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Impacts of climate change on the small ruminants farming systems in north western Tunisia and adaptation tools

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Abstract. Studies on the national adaptation strategy of Tunisian agriculture to climate change reveal that this phenomenon will have serious implications on water resources, ecosystems and agro-systems by 2030. Successive droughts will reduce livestock numbers by 80% in central and southern regions and 20% in the North. In this context, we studied the reaction of the small ruminants farming systems to this critical situation. An investigation has been carried out in the north west of Tunisia (240 small ruminants farms in Jendouba governorate and 151 in Kef governorate). Farms typology results (by PCA) indicate the presence of three farms groups in Kef and three in Jendouba with different farm sizes and flock numbers. The common problem is feed availability. Frequent droughts and over-grazing explain why the involvement of natural pastures and rangelands in animal feed calendars are declining noticeably, justifying the frequent use of transhumance. Large amounts of concentrates are used especially in summer, reducing farmers' incomes improved by other activities. In forest zones, twigs of trees and shrubs constitute a very good food resource. Farmers practice late weaning to reduce the quantities of concentrates presented to the lambs in order to preserve their farm's sustainability.

Keywords. Climate change – Small ruminants – Farming system – Adaptation – Sustainability.

Impacts des changements climatiques sur les systèmes d'élevage des petits ruminants au nord-ouest de la Tunisie et moyens d'adaptation

Résumé. Des études sur la stratégie nationale d'adaptation de l'agriculture tunisienne aux changements climatiques ; ont révélé que ce phénomène aura de graves répercussions sur les écosystèmes, les ressources en eau et les agro-systèmes d'ici 2030. La succession d'années sèches réduira l'effectif des petits ruminants de 80% dans les régions du centre et du sud et de 20% dans le Nord. Dans ce contexte, nous avons étudié la réaction des systèmes d'élevage des petits ruminants à cette situation critique. Une enquête a été réalisée dans le nord-ouest de la Tunisie (240 exploitations d'élevage de petits ruminants) à Jendouba et 151 au Kef). Les résultats de la typologie (par ACP) indiquent l'existence de trois groupes d'éleveurs au Kef et à Jendouba avec des superficies d'exploitations et des effectifs d'animaux différents d'un groupe à l'autre. Le problème de disponibilité d'alimentation, les fréquences de sécheresses et le surpâturage expliqueraient la participation limitée des pâturages naturels et des cultures fourragères dans l'alimentation des petits ruminants justifiant ainsi le recours fréquent à la transhumance. De grandes quantités de concentrés sont utilisées, dépassant parfois 1 kg) surtout en été ce qui diminue les revenus des agriculteurs. Dans les zones forestières, les animaux valorisent les brindilles des arbres comme ressource alimentaire alternative. Les éleveurs pratiquent le sevrage tardif pour réduire les quantités de concentrés présentés aux agneaux et assurer la durabilité de leurs exploitations.

Mots-clés. Changement climatique – Petits ruminants – Systèmes d'élevage – Adaptation – Durabilité.

I – Introduction

Sustainable agriculture and rural development are certainly the answer to World's food security concerns. However, today's choices and development paths are closely linked to climatic conditions (Mohamed, 2009). In fact, climate change will have far-reaching consequences on dairy, meat and wool production, mainly arising from its impact on grassland and rangeland productivity. Heat distress suffered by animals will reduce the rate of animal feed intake and result in poor growth performance (Rowlinson, 2008). Pastoral systems occupy two thirds of global dry land areas having a higher rate of desertification than other land uses (Neely *et al.*, 2009). In Tunisia, the livestock sector contributes by 35 to 40% of agricultural GDP in the national economy (Ben Salem, 2011). Small ruminant farming is an ancestral tradition. It plays an important economic, social and ecological role, not only in the central and southern parts of the country, but also in the north-west regions. However, agriculture has been and will, certainly, be affected by the negative impacts of climate change. Indeed, this phenomenon will have serious implications on water resources, ecosystems and agro-systems. The expected succession of dry years will cause the decline of livestock numbers (sheep, cattle and goat) by 80% in the centre and south of the country and 20% in the North (GEREP-Environnement, 2009). Therefore, the objective of this work is to carry out a typology of the small ruminants breeding systems in north-west Tunisia, to study the impacts of climate change on their functioning and the simple adaptation tools used by farmers in order to limit the effect of this phenomenon.

