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Characterization of sheep production systems in the mountainous and forest areas of Northern Tunisia: Alternative ways to improve their productivity

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Abstract - The overall objective of this study is to characterize the sheep production systems in mountainous and forest areas located in Northern Tunisia and to identify alternative ways to improve their productivity. A total of 81 farmers holding 1672 ewes and 73 rams were interviewed. Surveyed farms are in humid and semi-arid zones in northern Tunisia. Results analysis showed that the flock's reproductive performances are relatively low. Indeed, the average age at first mating of either females or males is late. It is respectively about 19.3 (2.3) and 20.6 (4.2) months. Similarly, the fertility and fecundity rates are respectively 87.3 (6.6) % and 102.8 (9.5) %. Statistical analysis demonstrates that these parameters were significantly ($p < 0.05$) influenced by the land area, the ewes' age and the flushing technique. Best results were recorded in areas with significant forage potential, among young farmers who are more receptive than the elderly and where flocks' feeding is well mastered. Due to a lack of funds, preventing them to buy concentrate feed, 83% of the surveyed farmers do not practice lambs' fattening. The animals' sale is carried out at an early age (7.5 months). An efficient extension program associated with adequate supervision and monitoring of sheep farmers is needed to better assimilate the breeding techniques and valorize the mountains' pastures. Organization of farmers into associations may facilitate the establishment of better development actions in these zones and better use of best breeding practices.

Key words: Sheep, Forests, Mountains, Productivity, Tunisia.

1. Introduction

Small ruminants production systems (sheep and goats) contribute to the livelihoods of millions of rural poor in most of the developing asian and africain countries, where 95% of the world's sheep and goat population is concentrated and also the majority of world's poor live (Shiva Kumara *et al*. 2017). In fact, apart from the social and economic functions, small ruminants are providing an important part of the meat supply for human consumption. Besides, the demand of livestock products increased between 2005 and 2015 by 21% for red meat in Tunisia (Dhraief et *al*. 2018) and the sheep rearing is contributing to 50 % of the red meat national production which was around 49.400 tons in 2016 (Givlait 2018). In addition, over the last two decades, the ovine meat consumption in Tunisia has increased by 24% in spite of the considerable rising in prices. Sheep production systems continue to have considerable roles in various regions of the country covering the farmers' subsistence in the north, center or south of the country. Nevertheless, they are confronting many constraints that are limiting their productivity and then farmers' income, which is threatening their sustainability. The most serious constraint on small ruminant production in Tunisia, in general, is the small average farm size. It is estimated that there are approximately 63% of the national total sheep farmers that have less than 20 ha average farm size. Livestock management has changed considerably as a result of the decline in the natural range and the increase in sheep herds. The use of concentrates has become essential, as already reported by Elloumi *et al.* (2011). This general change is found throughout the Maghreb and especially in the steppe zone, as in Algeria (Kanoun *et al.* 2015).
Ben Salem (2011) estimates that, as an example, the rangelands represent only 10 to 15% of animal feeding ration in Central Tunisia. Besides, feed deficits constitute the most serious problem because of

the inadequate and poor quality of the animal food resources, particularly during the dry season, in addition to the shortage of drinking water, poor flocks' management, poor animal health and poor interaction between researchers, farmers, extension workers and policymakers. These constraints existed before and are remaining and becoming more serious nowadays because of the current severe climate change problems such as the succession of dry years, floods, uncontrolled fires, overgrazing, etc. These circumstances contributed to the desertification of the pastoral areas, hence the importance of adapting new livestock systems (Hetem *et al*. 2011). Controlled grazing is also considered as a good management strategy to maintain or increase the live weight of livestock and to reduce vegetation degradation of rangelands in semi-arid areas (Islam *et al.* 2018). Complementation can be achieved by the crop fodder resources or the use of concentrates which is now practiced in the Maghreb. Faced with the quick changes in this context, farmers who remain in the livestock activity can, therefore, develop different climate change adaption strategies.

The overall objective of this paper is to characterize the sheep production systems in the mountainous and forested areas located in the north-western region of Tunisia and to identify possible ways to improve their productivity and resilience using the existing farmers' technical knowledge and traditional know-how.

2. Materials and methods

This study was conducted in four provinces of the Tunisian northwestern, humid and semi-arid region (Bizerte, Beja, Jendouba, Le Kef and Siliana). A total of 81 farmers holding 1672 ewes and 73 rams were interviewed. Sheep production systems were characterized in this region and breeding information was collected. The surveys covered the sheep farms' structural parameters (herd size, farm scale), socio-economic variables (farmer age, source of income, instruction level, residency), the herd management parameters (feeding, reproduction ways and veterinary intervention) and constraints limiting the animal's productivity as well as solutions used by farmers to maintain their flock's sustainability. An entire number of 45 variables were selected to characterize the sheep production systems in this zone. Statistical analysis was performed using the statistical software SAS ® 2005 (version 9.1). The freq procedure was used for descriptive analysis and frequencies were compared using chi square test.

