Forage Res., **48**(1) : pp. 69-74 (2022) **http://forageresearch.in**

FEEDING STRATEGIES OF SHEEP HERDS ADOPTED BY TRANSHUMANT AGROPASTORALISTS OF THE ALGERIAN STEPPE IN THE CONTEXT OF CLIMATIC UNCERTAINTY: CASE STUDY OF THE WILAYA OF DJELFA

M. BENIDIR*, B. BELKHEIR[1], F. GHOZLANE[2], A. BOUSBIA[3] AND ET S KALLI[4]

Institut Rational de la Recherche Agronomique d'Algérie, unité de Recherche de sétif, Route des fermes 19000 Sétif
[1]Institut Rational de la Recherche Agronomique d'Algérie, Centre de Recherche de Oued Ghir, 06000 Béjaia
[2]Ecole Nationale Supérieure d'Agronomie d'El Harrach
[3]Université 8 Mai 45 de Guelma, 24000 Guelma
[4]Université de Blida, B.P. 270, route de Soumaa, Blida, Algeria
**(e-mail : moh19ina@yahoo.fr)*

(Received : 18 April 2022 ; Accepted : 01 June 2022)

SUMMARY

The Algerian steppe has undergone many ecological and socio-economic transformations. This situation has led to profound changes in livestock farming practices and pastoral mobility. This study described the strategies adopted by steppe agropastoralists in feeding herds under the changing climate conditions in the Djelfa region. 42 transhumant agro-pastoralists were surveyed in two municipalities of Ain El Bel and El Guedid. The results showed that the feed resources of the livestock are of three types: produced on the farm, free provided by the rangelands and purchased (concentrates). New forms of adaptation to the changing context of the steppe implemented by agropastoralists have been identified. Finally, the study has brought some mechanisms and palliatives to ensure a sustainable development of agropastoralism in the Algerian steppe.

Key words : climate, feed, sheep herds, steppe, transhumant

The Algerian steppe is a vast region that extends over an area of 36 million hectares, including 20 million hectares of rangelands. The breeding of small ruminants, sheep and goats is the main activity carried out by the population of this region. With a population of more than fifteen million sheep, its contribution to the formation of agricultural GDP is around 50% (MADR, 2012).

Steppe livestock farming was characterized by the exploitation of fodder provided by rangelands. In the past, the population was nomadic and semi-nomadic practicing transhumance in search of vegetation on the steppe, Saharan rangelalds and Tell. This was an example of balance between man and his environment. The basis of this balance was mobility. The objective of this mode of exploitation is to avoid staying in the same place for a long time and to evenly distribute the animal pressure in time and space. This gave the rangelalds the opportunity to regenerate from one season to another. This mode of management worked with a tribal organization and customary law recognized and respected by all.

To this end, sheep farming plays a decisive role in the pastoral economy, and is considered the main cause of the degradation of the steppe by the overexploitation of pastures and the narrowing of transhumance corridors. This situation has pushed the pastoral population towards sedentarization and the clearing of the best rangelands (Benidir, 2013). However, sedentarization is not a single form of adaptation (Gaci *et al.,* 2021). To remedy this situation, agropastoralists resort to the practice of complementation and new forms of mobility (Huguenin *et al.,* 2015; Kanoun 2016). Through its food and fodder inputs, transhumance is an important practice for some agropastoralists (Kanoun *et al.,* 2018).

For this, the objective of this modest work is to help shed light on herd feeding strategies in the context of climate change. In addition, this work consists of formulating proposals with a view to ensuring sustainable agro-pastoral development and correcting the current process of ecological degradation of steppe rangelands.

MATERIALS AND METHODS

Presentation of study area

The study focused on the Djelfa region located

in the heart of the Algerian steppe and in the south of Algeria. It is located between 2° and 5° longitude and 33° and 35° latitude. The climate is of the arid to semi-arid type characterized by a cold winter and a dry winter. Precipitation is random varying between 100 to 400 mm. The choice of the region is dictated by its agro-pastoral specificity, a large sheep herd (more than 3.3 million head in 2016) (DSA, 2017).

The area covers 32,362 km2. The rangelands represent 66% of the total area of the wilaya and include land exploited by the generally anarchic grazing activity which degrades the esparto. The plant formations are based on perennial grasses (Alfa, Sparta, Drin) and based on perennial chamaephytes (White Mugwort, Field Mugwort,…..). Sheep farming is the dominant activity practiced by the population and transhumance is a very common practice in the region.

