakou and Tchaourou. The majority of the persons surveyed use the permanent workers which is 68.8%, 15.6% of contractual workers and 15.6% of others (Table 1). All the Farmers surveyed (32) are men and only Muslims. The breeding of large ruminants is practiced by many socio-cultural groups, leading (11) farmers whose Peuhls contribute for 34.4%; Bariba 31.2%; Dendi 21.9%; and others 12.5% (Figure 1). The age experience of large ruminant farmers investigated varies from 4 years to 40 years with an average of 23 and a standard deviation of ± 14,743. But the main activities practiced by the farmers were much diversified. Livestock is considered a main activity only in 81.3% of our sample. In addition, 18.8% of farmers practice the trade.

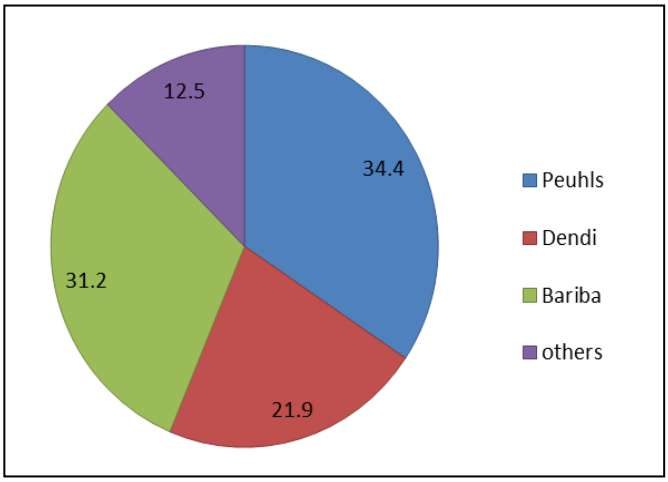

Fig 1: Distribution of Farmers by language group

Table 1: Variables describing the cattle farmers surveyed.

Variables	Modality	Meaning of the Modalities	Frequency (%)
District of the breeder	1	3rd District / Parakou	50%
	2	District Kika / Tchaourou	50%
labor	1	Permanent	68,8%
	2	Contractual	15,6%
	3	Other	15,6%
Breeder's Ethnic group	1	Peuhls	34,4%
	2	Bariba	31, 3%
	3	Dendi	21,8%
	4	Other	12,5%
Main activity	1	Yes	81,3%
	2	No	18,7%

Characteristics of the animals

The total number of large ruminants involved was 1337 with an average of 39.44 and a standard deviation of 28.424. The minimum was 5 and the maximum 125. In our sample 21.8% of farmers own the Borgou breed; 12.5% Azawack, 3.1% own Goudali, Yakana and Girolando; 6.3% Half-breed. Other farmers breed several breeds at once, 18.5% Borgou and Yakana; 12.5% Goudali and Borgou; 12.5% Goudali, Yakana and azawack; 6.3% other.

Herd management

In both districts, 50% of the farmers have a livestock building and 50% do not have. The products and materials used for cleaning vary from one farmer to another. 18.8% use cresyl and broom, 10.6% cresyl, shovel and broom, 31.3% use cresyl, bleach, and broom, 21.9% use Alfapoor, and 9.4% use cresyl and alfamec. In the farm 62.5% of the people surveyed have a feeder and a waterbowl, 37.5% do not have feeder nor waterbowl. 31.2% of the farmers control the reproduction while 68.8% do not control it. Moreover the majority of the farmers leave the animals free all the day which is 84.4% and 15.6% leave their animals a part of the day in pens and the other part of the day they are free. Several types of livestock compound are used to raise animals: 3.1% improved building, 71.9% traditional building and 25% semi-improved building. These buildings, feeders, waterbowls are emptied daily 15.6%, 25% per week, 6.3% per month and 53.1% others. In fact, 31.4% practice an integrated system while farmers do not value the manure. The integration allows the animals to have access to the fodder while fertilizing the fields. These integrations are mostly done in the rainy season which is 93.8% and 6.2% during the dry season. The animals sold are bulls and old cows which are 37.5%, 43.5% bulls 12.5% cows are sold only by farmers. All this information has allowed us to distinguish three (03) farming methods: breeding in semi-confinement and breeding in stabling or confinement. Regarding health monitoring, it was regular for only 20 farmers, 62.5% and irregular in 37.5% of farmers. These latter are constituted of those who call on the veterinarian in case of diseases, those who associate certain endogenous products and those who sometimes also intervene on their animals. In any case, they are satisfied with the veterinary services. Animal deworming was done in 100% of the sample (Table 2).