II – Materials and methods

This study was carried out in the governorates of Kef and Jendouba located in the north-west part of the country. The present work was focused on representative samples in each area: 151 small ruminants farms in the governorate of Kef spread over 11 delegations and 240 small ruminants farms in the governorate of Jendouba spread over eight (08) delegations. The observations covered sheep farms structural parameters (herd, agricultural surface), sheep reproduction, animal feeding and the farms economic results. Tools used by farmers to cope with the impacts of climate change were also discussed. Multivariate analysis were made only on 235 farms in Jendouba and 150 farms in the Kef area in order to elaborate a final distribution of farms into homogenous groups using STATBOX (software from GRIMMER).

III – Results and discussion

In the governorate of Kef, a total of 151 farms were investigated. The surveys' compiling results showed that the small ruminants farms are more specialized in meat sheep production with a total number of 7830 ewes which are mainly of the Thin Tailed Breed. The small ruminants farming system in the Kef governorate could be considered generally extensive depending largely on climatic conditions. During the dry years, farmers decrease their herd's size through the sales process. Three groups of farmers were selected using a principal components analysis (Fig. 1).

The first group (35 farms especially located in Nebber, Dahemni and Essers), interpreted from typological studies, is characterized by the presence of small farms (≤ 5 ha and ≤ 30 female units). Forage and pasture land areas are very low, which explains the high price of "achaba", a technique of leasing a land for grazing. These breeders do use neither animal feed complementation in flushing and steaming nor the ram effect. Many breeders use a gradual weaning method to decrease the amount of concentrate feed presented to the lambs. The average suckling period in the case of this group is medium (4 months) and farmers do not practice lamb fattening in order to reduce costs related to this operation to ensure the sustainability of their activity as the only source of income. The second group (69 farms located

mainly in Sakiet Sidi Youssef and ElKalaa khesba) is essentially characterized by good flock management and medium flock size ($30 < TT \leq 100$ female units). They use the flushing and steaming technique. These breeders have intermediate average total agricultural area ($5 < SAT \leq 100$ ha). This constraint obliges them to use transhumance to other regions with high rental prices. Flocks are characterized by a higher prolificacy rate than in the first group. The breeders of this group also practice better organized lamb marketing using sale contracts. The wool sale constitutes an additional source of income. The third group (46 farms located mainly in Kalaat Senan and Tajerouine) is characterized by large flocks (> 100 female units) and large agricultural land area (≥ 100 h). Farmers in this group devote large agricultural area to dairy cattle forage. The main problem in the small ruminants farms in the governorate of Kef is primarily the animal feed availability related to the scarcity of rain water.

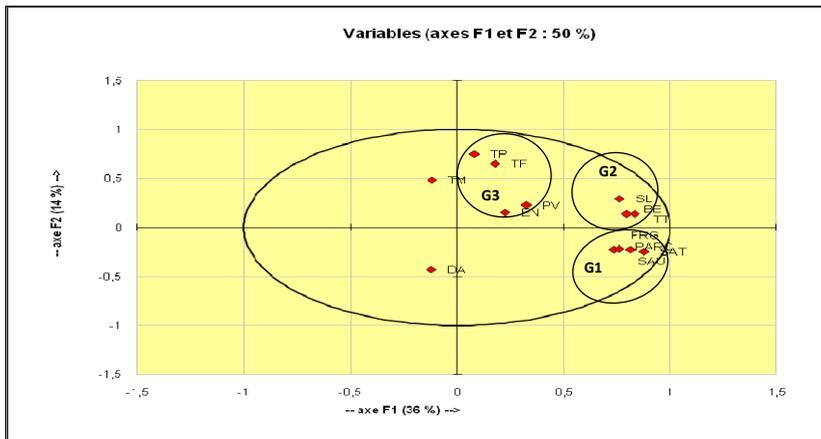


Fig. 1. Spatial localization of the farms according to the two principal components obtained from the multivariate analysis (case of the Kef governorate).