Methodology

The study involved 42 transhumant agropastoralists who were surveyed using a well-structured questionnaire. The respondents are spread over two municipalities. In this case Ain El Bel and El Guedid. The sampling of breeders was done according to the snowball method where a respondent indicates one or more breeders who give us the information sought. The respondents were met either in their place of residence or on the rangelands.

The questionnaire concerned sections relating to the structures of their herds, land ownership, the means held, agricultural practices and feed practices in order to collect information on the strategies of feeding and mobility of the herds to compensate for the lack of feed resources on the rangelands. A typological analysis was carried out in order to identify the different categories of agro-pastoralists. Statistical analysis was performed using SPAD5.5 software.

RESULTS AND DISCUSSION

Typology of agropastoralists surveyed

The principal component analysis performed on the quantitative variables revealed a high variability (82.24% expressed by axes 1 and 2) (Table 1 and Fig. 1).

Indeed, axis 1 explains 53.72% of the total discrimination represented by the variables: UAA (r=0.70), sheep population (r=0.79), cereal farming (r=0.59) and cattle population (r=0.62). It characterizes small-scale agro-pastoralists with a dominance of

TABLE 1
Inertia explained by the two axes after PCA

Number	Eigen value	Percentage	Cumulative percentage
1	2,1487	53,72	53,72
2	1,1410	28,52	82,24

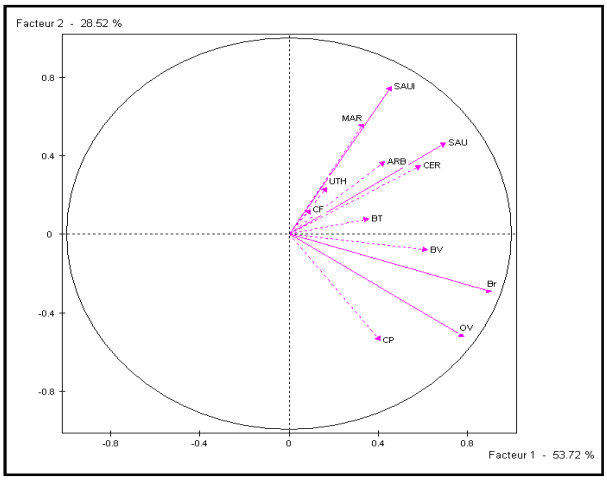

Fig. 1. Projection of the discriminant variables on the PCA plane 1-2.

cereal growing and small ruminant breeding. However, this discrimination is represented by the variables: IUAA (r=0.75), market gardening (r=0.57) and the number of goats (r=-0.54) for axis 2 which explains only 28, 52%.

The typological analysis carried out using PCA made it possible to describe three distinct classes of agropastoralists (Fig. 2).

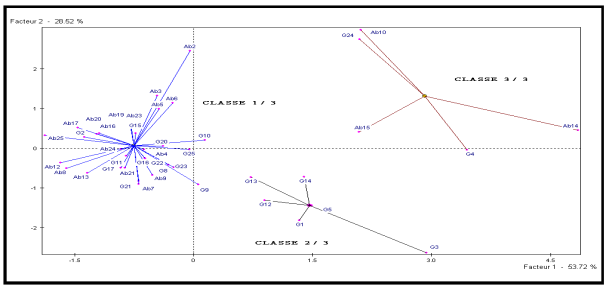

Fig. 2. Graphic representation of the three discriminating classes at the end of the PCA.

- Class 1: Small agro-pastoralists with a combination of cereal crops and small ruminants

It includes 31 agro-pastoralists, i.e. 73% of the sample, it is distinguished by a low UAA estimated at 9 ha, 70% of which is reserved for cereal growing. The other crops are negligible and are used for self-consumption.

The dominant population is sheep with an average of 168 heads followed by goats with 11 heads. However, 4 agropastoralists have a cattle population of 2 cows (Table 2). Agropastoralists in this class rely on family labor (4.4 UTH) in the management of their herds as well as other agricultural tasks.

