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Rabbit does (*Oryctolagus cuniculus*) reproductive performance and kits survivability reared under semi-intensive system in Benin

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Abstract

The profitability of rabbit production is closely related to does reproductive performance and pre-weaning kits survivability. The reduction in the producer's profit margin has caused the stagnation of Benin rabbit farming in recent years. To evaluate does reproductive performance, fifty six rabbit farms of 904 breeders and 1396 kits were surveyed on the basis of breeding stock, litter size at birth and the number of weaned kits and kindling interval in a longitudinal prospective study. Pre-weaning kit survivability from 0 to 35 day of age, and its variation potential risk factors were also investigated. The results showed an average breeding stock of 16.14 ± 2.83 per rabbit farm, with 13.66 ± 2.50 females for 2.47 males giving a sex ratio of 6 females for one male. The average litter size at birth was 5.75 ± 0.57 per doe. The average number of kits at birth per doe per month was 0.98 ± 0.18 with 0.73 ± 0.34 weaned rabbits per doe. The average number of kindling per doe, per month was 0.17 ± 0.31 with 2 kindling per doe per year. Pre-weaning kit survivability was 74.48% with the majority of the death occurring in the first week of age. Factors such as litter daily monitoring, farmer's instruction level, disinfection of hands and antiparasitic and anticoccidial prevention measures revealed to influence significantly pre-weaning kit survivability. The reproductive performance of rabbits observed in the herein study is well below that indicated by many authors. Further investigations are needed to identify the causes of the poor performance observed during this study, with the aim of improving does reproductive performance and hence, the profitability of the activity that employs a large number of beninese.

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Introduction

Although livestock rearing in sub-Saharan Africa contributes about 80% of animal protein supplies to populations, small species like poultry, guinea pigs, rabbits, which have lower requirements, are within the reach of the majority of poor households (Bergaoui, 1992). Rabbit production can be a significant source of income for households (Djellal *et al.,* 2006).

Rabbit is a prolific animal with a high capacity to valorize forage plants in high quality animal protein (Lebas *et al.,* 2010). Rabbit is known for its high fertility, early puberty and high growth rate of young, (Dalle Zotte, 2013).

One of the distinctive traits of Benin rabbit production sector is the coexistence of two production systems: a traditional system of small rabbit farms of 2 to 5 does and a rational system of average size of 20 to 50 does (Kpodékon *et al.,* 2006). Consequently, the share of traditional livestock is still important, much more than in other sectors.

The traditional rabbit production is difficult to estimate because it has a very little involvement in organized trade channels. Despite the opportunities offered by rabbit in undernourishment, food insecurity and unemployment alleviation, the sector is struggling to develop because of certain limiting factors such as kit mortality from 0 to 35 days of age (Belhadi *et al.,* 2002).

The optimization of reproductive performance is one of the main facts that ensure high productivity on rabbit farms (Castellini *et al.,* 2010). Profitability of rabbit production depends on the reproduction and the number of kits being weaned from one litter (Gacem *et al.,* 2009; Castellini *et al.,* 2010). Doe reproductive performance is affected by many factors such as breed (Topczewska *et al.,* 2013) and nutritional status (FortunLamothe and Gidenne, 2000; Castellini *et al.,* 2003, 2006). Additionally, litter size at kindling and the survivability of the kits up to weaning (Odeyika *et al.*, 2008), pre-weaning growth (Gerencser *et al.,* 2011) and genetic and environment (Lazzaroni *et al.,* 2012; Apori *et al.,* 2014), also, significantly influence the performance of commercial rabbit. There is a paucity of information about the real reproductive performance status of the does reared in semi-intensive Benin rabbit production system.

The aim of the current study was to evaluate does (*Oryctolagus cuniculus*) reproductive performance and pre-weaning kit survivability in semi-intensive rabbit production system in southeastern region of Benin.

Materials and methods

Study area

The study was carried out in the Southeastern region of Benin (districts of Porto-Novo and Ketou) which lies within (7° 10’ and 7° 41' 17 " N 2° 24' 24"and 2° 47'40" E, 1775 km². The average annual rainfall ranges between 1100 and 1200 mm.