In the governorate of Jendouba, a total of 235 farms were investigated. Average parameters describing the sampled small ruminants farms in Jendouba area, mostly specialized in sheep meat production. The PCA results (Fig. 2) shows the existence of three farming systems: the traditional extensive system, the integrated intensive and rarely, the intensive system. The first system is represented by the majority of farmers relying mainly on grazing in the mountain areas of Gare de Maoi, Fernena, Tabarka and Ain Drahem. In the irrigated areas and plains, the identified breeding system is the semi-intensive which is based on grazing and food supplementation (hay, barley, concentrates, etc...) especially during the fall period when grazing land decreases. Sheep breeds reared in this area differ between regions. In fact, in lowland areas, small ruminants systems are dominated by pure breeds: Barbarine, Black of Thibar and the Thin Tailed Breed, while in mountainous regions, the presence of crossbred and mixed breeds is very common.

In this region, the majority of small ruminants farmers are private breeders and the main constraints facing this sector are the rising price of concentrates feed and forage seeds. The irrigated areas devoted to this farming system are very limited because of the importance of the dairy cattle in this region. In the mountainous areas, sheep and goat farming is based generally on limited forest path areas and feed supplementation is mostly absent.

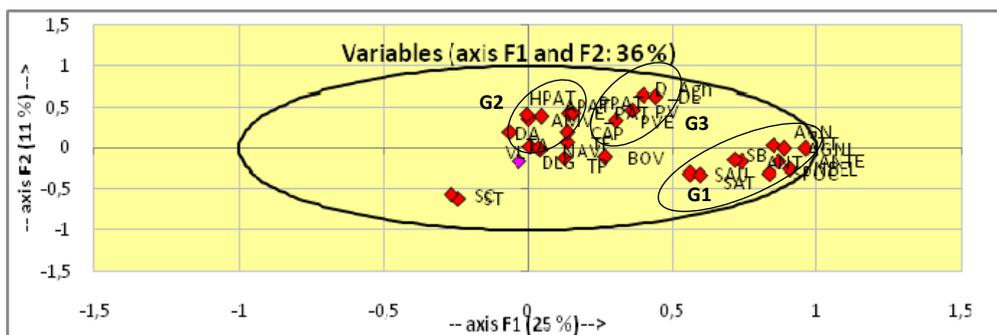


Fig. 2. Spatial localization of the farms according to the two principal components obtained from the multivariate analysis (case of the governorate of Jendouba).

IV – Adaptation tools to climate change

Global climate change is becoming a substantial reality. Tunisia is one of the most susceptible countries to the risks of these alterations particularly on the agricultural level. The major problem common to the majority of small ruminants farmers in Kef and Jendouba is feed availability. Indeed, the involvement of natural pasture and rangelands in the feed calendar is declining noticeably because of frequent droughts and over-grazing. In order to cover animal feed needs, large amounts of feedstuffs are imported which puts pressure on the national balance of payments. Small ruminants breeders in these regions are trying to find solutions which will help them to deal with the climate change problems and preserve their farms' sustainability such as the use of barley as a local feed resource. In forest zones and especially when it's summer, animals are fed on tree twigs and shrubs as a substitute for using concentrates. They also use a late weaning method in order to reduce the quantities of concentrates presented to the lambs.

In northwest Tunisia, small ruminants farms are better able to adopt the organic farming system and to adapt to warming or precipitation increases by switching to heat tolerant animals as goats or crops such as *Sulla* (*Hedysarum coronarium* L.), Perennial crops, such as *Festuca arundinacea* Schreb. and *Dactylic glomerata* L. would be used to valorize the marginal lands and glade forests (Chakroun, 2011).

V – Conclusions

The meeting point of climate change and livestock and especially small ruminants systems in developing countries is a pretty ignored research area. Little is known about the interactions of climate and increasing climate variability and the small ruminants farming systems evolution. There is a need to more fully understand the role that grazing areas plays in maintaining small ruminants breeding in favorable condition in north west Tunisia where feed and water resources availability at acceptable prices is the main constraint limiting the development of these breeding systems in the region.

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