- Class 2: Agropastoralists with large animal capital and low land capital

There are 6 agro-pastoralists in this class, all from the Elguedid region. They hold an average animal population of 389 heads with a maximum of 640 heads. The number of goats is also high with an average of 63 heads and a maximum of 100 heads (Table 2). On the other hand, the UAA is low with an average of 12 ha devoted to cereal growing which only manages to cover the feed needs of the herds. The use of paid labor for this class is systematic where the shepherds are paid in cash or in animals (Rebga).

- Class 3: Agropastoralists with average animal and land capital

This class includes only 5 agro-pastoralists (1 from the El Guedid region and 4 from the Ain El Bel region). The dominant livestock is sheep with an average of 300 heads with a maximum of 500 heads followed by goats with a low number estimated at 9 heads. Two agro-pastoralists declare having cattle (11 and 7 heads respectively).

The average UAA of this class is around 23 ha, of which 6 ha is irrigated, i.e. 28%. The area sown with cereals is estimated at 16 ha, market gardening and arboriculture occupy average areas of 1.4 and 2.8 ha respectively.

The workforce that provides agricultural activities and livestock management for this class is family and salaried (9UTH) (Table 2).

Operation of farming systems

Sheep breeding, sometimes associated with goats, cattle or horses, is the dominant activity practiced by the transhumant agro-pastoralists surveyed. Agropastoralists are breeders-fatteners where all of the live growth of the year is sold. Two types of fattening are practiced by agro-pastoralists, one is done throughout the year (*Khrouf Labiadh*) and the other is temporary (*Khrouf of El Aid Lakbir*). Female lambs are rarely sold, they are intended to replace cull ewes. The conduct of reproduction is traditional where breeders never separate females from males. This explains the spread of lambing throughout the year. Weaning is conducted by several techniques at one month of age in good years for both lambs and kids to take advantage of the milk for home consumption.

Farmer feeding strategies

The feeding of the herds varies according to the year, the season, the breeding system and the type of breeder (breeder or fattener).

Livestock feed resources come from three main sources:

*Feed produced on the farm (grain barley, green barley, cereal straw): crop residues (stubble) are an additional source for livestock feed. After exploiting their own stubble, transhumant agro-pastoralists carry out summer transhumance to exploit rented stubble. Livestock also receive supplementation based on hay and/or straw, particularly in autumn and winter. All the agro-pastoralists surveyed graze their livestock on green barley during part of the winter period.

*The feed provided by the rangelands: The rangelands constitute a free source of food for the

TABLE 2
Descriptive variables of the typological classes of transhumant agro-pastoralists

Typological classes	No. of agro-pastoralists	UAA (ha)	IUAA (ha)	Cereal	Arboriculture (ha)	Gardening (ha)	Livestock crops (ha)	Labor building	Cattle (heads)	Sheep (heads)	Goats (heads)
Class 1 : Small agro-pastoralists with a combination of cereal crops and small ruminants	31	9,06±6,44	1,84±3,26	6,39±5,68	0,60±1,10	0,35±0,80	0,13±0,34	4,40±2,66	0,16±0,45	168±41,1	11,55±9,59
Class 2 : Agropastoralists with large animal capital and low land capital	6	12±3,35	0,00±0,00	9,00±1,67	0,00±0,00	0,50±0,84	0,67±0,52	7,75±3,67	1,33±1,21	389±160	63,3±33,9
Classe 3 : Agropastoralists	5	23,4±13,89	6,8±6,30	16,8±12,44	2,8±4,21	0,00±0,00	0,8±0,84	9,08±4,08	3,6±5,13	301±149	9,8±8,56
Total with average animal and land capital	42	11,2±8,50	2,17±3,88	8,00±7,12	0,77±1,79	0,33±0,75	0,26±0,50	5,44±3,42	0,74±2,05	215±116	18,7±23,5

livestock and a key element for the orientation of the strategies of the breeders in terms of accumulation or reduction of animal capital. Apart from the spring season, exploitation during the other seasons is partial or non-existent. During the summer season, herders live on the stubble fields of the Tell (Table 3).

TABLEA 3
Duration of exploitation of rangelands

Season	Duration (days)
Autumn	40
Winter	50
Spring	90
Summer	0
Cumul	180

*Purchased feed (bran, concentrated feed): The feed supplement for livestock is based on barley and bran, generally given to lactating ewes. It is practiced only in winter and autumn with a total duration of 70 days (Table 4).