Table 2: Variables describing the conduct of the farms surveyed

Variables	Modalities	Meaning of Modalities	Frequency (%)
Integrated system	1	Yes	31,4%
	2	No	68,6%
Livestock building	1	Traditional	71,9%
	2	Semi-improved	25%
	3	Other=3	3,1%
Presence of feeder	1	Yes	62, 5%
	2	No	37,5%
Frequency of cleaning the feeders	1	Daily	15,6%
	2	Per week	25%
	3	Per month	6,3%
	4	Other	53,1%
Presence of trough	1	Yes	62,5%
	2	No	37,5%
Reproduction	1	Controlled	31,2%
	2	Uncontrolled	68,8%
Integration period	1	rain	93,8%
	2	dry	6,2%
Health monitoring	1	Yes	62,5%
	2	No	37,5%
Cleaning and bath	1	Cresyl and broom	18,8%
	2	Cresyl, broom and shovel	10,6%
	3	Cresyl, bleach, broom	31,3%
	4	Alfapoor	29,9%
	5	Cresyl and alfamec	9,4%

Our work allowed us to translate our results into factorial axis.

In the factorial axis 1, negative variables are: Non-availability of the building, traditional and or semi-modern breeding, uncontrolled reproduction, other breeds and ethnic groups.

The positive variables in the factorial axis 1 are: Livestock building present, modern breeding, controlled breeding, the majority ethnicities are Peuhls, Goudali, Borgou and Yakana breeds are dominant.

In the factorial axis 2 there are negative variables: Presence of trough and feeder, veterinary follow less accentuate.

The positive variables in factorial axis 2 are: Absence of waterbowl and feeder, total absence of veterinary follow.

In the factorial axis 3, negative variables are: Absence of an integrated system, absence of a food preservation system.

The positive variables in factorial axis 3 are: Presence of an integrated system, Presence of food preservation system.

The projection of the farms on the factorial axis 1 & 2 is presented in Figure 2.

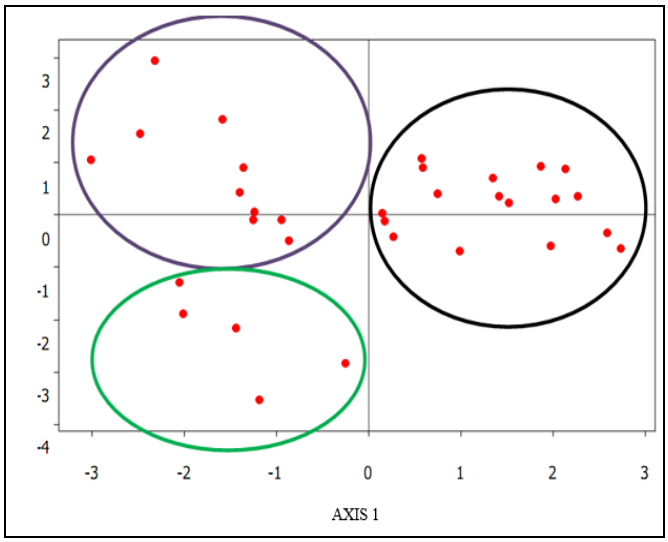

Fig 2: Distribution of groups of farmers on factorial axis 1 and 2

Typologies of farmers

Farmers are classified into three groups.

Group 1: 16 farmers (53.125%)

Group 1 is constituted of farms where cattle breeding (Borgou and Yakana) are priority. This group is constituted mainly of the Peulh socio-cultural group (100%). These farms are much more concentrated in the same proportions (70.59%) at the level of the third district of Parakou and (29.41%) in the district of Kika with an integrated system of 40.32%, a health monitoring at 58%. It consisted almost only of farms headed by men and they have 4 to 40 years of experience in breeding. The farmers of this group practice mainly a breeding in rambling. Most farmers use veterinary products as well as endogenous products and a few have waterbowl and feeder with a daily cleaning frequency at 29%, per week at 58.52% and 12.08% per month. The livestock building is traditional in style at 88.23% and with uncontrolled reproduction at 100%. Livestock diet is mainly based on fodder.

Given the characteristics, we can say that this group makes a traditional breeding.

Group 2: 10 farmers (31.125%)

Group 2 is constituted of holdings for which the breeding is smaller. These farmers are more distributed in several ethnic groups which are 33.33% of bariba etc. moreover, the breeders are concentrated to 60 percent in the district of Kika and 40% in 3rd district of Parakou. They use veterinary products at 87.2%; the animals are not left to wander much unlike the 1st group which is 63.33%. The reproduction is controlled by 80% farmers and one semi-improved breeding building 40%. These farmers have guards who are paid 40% per month, waterbowl and feeders are cleaned especially per day. Others regard livestock as a main activity and others do not. Among these breeders, 80% use health monitoring, with a breeding experience of 4-25 years. Considering characteristics, we can say that this group makes a semi-improved breeding.

