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# Dynamics of livestock farming systems and adaptation strategies to climate and socio-economic changes in the Sétifienne semi-arid zone (Algeria)

M. Benidir<sup>1</sup>, B. Belkheir<sup>2</sup>, S. Kalli<sup>3</sup> and A. Bousbia<sup>4</sup>

<sup>1</sup>Algeria's National Institute for Agricultural Research (INRAA). Setif 19000 (Algeria)

<sup>2</sup>Algeria's National Institute for Agricultural Research (INRAA). Bejaia 06000 (Algeria)

<sup>3</sup>Higher National School of Agronomy (ENSA), El Harrach Algiers (Algeria)

<sup>4</sup>Faculty of Nature and Life Sciences, University of Guelma 24000 Guelma (Algeria)

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**Abstract.** The semi-arid highlands of Setif have been characterized by sheep farming and cereal cultivation for centuries. With the arrival of French settlers in the 19th century, cereal production became a priority in order to provide a growing metropolitan market. The integration of cereal farming and livestock production has since developed and resulted in the reservation of part of the sole for fodder crops and the creation of permanent grassland in wet areas (areas near rivers). Since independence (1962), public policies have induced, through the fixing of consumer prices and the subsidy of imported products such as cereals and milk, profound transformations within production systems. As a result, the traditional system, combining cereals and sheep, is currently undergoing major changes. This system is transformed from extensive agro-pastoral to a model in the process of intensification of livestock-mixed farming. The best-structured farms are geared towards valorizing the most profitable links in the production chain, while the majority of farms continued to practice cereals and livestock farming. The semi-arid farms have adopted a diversification strategy of agricultural and livestock activities with a view to improving their incomes and ensuring their sustainability.

**Keywords.** Dynamics – Breeding – Adaptation – Climate – Semi arid.

## *Dynamique des systèmes d'élevage et stratégies d'adaptation face aux changements climatiques et socio-économiques dans la zone semi-aride Sétifienne (Algérie)*

**Résumé.** Les hautes plaines semi-arides de Sétif se caractérisaient par l'élevage ovin et la culture de céréales depuis des siècles; avec l'arrivée des colons français au 19ème siècle, la production de céréales est devenue prioritaire pour pourvoir un marché métropolitain porteur. L'association céréales-élevage s'est depuis développée et a abouti à la réservation d'une partie de la sole aux cultures fourragères et à la création de prairies permanentes dans les parcelles humides. Depuis l'indépendance (1962), les politiques publiques ont induit par le biais de la fixation des prix à la consommation et la subvention de produits importés tels que les céréales et le lait, des transformations profondes au sein des systèmes de production. Par conséquent, le système traditionnel, combinant céréales et ovin, subit actuellement des mutations majeures. Ce système se transforme de l'agro-pastoral extensif vers un modèle en voie d'intensification de polyculture-élevage. Les exploitations les mieux structurées sont orientées vers la valorisation des maillons les plus rentables de la chaîne de production, alors que la majorité des exploitations ont continué à pratiquer la céréaliculture et l'élevage. Les exploitations en zone semi-aride ont adopté une stratégie de diversification des activités agricoles et d'élevage en vue d'améliorer leurs revenus et d'assurer leur durabilité.

**Mots-clés.** Dynamique – Élevage – Adaptation – Climat – Semi-aride.

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## I – Introduction

The semi-arid zone of Setif has been characterized by pastoral farming and cereal cultivation for centuries. However, under the combined effect of climate change and policies implemented by the government since independence, the integrated cereal-sheep farming system has evolved into mixed crop-livestock farming. Many farms have adopted cash cropping and replaced sheep with dairy cattle that have gradually moved from humid coastal areas to the semi-arid high plains. Livestock production, a strategic and indispensable activity of farming is highly integrated with mixed cropping (mainly cereals) in smallholder farms (5 to 15 ha). Over 95% of the smallholder farms rear livestock that contributes significantly to the farm's income and secures it by enhancing the co-products of cereals (straw, stubble) and fallow. There is a steady decline in the average size of the farm, due to the fragmentation of agricultural land through inheritance. The reduction in farm sizes coupled with smaller herd sizes, water scarcity, erratic and low rainfall, as well as the effect of climate change, increase the risks and vulnerability of agricultural enterprises. In this context, the present work aims to document the dynamics of farming systems in a semi-arid region characterized by low forage production potential, as well as the strategies adopted by pastoralists for adaptation to climate change.

## II – Materials and methods

### 1. Description of the study area

Setif is located in the high cereal plains of eastern Algeria. Its total area is 6504 km<sup>2</sup> or 0.27% of the national territory. Its altitude varies between 900 and 2000 m a.s.l. It is characterized by a continental climate with low and irregular rainfall (the annual average is 400 mm). It is subdivided into three zones according to the aridity gradient: northern semi-arid zone (NSZ), central semi-arid zone (CSZ), southern semi-arid zone (SSZ). Given its semi-arid characteristics, local agriculture is mainly based on sheep farming and cereal production, which occupies a large area estimated to be 180,765 ha. Milk production increased significantly from 66 million litre in 2000 to 248 million litre in 2012 (DSA, 2012).