The quantity distributed is different from one breeder to another with an average of about. The feed calendar presents a model followed by each category of breeders surveyed (Table 5). However, it varies depending on the year (dry or rainy). In a dry year, forage availability decreases and supplementation then becomes systematic.

Table 5 shows that rangeland is the main source of livestock feed. Transhumant herders leave the rangeland idle throughout the summer and part of the autumn and winter. Feed supplementation based mainly on barley is carried out after the return of the herds from the rangelands. It should be noted that the use of supplementation is necessary because the productivity of the rangelands is low. Concerning stubble (summer), straw and hay (autumn and winter) are considered to be an additional fodder supply and make it possible to reduce the animal load on the rangelands.

TABLE 4
Duration of herd supplementation

Season	Duration (days)
Autumn	40
Winter	30
Spring	0
Summer	0
Cumul	70

1kg/head.

Adaptation of agropastoralists to climatic hazards

To overcome climatic uncertainties and harsh environmental conditions, transhumant agro-pastoralists rely on different strategies, in this case the mobility of herds.

TABLE 5
Food calendar of transhumant agro-pastoralists.

Feeds	S	O	N	D	J	F	M	A	M	J	J	O
Rangelands												
Stubbles												
Straw/hay												
Green barley												
Supplementation												

Mobility of herds

Agropastoralists use their social networks to gather information on the condition of rangelands in the target area. They also carry out a survey of grazing sites using a scout.

Transhumant agro-pastoralists in the study area travel during the summer (Tell zone) and winter (Saharan and pre-Saharan routes) for up to 5 months to take advantage of free fodder resources in order to reduce fodder purchases. and concentrate feeds and to avoid decapitalizing livestock. Decapitalization is known among sedentary people (Kanoun et al., 2015). Transhumance is motorized using personal or rental means of transport (Benidir, 2015).

Cultivation of rangelands

In the steppe, pastoralism has given way to agropastoralism (Bourbouze, 2010). The agro-pastoralists of the study region resort to the cultivation of rangelands in cereals (barley and wheat) to constitute a grain stock for the livestock. Barley is grazed green (depriming) during part of the winter period. Abbas (2004) considers this practice as a major component in eating behavior. When the climatic year is declared a disaster, the agro-pastoralists graze the cereal grasses. This practice is also common in cereal growing areas (Benniou and Aubri, 2009).

Animal capital (productive power and adaptability)

The ability of livestock systems to adapt to difficult conditions depends not only on the actions and decisions of farmers but on the responses specific to the animals and their productive potential (Blan et al., 2008). All agropastoralists also rely on animal capital (productive power and adaptability). This is why they adopt selection strategies based on the prolificacy of the ewes (two lambings per year and the possibility of obtaining viable twin births). Kanoun et al. (2017) report those breeders in steppe environments rely much more on the resistance of ewes (robust character) and their reproductive potential.

Adjustment of livestock to resources

In addition to their local knowledge, some of them use reproductive biotechnologies (the placement of vaginal sponges). Two paths are adopted: the first targets very early lambings so that the lactation of ewes coincides with the presence of green in the spring, the second exploits the late lambings of certain females to fatten the lambs on fallow land and cereal stubble in order to sell them in religious occasions (Aid Elkebir, Ramadan, Weddings). This practice is reported by Benoit et al. (1997) and Kanoun et al. (2015).

CONCLUSION AND RECOMMANDATIONS

The Algerian steppe zone and the region of Djelfa in particular was once known as the land of nomadism and sheep farming par excellence. Today, it is experiencing profound changes in the way of managing pastoral space, the consequences of which are: the emergence of a new form of transhumance based on motorization, the extension of cultivated areas and the complementation of livestock. We also noted the disappearance of traditional transhumance replaced by random movements of herds and according to fodder opportunities.

The feed management adopted by agro-pastoralists to cope with drought conditions is based on the exploitation of all the resources available in this case: the feed produced (barley, straw and crop residues), the free feed provided by the rangelands and fallow, and purchased feed.

Agropastoralists adopt certain strategies to adapt to situations of uncertainty. The practice of transhumance is one of these strategies. However, this practice alone cannot fill the local fodder deficit due to the degradation of natural resources, the narrowing of transhumance corridors due to anarchic plowing and the illicit appropriation of rangelands.