Group 3 (5 farmers, who are 15.625%)
Group 3 was much more concentrated in the third district and consisted entirely of Dendi men. All these farmers were in breeding for more than 10-50 years, Labor is contractual with a given percentage. Veterinary products are 100% used by farmers, feeders and waterbowl are cleaned more per day, and animals are kept under control or 70%. A good animal health monitoring by farmers with a regular dietary supplement are done. Breeding is 100% controlled by the farmers. Considering characteristics, we can say that this group makes an improved breeding (Table 3).

Table 3: Frequency (%) of the different methods describing the cattle breeders surveyed according to the groups of the typology.

Variable	Modality	Group 1	Group 2	Group 3
District	District / Kika	29,41	60	100
	3rd arrond/Parakou	70,59	40	00
Ethnic group	Peuhls	100	13,33	0
	Bariba	00	26,67	0
	Dendi	00	33,33	70
	others	00	26,67	30
labor	Permanent Contractual others	52,35	40	20
		17,64	50	20
		30,01	10	60
Presence of trough	Yes	41,1	90	100
	No	58,74	10	00
Frequency of cleaning	Daily	29,4	60	80
	Per week	58,52	40	20
	Per month	12,08	00	00
	others	00	00	00
Reproduction	Controlled	00	80	100
	uncontrolled	100	20	00
Wandering	Yes	100	63,33	30
	No	0	36,67	70
Activity conducted	Yes	60	31	30
	No	40	69	70
SM	Yes	40,32	70	80
	No	59,68	30	20
Building	Traditional	88,23	60	20
	Semi-improved	11,77	40	80
	other	00	00	00
Health monitoring	Yes	58	80	90
	No	42	20	10
animals affected	sell	100	90	100
	Consumption	0	10	0
Veterinary product	Yes	60	87,2	100
	No	40	12,8	00
Experience	4-10 years = 1	60	70	00
	10-25 years = 2	30	30	30
	25-50 years = 3 October 70	10	00	70

Factors favoring *Boophilus microplus* infestation in the farms surveyed
Our field investigations revealed that 100% of our samples, 32 farms were affected by this tick. This allowed us to identify six factors that could be causing its appearance. We can therefore mention among others: Lack of cleaning, exotic breeds, fodder, rain, high humidity, humidity rate and exotic breeds. Two of these factors are highly representative:

Humidity and exotic breeds
Among the 32 farms with ticks *Boophilus microplus*, 30 were affected during the rainy season and 2 during the dry season respectively 93.8% and 6.3%. Humidity and exotic breeds were therefore factors that favoring *Boophilus microplus* ticks (Figure 3).

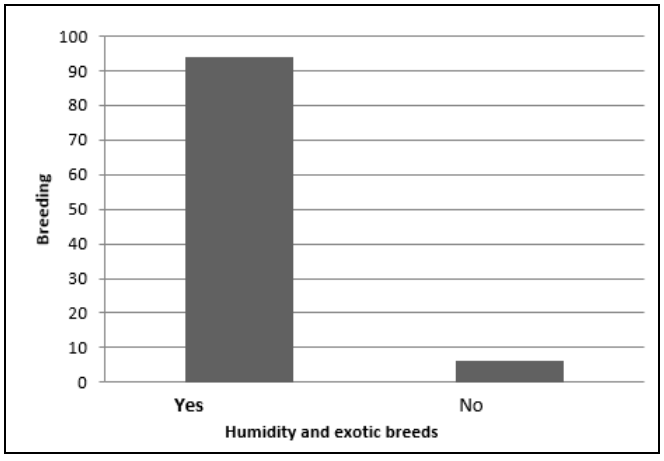

Fig 3: Effect of Humidity and the importation of exotic races on the occurrence of ticks on cattle.

The Fodders

In our sample, 14 farms were infected at the pasture and especially on fresh fodder are 43.8% and 25% or 8 farms and other 31.2%. Fodders constitute a factor favoring *Boophilus microplus* ticks (Figure 4).

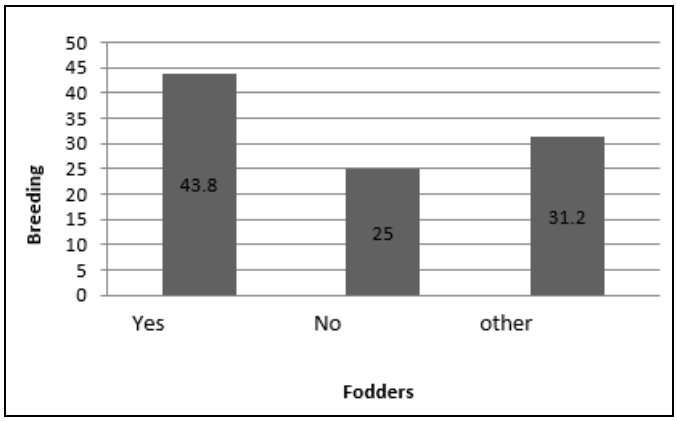

Fig 4: Effect of fodder on tick emergence in cattle

Inventory of ticks observed under a microscope in the communes of Parakou and Tchaourou