3. Results and discussion

Characterization of sheep production systems in mountainous and forested areas in northwestern Tunisia focuses on several aspects such as the flocks' size, the forage area and the availability or not of food resources. Results show a relatively high diversity for studied parameters.

3.1. Socio-economic situation of the surveyed farmers

Surveyed farmers in target region were respectively 31%, 27%, 19%, 13% and 10 % in Beja, Jendouba, Le Kef, Siliana and Bizerte. Sheep farmers belong to different age categories: < 40 years old (28%), 40-60 years old (56%) and > 60 years old (16%) which shows that the majority of them are young people. However, according to their education level, nearly 54% of them are illiterate. The averages of the total agricultural land and the forages' area in the case of all the surveyed farms are respectively of 8.3 ± 7 hectares and 2.3 ± 2 hectares. The main used crops are cereals and olive trees occupying respectively 30% of the useful agricultural area.

3.2. Livestock health management, productive and reproductive performances

An average of 21 female sheep units (FU) was recorded in the surveyed farms. The average ram number is relatively low (01 ram/farm). Three ovine breeds were found: the Barbarine (called locally Nejdi or Arbi), The Black of Thibar (NT) and the Western Thin Tail (QF). Cows and goats' average number is about 09 and 01 respectively/farm. Generally, the flocks are small and mixed. Only 14 % of farmers treat their flocks against external parasites. This low rate results of the farmers' lack of awareness about the importance of the flocks' health management. About 74 % of the surveyed farmers treat their animals against internal parasites. The lambs' average age at weaning is relatively late (5 months). In fact, lambs continue to suckle their mothers because of the lack in pasture areas. Weaning occurs during the sale period and depends more on the natural food resources availability. The average age at sale is 07 months and it varies depending on the year (climate conditions), animals' food resources and raw materials' market prices. Only 17% of the surveyed farmers practice the lambs' fattening. Others sell them directly after weaning. Females and males' average ages at first joining are late (19 and 21 months, respectively).

Prolificacy and fertility rates were studied according to the farms' location, the total agricultural area, and the sheep breeds (table 1).

Table 1. Fertility and prolificacy rates measured in the surveyed farms

	Location					Area (ha)			Breeds		
	1	2	3	4	5	5	5-10	>10	B	NT	QF
Fertility (%)	93	97	100	93	88	84	89	91	85	89	90
Prolificacy (%)	101	104	101	106	103	102	101	102	102	105	101

1= Beja, 2= Jendouba, 3= le Kef, 4=Siliana, 5= Bizerte, n: number of surveyed farmers, ha: hectares, B: Barbarine breed, NT: Black Thibar Breed, QF: Western Thin Tailed breed. Numbers in rows followed by the same letter are not significantly different.

Results show that farms' location affects significantly ($p<0.05$) the fertility rate. In fact, three bio-climatic zones exist in the north of Tunisia (sub-humid, humid and semi-arid zone) which explains diversity in the animal feeding resources. The farm size has also a significant effect ($p< 0.05$) on the flocks' reproductive parameters. Better results were recorded in the large-scale farms (> 10 hectares). However, smallholders (< 5 hectares) try to valorize forests and mountains animal food resources to maintain the sheep breeding activity. Young farmers (< 40 years old) keep trying to improve their flock management ways but they stay limited by the high analphabetism rate (46% of the surveyed farmers). The highest fertility and prolificacy rates were recorded in the case of the QF (fertility rate= 90%) and the NT (prolificacy rate = 105%). However, these results remain low relatively the breeds real performances, which could be explained by the non-application of the concentrate complementation during the critical periods (only 6% and 18.5% of the surveyed farmers apply the males and females flushing, respectively).

3.3. Constraints limiting the sheep production systems in the mountainous and forested investigated zones

Herds of goats and sheep are common throughout the region, often grazing on communally managed lands. However, many constraints are limiting these flocks productivity as the grazing land degradation, the animal food resources increasing prices as those of the oat and barley grains, concentrate etc. Moreover, forest and mountainous people living in these regions are attempting difficult weather conditions particularly during the summer and winter and the most threatening problem is the succession of the dry years. Environmental degradation, caused mainly by poor maintenance of terraces and overgrazing, is widespread. The resulting decline in productivity, combined to long distances to markets, increasing competition from subsidized food imports and growing incidence of drought, has led to increasing poverty and food insecurity. Many farmers are leaving mountain areas to find employment opportunities elsewhere and a significant number of households are likely to shift out of agriculture. As a result, farming and herding practiced by rural mountain people, has become, increasingly stressed and vulnerability to food insecurity is becoming quite high in these zones.