To remedy this situation and ensure sustainable development of steppe agropastoralism and reduce the effects of global warming, it is necessary to opt for the restoration of degraded steppe rangelands by endemic or introduced resistant pastoral plantations (Opuntia, Atriplix, Artemisia, etc.), to limit cereal growing to lowland areas (Dayate), rustic arboriculture associated with fodder crops and the regulation of transhumance in order to restore the balance between the steppe and the Tell and the Sahara, the conservation of local breeds adapted to the harsh conditions of the region.

ACKNOWLEDGEMENT

We would like to express our thanks with deep gratitude to all the people who have contributed to its realization.

REFERENCES

Abbas, K., 2004 : La jachère pâturée dans les zones céréalières semi-arides : Pour une approche de développement durable. *Options Méditerranéennes*, **62** : 169-173.

Benidir, M. 2015 : Evaluation multicritère de la durabilité des systèmes d'élevage en zone steppique. Cas de la région de Djelfa. Thèse ENSA, 180 p.

Benidir, M., F. Ghozlane, A. Bousbia and B. Belkheir, 2013: The use of a critical analysis of a multicriterion method (IDEA) for assessing the sustainability of sedentary sheep rearing systems in the Algerian steppe areas. *African Journal of Agricultural Research,* **8**: 804-81.

Benniou, R. and C. Aubry, 2009. Place et rôle de l'élevage dans les systèmes de production agricole en régions semi-arides de l'est de l'Algérie. *Fourrages*, **198** : 239-251.

Benoit, M., G. Laignel, G. Lienard, B. Dedieu, and J.M. Chabosseau, 1997 : éléments de réussite économique des élevages ovins extensifs du Montmorillonnais. *INRA, Prod. Anim*., **10** : 349-362.

Blanc, F., F. Bocquier, J. Agabriel, P. D'Hour, and Y. Chilliard, 2008. La composante animale de la flexibilité des systèmes d'élevage. L'élevage en mouvement : Flexibilité et adaptation des exploitations herbivores. Ed, Quæ 2008. pp 73-92.

Bourbouze, A. 2010 : Situation et évolution de l'agropastoralisme au Maghreb. Chapitre 3 In "Agriculture et paysannerie du monde" de B A Wolfer, Ed. Quae, pp. 63-81.

DSA de Djelfa, 2016 : Rapport de la situation agricole de la wilya de Djelfa.Cahiers des statisqtiques agricoles. 49 p.

Gaci, D., J. Huguenin, M. Kanoun, J.P. Boutonnet , and H. Abdelkrim, 2021 : Nouvelles mobilités pastorales : cas des éleveurs d'ovins de la wilaya de Djelfa, Algérie. *Revue d'élevage et de médecine vétérinaire des pays tropicaux*, **74**: 3-11.

Huguenin, J., M. Kanoun, A. Meguellati, L. Julien, and R. Hammouda, 2015: The mobility of livestock is adjusted to mitigate the effects of climate change in the steppes of Djelfa (Algeria). 22 ème Rencontres, recherches, ruminants.3R, Paris, p 86.

Kanoun M., J. Huguenin, H. Yakhlef, A. Meguellati-Kanoun, L. Julien, M. Benidir, S. Taugourdeau, and A. Bellahrache, 2017 : Diversités des stratégies d'adaptation des agropasteurs ovins face aux situations d'incertitude en territoires steppiques : cas de la région d'El-Guedid. *Revue des BioRessources*, **7**: 28-42.

Kanoun, M., 2016 : Adaptation des éleveurs ovins face aux incertitudes générées par de multiples changements d'ordres environnementaux et socioéconomiques dans les territoires steppiques. Cas des agropasteurs de la région d'El -Guedid Djelfa**.** Thèse ENSA, ElHarrach-Algérie, 209 p.

Kanoun, M., J. Huguenin, H. Yakhlef, A. Meguellati-Kanoun, L. Julien, S. Taugourdeau, and A. Bellahrache, 2015 : Pratiques d'alimentation pour l'engraissement des agneaux dans des systèmes d'élevage agropastoraux de la région d'El-Guedid-Djelfa. *Livestock Research for Rural Development,* **27**, Article #211.

MADR, 2012 Statistiques agricoles, effectifs et productions animales. Ministère de l'agriculture et du développement rural. Série C.