

Study of goat rearing systems and their impact on young goat production in the Sahelian zone of Africa: The case of West Mayo-Kebbi, Chad

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Climate change has become a significant concern for scientists and policymakers worldwide in the last decade. In addition to its environmental and human health threat, climate change dramatically affects livestock populations, their production (Nair *et al.* 2021), and food security and nutrition (Assan 2021). Recent research highlighted the need for indigenous resilient species to cope with the impacts of climate change (Nair *et al.* 2021). Goats are cited as the best model to cope with climate change's direct and indirect effects (Sijian *et al.* 2021). In the Sahelian zone of Africa, the autochthon goats are the most represented and domesticated animal species destined for production. Despite the climatic and nutritional constraints, the production performances remain dependent on the availability of food resources and feeding practices (Mopaté *et al.* 2019). Through their vast, unmeddled genetic pool, autochthon goats are resilient to the complex local climatic conditions and could thus maintain their production under low feed value and quantity input; hence, they assure the sustainability of the farming systems as a means to alleviate poverty and thwart rural-urban migration. For these reasons, goat rearing presents a potentially sustainable and holistic approach in Africa (Parker *et al.* 2019) since it often supports fragile and complex economic areas (D'Oronzio *et al.* 2022). In Chad, goat rearing and its productivity are still marginalized (Kyeblouabé *et al.* 2022). The breeding is left to itself with little human intervention. Moreover, the breeding data relating to reproduction and production are not recorded in most cases, which indicates that goats

as potential animals are not well exploited and valued by the breeders.

The study conducted in West Mayo Kebbi – Chad, in the south-western part of Chad (9° 19' 48" N / 14° 45' 0" E). The province belongs to the Sahelian zone of Africa, where the climate is characterized by a long dry season (from November to April) and a short humid and rainfall season (from May to October), with an annual average temperature of 28.9°C and rainfall of 606.9 mm (Mfewou *et al.* 2022). The study includes three districts in the province of West Mayo-Kebbi: Lagon, Léré, and Pala Erdé (goat farmers: 96, total animals: 3599). Occasional interviews with the breeders were conducted on-site, and breeding data was collected. The animal targeted belonged to the local breed, the Kirdimi goat, called dwarf goat (Fig. 1) because of their small morphometric characteristics (Meyer 2022). Their sexual activity seems continuous all year and improves when feed and pasture availability becomes favourable (Kyeblouabé *et al.* 2022).



Fig. 1. Morphological aspect of Kirdimi goat with a fawn coat (Kyeblouabé 2022).

The goat-rearing systems were identified and assigned to traditional extensive and semi-extensive systems based on feeding practices.

The production performances of young meat goats were evaluated according to several criteria: the kidding mode (simple, double, or triple), the mortality rate, and the age at weaning of the kids, which were calculated according to the data collected from farmers. ANOVA was carried out using the software SAS (SAS Institute *Inc.*®). Farming systems (FS) and district (D) effects on goat production

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performances were performed using the GLM procedure:

$$Y_{ij} = \mu + FS_i + D_j + e_{ij}$$

Where, μ , mean of the studied population; Y_{ij} , production performances; e , residual error.

The comparison between variables was performed using the Duncan test. The threshold of signification was set at $P < 0.05$.

The present study identified two goat-rearing systems in the study area: the traditional extensive (TE=24%) and the semi-extensive (SE=76%) systems. The number of goats in the breeding was higher in the SE compared to the TE systems (2747 vs 852), and their feeding is based on grazing, up to 90% and 100% for the SE and TE, respectively. Supplementation is practiced in both systems, but its share is significantly higher in SE (97%) using hay always produced on-site, in the farms (26%), and agricultural by-products such as cotton seeds, cotton cake, and peanut cake (98%). This result showed a difference between the two rearing systems in the feeding practices. According to the farmers, other differences lie in the animal housing and the herd health monitoring, which are absent in the traditional extensive system. Like our findings in Chad, Mopaté *et al.* (2019) also reported that goat breeding is conducted in the traditional extensive or the semi-extensive systems, and low use of inputs characterizes both approaches.

The results deduced that the most kiddings (SE=89% and TE=78%) were registered during the dry season, with quite an equivalent average annual number of live young goats produced per farm in the SE and TE systems (28±10 vs 27±14). Similarly, the mean annual number of neonatal mortality per farm did not vary between the SE and TE systems (6.9±3.3 vs 6.7±3.8). These high results lead to poor health monitoring and insufficient use of veterinarian services, as reported by all the respondents. Indeed, the minimal veterinarian intervention and the lack of supervision of kids and goats induce the dissemination of contagious conditions, the worsening of disease expression, and increased animal death. Other studies (Ngongolo and Mmbaga 2022) found that kids' mortality in Kirdimi goats did not differ from the other breeds and is significantly influenced by disease occurrence.