The climate is subequatorial with a long rainy season from March to July followed by a short dry season in August and a shot rainy season from October to November followed by a long dry season from December to February. This made the climate up of 4 seasons. The average mean annual minimum temperatures is 21 °C and the maximum 32 °C with the relative humidity range from 65 to 80%.

Sampling and study design

A longitudinal observational design enabled the following up of 56 rabbit farms with a total of 904 breeding stock and 1396 born kits in a period of 6 month from June to November 2018. Rabbit farms were selected using a multi-stage cluster sampling method with a simple random selection of farms within the clusters formed by the districts of Porto-Novo and Ketou in Southeastern region of Benin. The final phase of the selection is non-probabilistic based on the farmer's obvious willingness to participate in the study. The aim of the study was to assess the reproductive performance of does reared in the semi-intensive rabbit production system.

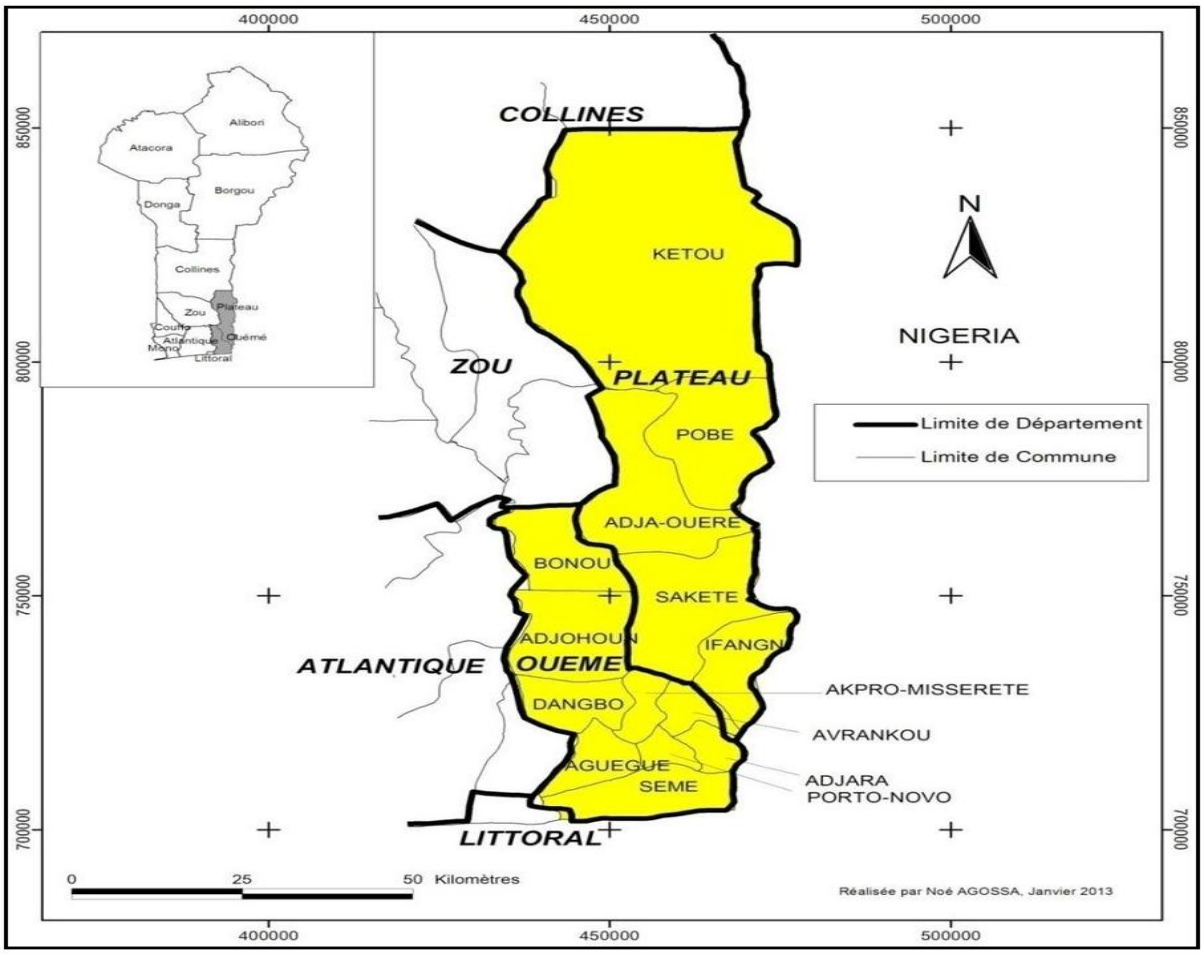

Fig. 1. Southeastern region of Benin (DGFRN, 2013).

Data collection

Litter size at birth and kits weaned per litter was determined by counting the number of kits at birth, on one hand and the number of weaned kits of 35 day of age, on the other hand per litter. The number of female and male rabbits was counted per farm to determine the sex ratio. Kindling interval was taken as the time elapse between two successive kindling. Also pre-weaning kit survivability potential variation factors were investigated in terms of lactating doe weight, age, parity, health status, ability to form the litter (remove little or much fur), litter size at birth, kit weight taken within the 24 hours following birth. Information related to the farmer such as instruction level, production management skill in terms of daily kit health status monitoring, hygiene and prophylactic measures implementation like antibiotic and antiparasitic prevention, reproduction planning, the type of kindling box (opened or closed roof) provided to kindling doe and manure management were also recorded.

Statistical analysis

