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Analysis of forage balances in the Djelfa region from 2001-2015. What is the place of pastoral and cultivated resources?

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Abstract. The degradation of pastoral resources has been accelerated as a result of the severe droughts in the 1970s and 1980s. In addition to that, the new land practices had a major impact resulting in a territorial dynamic recomposition. They have led to a scarcity of the available forage for rangelands by reducing their surface area and their productivity. This study aims to analyze the ability of agropastoralists to adapt to this uncertain context of forage availability and to maintain the level of animals' production. To do this, forage balances were computed during a period from 2001 to 2015 in the Djelfa region. The data studied came from the Department of Agricultural Statistics of the Ministry, the agricultural services of Djelfa and surveys of agropastors. Univariate descriptive statistical analysis showed a diversity of forage resources used to fulfil the nutritional requirements of animals. The share of pastoral supplies from home terroirs and pastures from transhumance contributes to 58% of animal needs. Thus, the pastoral resources remain decisive in the pastoralists' strategy for animal feeding. Nevertheless, the contribution of grown fodder and purchased feed is growing. It accounted for nearly 38%, of which 58% and 42% are concentrated feed purchased (mainly grain) and fodder grown (mainly barley in green), respectively. However, coefficients of variation ranging from 20% to 77% imply that both access to pasture and the contribution of forage resources remain irregular, uncertain and monetarised.

Keywords. Fodder – Balance – Djelfa – Diversity – Agropastoralists – Resources.

Analyse des bilans fourragers de la région de Djelfa de 2001-2015. Quelle place pour les ressources pastorales et cultivées ?

Résumé. La dégradation des ressources pastorales s'est accélérée suite aux fortes sécheresses des années 1970/1980. En plus, les nouvelles pratiques foncières ont eu un impact majeur, entraînant une dynamique de recomposition territoriale. Elles ont conduit à une raréfaction du disponible fourrager des parcours par la diminution de leur surface et de leur productivité. Cette étude vise à analyser la capacité des agropasteurs à s'adapter à ce contexte d'incertitude pour maintenir le niveau de production des animaux. Pour ce faire, nous avons analysé les bilans fourragers durant une période allant de 2001 à 2015 dans la région de Djelfa. Les données étudiées provenaient du département des statistiques agricoles du Ministère, des services agricoles de Djelfa et d'enquêtes auprès des agropasteurs. Les analyses statistiques multidimensionnelles ont montré une diversité des ressources fourragères pour assurer les besoins nutritionnels des animaux. Les parcours des terroirs d'attache et les pâtures de transhumance contribuent à hauteur de 58 % aux besoins totaux des animaux. Ainsi, les ressources pastorales restent déterminantes dans la stratégie des éleveurs pour l'alimentation animale. Il s'avère néanmoins que la contribution des aliments cultivés et achetés est en augmentation. Elle représente près de 38 %, dont 58 % et 42 % sont respectivement des aliments concentrés achetés (surtout orge) et des fourrages cultivés (principalement de l'orge en vert). Cependant, les coefficients de variation allant de 20 % à 77 % impliquent que l'accès aux pâturages et la contribution des ressources fourragères restent irréguliers, incertains et monétarisés.

Mots-clés. Bilan – Fourrage – Djelfa – Diversités – Agropasteurs – Ressources.