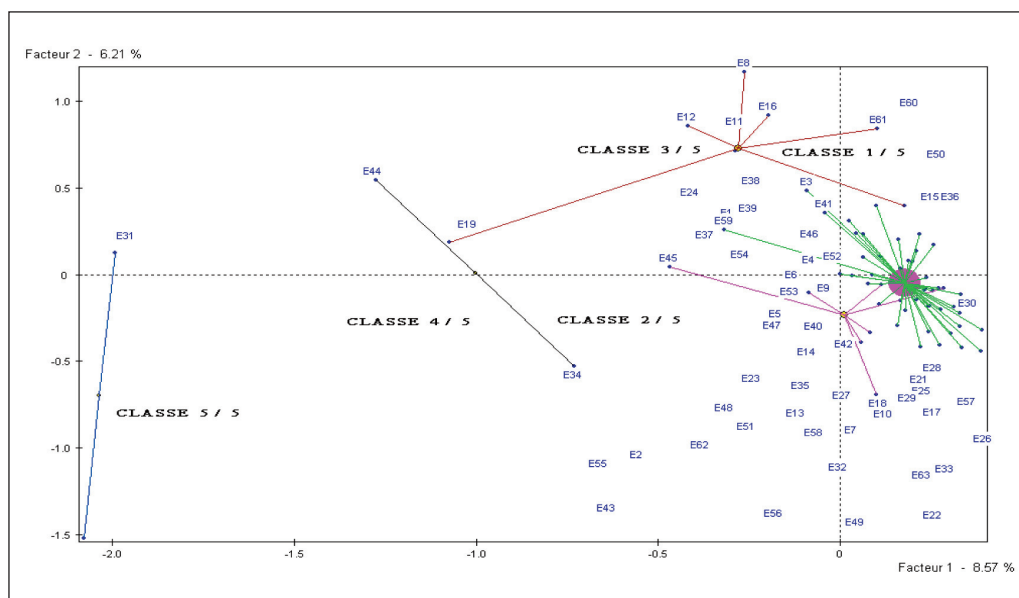
### 2. Methodology

A total of 63 farms were surveyed to document the farm structure, production systems and adaptation strategies of livestock farmers to climate change, and to political and socioeconomic conditions. A detailed questionnaire was developed to collect information and the survey took place in 2013-2014.

These farms were selected from a long list based on the following criteria: *i*) farm size (UAA and livestock number), *ii*) dairy production *iii*) area cultivated with fodder crops. These farms are distributed over the 3 bioclimatic zones (NSZ, CSZ, SSZ).

## III – Results and discussion

The typology established with the factor analysis (Figure 1) revealed that 70% of the sample studied consisted of small farms holding less than 10 head of cattle and less than 10 ha for the land base. This confirms the data of Sétif's Agricultural Services Directorate (80% of farms with less than 10 heads). This observation indicates the weak structure of these farms, which constitutes a risk to their sustainability.



**Fig. 1. Graphic of the groups identified by the MCA.**

The analysis indicated that there are 2 types of feeding systems:

A) The grassland system: is practiced in the CSZ and NSZ farms, especially those located on the banks of the Wadi Boussellem, a zone favorable to milk production. The feeding is based on grassland grazing all year round. Concentrate feeds are distributed throughout the year with variations depending on the season and the physiological stage of the livestock (Madani *et al.*, 2004).

B) The fodder system: is present in the SSZ farms that are poor in grassland resources. Feeding is based on cultivated fodder (irrigated forage, barley), straw, grazing stubbles and fallow land.

Fallow land is strongly integrated into the livestock feeding system, reflecting the low level of integration of forage crops in this region (Abbas and Abdelguerfi, 2005).

The feeding is essentially based on concentrate feeds because of the lack of off farm purchased cereal straw. The low level of integration of forage crops in rotations in the study area is attributed to the evolution of production systems towards cash crops that are deemed to be more water efficient than milk production.

To cope with the changes brought about by the climate as well as the agricultural policies of the government, the farmers of the region adopted adaptation strategies consisting of:

- Allocation of water to fodder used by dairy cows and to vegetable crop production (sources of income).
- Utilization of cereal crops by-products (straw, stubbles) and the adaptive management of cereal crops through their allocation to animals as feeds, in case of drought.
- Fattening of cattle, especially calves born on the farm.
- Exploitation of fallow land which significantly increases the contribution of the crops to the forage system of the farm.

## IV – Conclusions

We can conclude that the emergence of dairy cattle farming in a semi-arid cereal-growing area is a strategy adopted to diversify and improve the income sources of family farms. In addition, this strategy ensures the sustainability of these farms, which are shrinking in size due to fragmentation of land by inheritance. The presence of dairy cattle on the farms of the semi-arid region could have positive consequences because it makes it possible to utilize cereal stubble and straw, ensuring their viability by generating additional income. The sustainability of livestock farming in the semi-arid cereal-growing zone depends primarily on the strategies to be developed by the farmers, in this case the conversion of the cereal cropping-fallow system to the cereal-forage / legume system. This allows the fodder system to be better integrated into both the cropping and the livestock systems.

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