Data were stored in Excel version 2010 of Microsoft Corporation. The analysis was made with the facilities of SAS (Statistical Analysis System) version 9. 04. Average number of kindling, flock size, litter size at birth, number of weaned rabbit per litter were calculated using the descriptive frequency procedure. The Cox regression analysis with Logrank Chisquare test enabled to identify the potential kit survivability variation factors with significant effect in the regression model.

Results

Does reproductive performance

Does reproductive performance results are presented in Table 1. The average number of rabbit does and

bucks were 13.66 and 2.47 respectively making a sex ratio of 6 females for one male. An average of 2 kindling was recorded per doe per year with a litter size of 5.75 kits, resulting in 12 kits produced annually by one doe. Nine 35 day-old kits per doe were weaned annually. The pre-weaning kits survival rate is 74.48%.

Table 1. Doe reproductive performance (Mean number ± Standard Error).

Does	Bucks	Kindling /doe/month	Litter size at birth/ doe / month	Litter size at birth	Weaned kits/doe/ month
13.66 ± 2.50	2.47 ± 0.50	0.17 ± 0.31	0.98 ± 0.18	5.75 ± 0.57	0.73 ± 0.34

Pre-weaning kits survivability analysis

The results in Table 2 and Fig. 2 show the pre-weaning kits survivability analysis. From day 0 to day 6 pre-weaning period, kits mortality rate was relatively higher with the mean pre-weaning survivability falling from 100 to 82%. Consequently, the relative risk of mortality expressed by the Cox hazard ratio was higher in the first week pre-weaning period. A slight decrease in kits survivability was noted in the pre-weaning 4 week remaining period corresponding to a lower risk of mortality.

Table 2. Pre-weaning kits survivability analysis.

Time (days)	Cumulative hazard ratios	Means		
		Survivability	Standard errors	Hazards cumulatifs
0	0.43	0.99	0.00	0.00
1	2.67	0.94	0.00	0.05
2	4.61	0.90	0.01	0.09
3	6.56	0.87	0.01	0.13
4	7.59	0.85	0.01	0.15
5	8.65	0.83	0.01	0.18
6	9.32	0.82	0.01	0.19
7	9.44	0.82	0.01	0.19
8	9.55	0.81	0.01	0.20
14	9.67	0.81	0.01	0.20
16	9.78	0.81	0.01	0.20
17	9.90	0.81	0.01	0.20
19	10.02	0.81	0.01	0.21
20	10.14	0.80	0.01	0.21

Pre-weaning kits mortality risk factors

Five potential variation factors have had a significant effect on pre-weaning kits survivability and were taking into account in the Cox regression model (Table 3). These factors are: daily farmer litter health status monitoring, farmer's instruction level, hand disinfection at the entry and exit of the farms, monthly antibiotic and antiparasitic prevention implementation measures.