After the observation of ticks collected on the ground precisely in the district of Kika and the 3rd district of Parakou we observed two genera essentially namely: Boophilus and Amblyomma (Table 4)

Table 4: Ticks observed

Ticks identified	Number of livestock breeders in the commune of Parakou	Number of livestock breeders in the commune of Tchaourou
Boophilus microplus	05 breeders	07 breeders
Amblyomma lipidum	03 breeders	00 breeders
Boophilus microplus and *Amblyomma lipidum*	02 breeders	-
Boophilus microplus and *Amblyomma variegatum*	-	03 breeders

The observation of these collected ticks allows us to have an idea on the genus of ticks which attack the cattle. In Tchaourouou we have *Boophilu smicroplus*, *Amblyomma variegatum* and in the 3rd district of Parakou, *Amblyomma lipidum* and *Boophilus microplus*.

Abundance of *Boophilus microplus* in farms, in the communes of Parakou and Tchaourou.

Abundance is a term that defines a quantitative order for describing a population with a complete count of an animal population. This is the relative quantity to the number of individuals of a given species per unit area or volume in relation to their total number. The numbers of parasites encountered are mentioned in Table 5.

Table 5: Number of parasites encountered.

Study areas	District of Kika / Tchaourou	3rd District / Parakou
Number of large ruminants	296	271
Boophilus microplus	07	05
Amblyomma variegatum	03	00
Amblyomma lipidum	00	03

Abundance in kika / Tchaourou = 7 / 29.6 * 100 = 23.647% and Abundance in the 3rd district / Parakou = 5 / 27.1 * 100 = 18.45

Consequences of diseases caused by *Boophilus microplus* in the communes of Parakou and Tchaourou

30 farms in our sample were affected by the *Boophilus microplus* tick. Several consequences were recorded: 9.6% (03) farms record mortality, 28.3% loss of weight, 26.3% dermatosis, 7.7% decrease in production and 28.1% loss of leather (Figure 5).

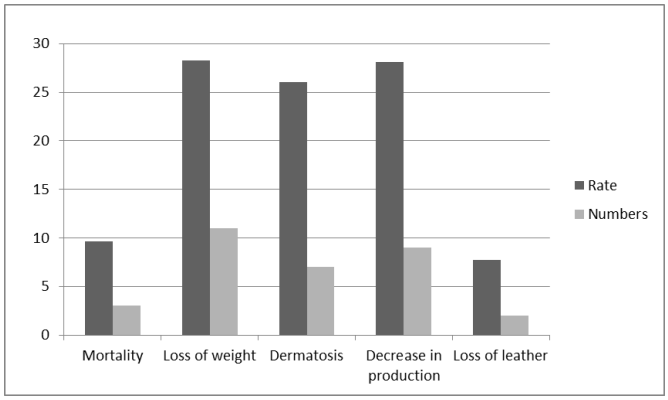

Fig 5: Consequences of *Boophilus microplus* on cattle

Discussion

The three (03) types of farms identified in our study are different from the two (02) types listed in typology of cattle breeding systems in the northeastern commune of Gogounou, Bénin by Alkoiret *et al*., (2009) [1] and Ouaké in northwestern Bénin by Alkoiret *et al*., (2011) [2]. This diversity of results can be justified by the difference in study areas.

Lack of maintenance, exotic breeds, fodder, rain, high humidity, humidity rate and exotic breeds are the risk factors identified in our study. One of these factors has been reported by Madder *et al*., (2011) [13]. The presence of the tick was revealed in Bénin by sampling on the implantation site of imported cattle and on nearby sites and by a high humidity and an ambient temperature of least 15-20 °C are the basic risk factors for *Boophilus microplus* [7].

During our study, we have through our investigation, and the experience conducted, noticed that the abundance rate of the

Kika / Tchaourou district is higher than that of the 3rd district of Parakou. This difference may be due to exotic breeds on the Okpara farm. This was said by Madder *et al*., (2011) [13]. Mortality, weight loss, production decline, dermatosis, and loss of leathers are the major consequences identified in our study. Among these other consequences have been reported by (Bruce, 2014) [5] as weight loss.

Conclusion

Our study reveals that six factors are the basic risk factors for *Boophilus microplus*. We can therefore mention among others: Lack of cleaning, exotic breeds, fodder, rain, high humidity, humidity and exotic breeds. Two of these factors are highly representative: humidity rate and exotic breeds. We have observed two kinds of ticks namely: Boophilus and Amblyomma

Acknowledgements

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