3.4. Practices adopted by farmers and possibilities to improve their flocks' productivity

Finding solutions to the critical situation of the sheep farmers in the investigated zones is certainly vital to ensure the sustainability of these specific farming systems and to enhance the farmers' resiliency. That is why; farmers have adopted some practices, spontaneously. Surveys results showed a gradual transformation in these people attitudes towards the use of natural resources as temporary migration and valorizing their know-how which exists almost in every region of Tunisia. Most rural mountain people are planting cereal and fodder crops each autumn. The crops are mainly rain-fed wheat, barley and legumes. A number of measures could also yield to important gains in sustainability and food security. Improved watershed planning and management are needed to protect both existing levels of productivity and downstream rural and urban water users; introduction of conservation tillage and better integration of crops and livestock production systems could improve both productivity and sustainability. More equitable regulation and control of common grazing resources would also reduce both environmental damage and food insecurity. Extra efforts are also needed to facilitate land consolidation, forage stronger linkages between farm and off-farm economies and finally organization of the farmers into associations may facilitate the establishment of targeted development actions as it was carried out in the case of the Sicilo-sarde dairy breed in northern Tunisia (Brahmi and Khaldi, 2016).

4. Conclusion

Characterization of the sheep production systems in the mountainous and forested areas in Northwestern Tunisia showed that there are mainly structural, technical and animal food deficits problems resulting of the farms' small size associated to the accumulation of climate change problems. Consequently, sheep farmers used their inherited knowledge and traditional know-how as the valorization of the forest sub-products. Keeping the local hardy breeds that are less susceptible to diseases and more adapted to the available local food resources. In addition, the organization of these farmers into associations may facilitate the establishment of targeted development actions.

5. References

Ben Salem H. : Mutations des systèmes d'élevage des ovins et perspectives de leur durabilité. *Options Mediter.* **A (97)** pp 29–39, 2011. [Google Scholar]

Brahmi A and Khaldi R. : Analyse de la chaine de valeur de la filière lait ovin en Tunisie. *Options Mediter.* **A (115)** pp 71-76, 2016 [Google Scholar]

Dhraief M.Z, Bedhiaf-Romdhani S, Dhehibi B, Oueslati-Zlaoui M, Jebali O and Ben Youssef S.: Factors Affecting the Adoption of Innovative Technologies by Livestock Farmers in Arid Area of Tunisia. FARA Resarch Report. **Volume 3 (5)**, 2018. [ResarchGate]

Elloumi M, Selmi S and Zaibet L. : Mutations des systèmes d'élevage des ovins et perspectives de leur durabilité. *Options Mediter.* A (**97**) pp 11–21, 2011. [Google Scholar]

GIVLAIT, 2018. Groupement Interprofessionnel des Viandes Rouges et du Lait. Tunisie. http://www.givlait.com.tn/presentation-filiere-viandes-rouges.html

Hetem RS, de Witt BA, Fick LG, Fuller A, Maloney SK and Meyer LCR.: Effects of desertification on the body temperature, activity and water turnover of Angora goats. *J. Arid. Environ.* (**75)** pp 20–28, 2011. [CrossRef] [Google Scholar]

Islam M, Razzaq A, Gul S, Ahmad S, Muhammad T,Hassan S, Rischkowsky B, Ibrahim M and Louhaichi M.: Impact of grazing on soil, vegetation and ewe production performances in a semi-arid rangeland.*J. Mt. Sci*. (**15**) pp 685, 2018. https://doi.org/10.1007/s11629-017-4702-7

Kanoun M, Huguenin J, Yakhlef H, Meguellati-Kanoun A, Julien L and Taugourdeau S. : Pratiques d'alimentation pour l'engraissement des agneaux dans des systèmes d'élevage agropastoraux de la région d'El-Guedid-Djelfa. *Livest. Res. Rural. Dev.* 27 **(10), 2015**. [Google Scholar]

Ruppert JC, Harmoney K, Henkin Z, Snyman HA, Sternberg M, Willms W and Linstadter A.: Quantifying drylands' drought resistance and recovery: The importance of drought intensity, dominant life history and grazing regime. *Glob. Chang. Biol.* **21 (3).** pp 1258–1270, 2015. dx.doi.org/10.1111/gcb.12777.[CrossRef] [PubMed] [Google Scholar]

Shiva Kumara C, Reddy BS and Suresh S Patil., 2017. Small Ruminant Production in Karnataka State of India- an Overview. *Euro J Zool Res.*, **5 (1)** pp 28-35, 2017. [Scholars Research Library]