Discussion

A rabbit doe give birth twice a year on average with a mean litter size at birth of 5.75 Kits in semi-intensive rabbit production system of Benin. This result paralleled the average litter size of 5.9 kits observed in Ghana by Apori *et al.* (2014) with exotic California

White and New Zealander breeds. Akpo *et al.* (2008) reported the same average litter size in their study in South Benin. The sex ratio observed (2 males for 10 females) in our study is consistent with that reported by Kpodékon *et al.* (2006). The mean annual kindling frequency per doe observed in our study was 2. This poor performance is below the results of Apori *et al.* (2015) who reported an annual kindling frequency of 3.5 on average per doe in Ghana.

Table 3. Pre-weaning kits mortality risk factors.

Risk factors	Hazard ratio	Confidence interval	Probability
Litter daily monitoring	0.085	[0.03 ; 0.219]	< 0.05
Farmer's instruction level	0.37	[0.26 ; 0.55]	< 0.05
Hand desinfection	0.244	[0.15 ; 0.394]	< 0.05
Antiparasitic prevention	7.976	[2.48 ; 25.62]	< 0.05
Anticoccial prevention	13.125	[4.09 ; 42.10]	< 0.05

The results disagrees with the short kindling interval mentioned by Azard (2006) in a classical semi-intensive production rhythm, with artificially-inseminated and reproductive hormone-assisted doe which is expected to give birth theoretically every 41 - 42 days with 11 to 12 days kindling interval. However, the lower fertility rate obtainable in semi-intensive system reduces the distance between expected and actual production (Castellini, 2007). This kindling interval is 1 to 3 days in an intensive production rhythm (Castellini *et al.,* 2010), again with the practice of artificial insemination and hormonal assistance. Studies have shown that rabbit does after kindling is found in a negative energy balance of -40% (Parigi and Xiccatto, 1998).