The average number of dead young goats per farm varied according to the districts (Fig. 2) as a matter of fact, it was higher in the district of Lagon in comparison to the Léré and Para-Erdé districts ($P < 0.05$). This high mortality

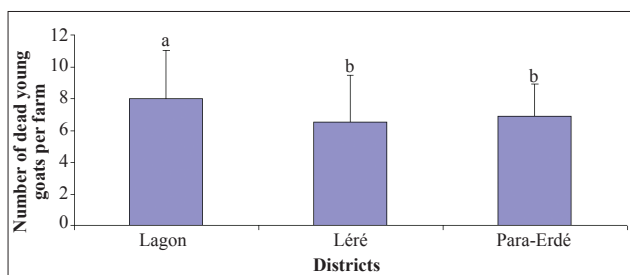


Fig. 2. Variation of the average number of dead young goats per farm according to the districts of Mayo-Kebbi (a, b: $P < 0.05$).

rate would be one of the most visible consequences of environmental factors. According to our investigations, neonatal mortality occurred significantly more during the rainy season, specifically from August to October. This seasonal effect on kids' mortality could be linked to a more significant infestation of the young goats by the endoparasites during the rainy season. This could be explained by the poor husbandry practices regarding housing, feeding, and the low recourse to veterinary care. It also seems that during this period, the underfed female goats did not produce enough milk to satisfy the kids' nutritional needs, resulting in higher mortality rates.

The kidding mode was higher in the SE system compared to the TE system (Fig. 3). This result could be related the share of feed supplementation used in SE farms. Other factors can influence the goat kidding mode, which is not considered in this study, and according to Perumal *et al.* (2019), birthing singles, twins, or triplets can vary with months, seasons, and years.

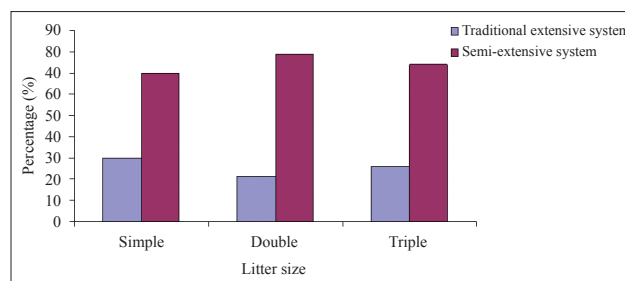


Fig. 3. Variation of the kidding mode of the Kirdimi goat in the traditional extensive (TE) and semi-extensive (SE) systems.

In present study, weaning age did not vary in both rearing systems (SE=6.5±1 months and TE=6.4±1 months) and occurs naturally when goat milk has run out without human intervention. Though preceded by a pre-weaning period with length, it is related to feeding practices in both systems and the scarcity of natural resources. Hence, kids register weak growth during this period, which is compensated consequently by a delay in the factual weaning. Thus, the nutritional status affects the body's growth and, thereby, the age at puberty up to one year. Optimal management of the kids during the pre-weaning period can advance the age at weaning and the onset of puberty (Mayeriya *et al.* 2017).

As feed supplementation is practiced by hay and agricultural by-products produced on farms, it would be wise to introduce more nutritive inputs such as concentrate to strengthen the kid's growth and shorten the pre-weaning period.

In conclusion, most breeding goats in West Mayo-Kebbi province belong to the semi-extensive farming system, where the proportion of feed supplementation with agricultural products and by-products is more critical than the traditional extensive system. Feeding practices are based on grazing and complementation with forage, and agricultural by-products yielded on the farms. Regarding the production performances, no significant difference was found between the two farming systems, except for the

kidding mode, which was higher in the SE farming system under its double and triple forms. However, the weaning age is late in the two systems, and it could be attributed to the insufficient feed resources available for young goats, which makes the maternal milk a good nutritional source, free and available, even though scarce, and an excellent growth aid to the youngsters until feed accessibility improves. Indeed, farmers always prioritize feed supplementation for adult goats because they are the principal and immediate meat providers in the West Mayo-Kebbi region. Thus, it leads to an unsatisfying growth rate for the young goats. In addition to the slow growth, the mortality rate of kids is high in both farming systems due to the lack of recourse to veterinary care, especially during the neonatal phase.

SUMMARY

The present study was conducted in the province of West Mayo Kebbi–Chad, and involved 96 goat farmers covering 3599 animals belonging to the local breed. Production performances of kids raised for butchery were estimated based on their kidding mode (simple, double, or triple), their mortality rate, and their age at weaning. Present findings showed the pinpointing of two main goats rearing systems: the traditional extensive (TE=24%) and the semi-extensive systems (SE=76%), with a higher number of goats reared in the SE compared to the TE systems. Feeding is based on grazing at 90% and 100% for SE and TE, respectively. Supplementation is practiced in the SE system, using hay and agricultural by-products. Most of the kidding was recorded during the dry season, with a comparable average annual number of live kids produced per farm for the SE and TE systems. Similarly, the average annual kid's neonatal mortality per farm did not vary between the SE and TE systems. The simple, double, and triple kidding mode was higher in the SE system compared to the TE system, yet the age at weaning was similar in both systems. Besides, the study also showed that the most goat farmers belong to the SE farming system. Their feeding practices are almost the same in both farming systems except for supplementation, which is usually practiced in the SE. Conclusively, the production performances did not vary between the two farming systems, except for the kidding mode, which was higher in the SE farming system.

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