I – Introduction

In Algeria, livestock production remains a sector of considerable political, social and economic importance. Indeed, this sector represents nearly 51% of the Gross Domestic Product of Agriculture (GDP). The breeding of small ruminants, especially sheep, accounts for more than 50% of this GDP and is mainly concentrated in the steppe territories where many changes have been recorded: reduction in the surface area of rangelands, development of irrigated agriculture and high urbanization of rangelands. This has led to a context of high uncertainty which is increasing and accelerating the transformation of sheep production systems into steppe areas into agropastoralism and even more intensive forms of agriculture and livestock farming. Pastoralists / agropastoralists, regardless of their capacities, resources and capital production (assets), cannot escape the various factors of disruption (Hadeid *et al.*, 2015; Kanoun, 2016; Hammouda *et al.*, 2019). These developments, already reported in the 1970s, are now being accelerated and amplified. In addition to that, the different specialists in the natural, social and agricultural sciences confirm a regressive dynamics of the coverage vegetation and therefore the decrease of natural and pastoral feed resources for small ruminants (Nedjraoui, 2004; Aidoud *et al.*, 2011; Bencherif, 2011; Ait-Alhayane, 2016). However, statistical data indicates that the sheep population not only remains stable but also shows a significant increase: estimated at 10 million heads in 1975-1977, it increased to over 27 million in 2018. Thus, steppe sheep farming is at the heart of a striking paradoxical evolution.

The ambition of this study is to qualify the different forage resources used (nature, origin and contribution) to feed the steppe sheep herds in the Djelfa region. For this purpose, we exploited and interpreted data from state institutions (Djelfa Agricultural Services, Department of Agricultural Statistics of the Ministry and High Commissioner for Steppe Development) and individual interviews with sheep farmers (sedentary, semi-transhumant and transhumant). Therefore, we were able to work on the hypothesis that animal feed comes largely from grazing spontaneous forage resources, despite an increase in cultivated feed.

II – Material and method

The choice of the region of *Djelfa*-Algeria was mainly dictated by the nature of our theme, which includes a study area where the population is still attached to livestock activities, particularly sheep, and is highly dependent on them. Indeed, the *Djelfa* region has more than 3.5 million heads (14% of the national livestock population) and is the leading region in the country. Converted into LU, its livestock is essentially composed of sheep, representing 72% of the total number of livestock.

To analyze the dynamics of forage resource use, we put emphasis both on institutional databases and on livestock farm surveys. So, the first step of our work is based on statistics from the various institutions responsible for collecting data on agricultural and ecological activities, particularly those that allow us to analyze the evolution in the nature and the contribution of feed resources used (natural range areas, cultivated fodder, subsidized food, forage resource yields, animal requirements). Using the work of INRA (1988), conversion coefficients were selected and assigned to each forage resource expressing its nutritional value in forage units (FU). In addition, to calculate the nutritional needs of the livestock, we used the "livestock unit" (LU) in order to account for the different species and animal categories studied (sheep, goats, cattle, horses, camels, donkeys). The values used are those of Moskal (1983). Fodder production (spontaneous and cultivated), was estimated on the basis of the yield evaluation using the quadrature-point method carried out by the "evaluation unit of the Djelfa Agricultural Directorate" and the "High Commission for the Development of the Steppe" (DSA, 2018 and HCDS, 2010). The second step consisted of single-run surveys of sheep farmers (30 agro-pastoralists) based on a semi-directive questionnaire focusing on the following aspects: nature, origin, contribution of forage resources and level of feed self-sufficiency. The data obtained were subjected to statistical descriptive univariate analyses.

Our approach is based on systemic and constructive approaches. Indeed, these approaches, which make it possible to integrate factors of different origins, are recognized as essential to account for the relationships between livestock production methods and their natural and socio-economic environment (Gibon, 2005; Lambin, 2005).