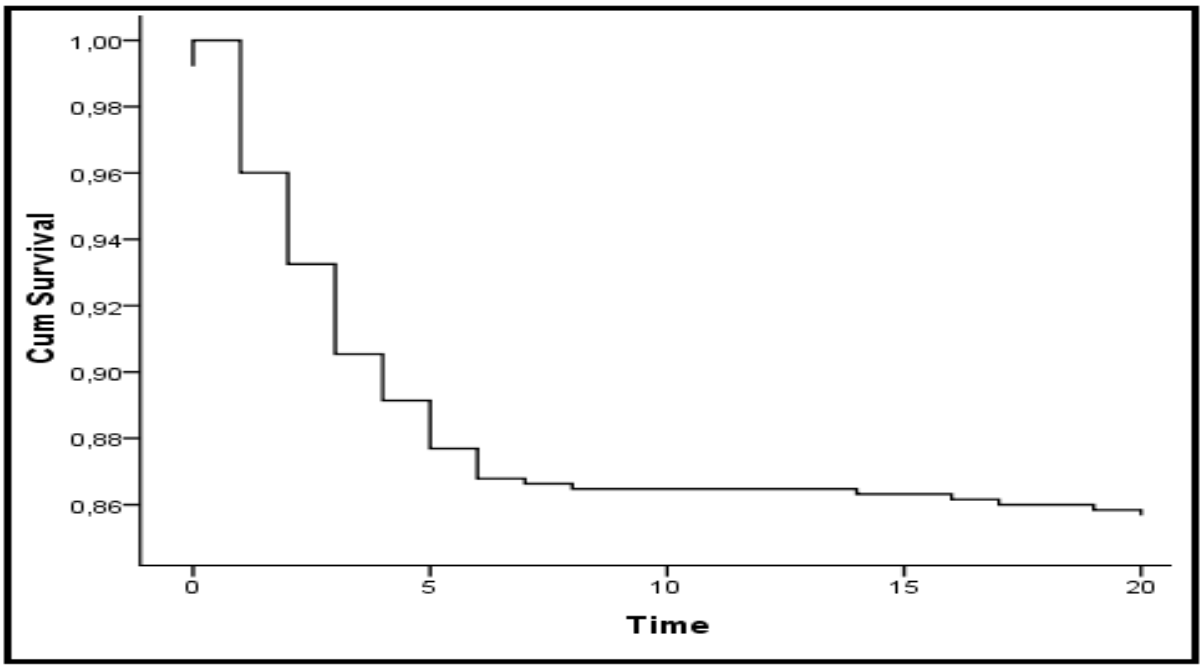

Fig. 2. Kaplan Meier pre-weaning kits survivability curve.

This deficit worsens with major negative protein balances when the rabbit is both lactating and pregnant according to the same authors. Nutritional recovery of lactating rabbits is therefore necessary for a later phase of gestation. This nutritional recovery time is long and lasts an average of 6 months for the lactating does of the rabbit farms surveyed during our study. This inter-kindling recovery time varies

between 44 and 63 days according to Akpo *et al.* (2008) and Castellini *et al.* (2010), with a beneficial effect on doe's fertility. It is 95 days on average for Californian White and New Zealander breeds according to Apori *et al.* (2014), in the same rearing condition. These parameters that characterize the reproductive performance of rabbits raised in the farms surveyed in this study in southeastern Benin are well below those observed by some authors (Akpo *et al.,* 2008; Oke and Iheanocho, 2011; Sivakumar *et al.,* 2013). In the current study a doe produce annually on average 9 rabbits. Apori *et al.* (2016) reported a value of 20 rabbits produced per doe per year in Ghana. According to Kpodekon *et al.* (2006), a doe produced annually an average of 25 to 35 rabbits in Benin. 40 to 45 rabbits are produced per year per doe in France (Lebas *et al.,* 1996). It is noticeable through studies that the prolificacy of a doe is theoretical related to many reproduction factors such as litter size (Castellini *et al.,* 2010) and kindling interval. The litter size in our study agrees with those reported by many other authors (Akpo *et al.,* 2008; Apori *et al.,* 2015). The discrepancy on the prolificacy influencing factors lies on the kindling interval which is very long, 180 days in the herein study. Doe reproduction activity such as pregnancy and lactation are nutrient-demanding activity (Iyeghe-Erakpotobor *et al.,* 2005). Also Delgado *et al.* (2016) demonstrated that triglyceride mobilization during the period between insemination and weaning has a beneficial effect on doe fertility. Hence, the rising question here is whether the breeding does in the surveyed rabbit farms during our study receive an appropriate feed diet for a quick recovery of the energy and protein investment caused by the pregnancy and lactation phases? The other aspect is also the farmer personal breeding stock management with a regular natural planned doe insemination in a semi-intensive rearing system.

Pre-weaning kits mortality observed in our study is 25.52%. This value is higher than that reported by Baumanne and Stauffacher (2001) and Kpodekon *et al.* (2006) which are 20 and 22% respectively. The results in Table 3 and Fig. 2 demonstrated an average pre-weaning survivability of 74.48% with 20% of the mortalities occurring in the first week after birth. Factors like, litters health status daily monitoring, disinfection of hands at the entry and the exit of the buildings, farmer's instruction level, antibiotic and antiparasitic prevention measures have significantly influenced the average pre-weaning survival rate. These identified significant pre-weaning survivability variation factors are closely associated to the management skill of the farmers. This finding corroborates the results of Kpodekon *et al.* (2006), who observed a significant farmer effect on pre-weaning kits mortality in their study.

Conclusion

The results of this study demonstrate a low reproductive performance, below the technical and economic parameters essential to the profitability and the professionalization of rabbit production activity in Benin. This compromises the survival of the industry and endangers the employment of hundreds of farmers who depend on the income from this activity for their livelihood. Future investigations are planned to identify the actual causes of this observed performance.

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