III – Results and discussion

1. Contribution of natural forage resources: uncertainty and irregularity

The fodder intake balances (in forage units: FU), established in the Djelfa region during the period 2001-2015, show that the contribution of the various local fodder resources is low and covers on average $45\% \pm 14$ of the livestock's feed requirements (Table 1). The coefficient of variation of 31% shows that the contribution is irregular. In addition to the impact of climate change hazards, this irregularity is mainly due to poor governance of land tenure systems applicable to steppe rangelands, which has led to severe degradation of pastoral resources (Kanoun, 2016; Hammouda *et al.*, 2019). Indeed, decentralization has strengthened the capacities and powers of some local actors to extend their control (land grabbing) over their agricultural and livestock practices, which is incompatible with the preservation of natural resources (Bessaoud, 2006, Bencherif, 2011 and Kanoun *et al.*, 2013). On average, the local rangelands account for $22\% \pm 9$ of total feed resources. The coefficient of variation of 42% indicates the level of uncertainty of this contribution. Rangeland rehabilitation programmes do not seem to yield results in terms of contribution of this forage resource to herbivores' intake. Indeed, the contribution of the restored rangelands (Atriplex-based pastoral plantations and enclosed grazing areas) is below the desired potential. This forage source covers only 1% to 5% of the total requirements of the animals. In addition to the deterioration of climatic conditions, the management practices implemented and the lack of interest of livestock farmers for environmental issues are the determining factors explaining the low pastoral productivity and the development of plant species that are less appreciated by the animal (Guesmi, 2016). The study carried out by the HCDS (2010) indicates a very high level of grazing land degradation, particularly in the western and central steppe. Even with the contribution of transhumance, grazing cannot meet the total needs of the livestock. Such contribution varies between 25% and 55%. However, its coefficient of variation of 20% suggests a more stable contribution than other feed resources. The strengthening of physical capital (development of motorization) explains this ability of herders to improve their self-sufficiency through transhumance (Kanoun, 2016). The results of the survey with transhumant herders showed that the amplitude of transhumance and the number of farmers resorting to new pastoral areas have increased significantly over the past two decades. Finally, grazed resources remain a determining factor in livestock farmers' feeding strategies, covering on average 58% of animal requirements.

Table 1. Contribution of the various forage resources to the feed requirements of livestock (%)

Types of contribution	Minimum	Maximum	Average	SDn	CV
Transhumance ¹	25	55	34	6	20
Local rangeland	13	45	22	9	42
Local fodder contribution ²	28	82	45	14	31

¹Estimated transhumance inputs: transhumant livestock*20UF/month*duration of mobility (5 months/year).

²Local fodder contribution: cultivated and spontaneous resources + transhumance contribution + subsidized food.

2. Place of cultivated resources: still insufficient to reduce the deficit

Table 2 illustrates the diversity of cultivated resources and the uncertain contribution of cultivated forage production to compensate for the inadequacy of spontaneous pasture. All the coefficients of variation of the different forage crops are very high, i.e. the production of these resources is subject to a multitude of uncertainties, particularly social, economic and natural. These indicators reflect the irregularity of the cultivated forage supply in recent years. Moreover, the contribution of this food category is around 16% on average and varies between 3% and 32%. This contribution is mainly ensured by the production of irrigated green barley (with sprinkling and raw spreading), which represents nearly 60% of the total production of cultivated fodder. Alfalfa production has the highest coefficient of variation, both in terms of production (122%) and in terms of surface area (161%). In recent years, the region has seen a significant increase in the area under Alfalfa cultivation. This growing interest in this animal feed source is mainly due to the development of groundwater resource mobilization for agricultural irrigation. The results of our survey among agropastoralists showed that nearly 42% of the breeders have drilled deep wells. On the other hand, the analysis also reveals that the area cultivated with Alfalfa varies between 0.5 hectares and 3 hectares for 45% of the breeders surveyed. At a local level, this forage crop has shown rapid adaptation and recovery after first cut (Chaabena *et al.*, 2004). According to these authors, the number of cuts/year varies from 6 to 8. In addition to that, it is exploited in green or hay form for most of the year (March to November). The incentives in our study area encourage the adoption of alfalfa (*Medicago sativa*) by local livestock population. On the other hand, to ensure the sustainable development of livestock farming activities, water resources need to be regulated and it is better to choose Alfalfa cultivars that do not require significant irrigation. Another characteristic of steppe sheep farming is the frequent membership of breeders in a professional organization, in particular the Chamber of Agriculture of Djelfa. This membership allows them to benefit from concentrated feed, in the form of granular barley. However, the results showed that the contribution of this subsidized distribution is low: 5% of total feed.

Table 2. Cultivated feed production (in M FU) in the Djelfa region

Type of resources	Minimum	Maximum	Average	SD	CV	Share in forage production
Green alfalfa	0	2.8	0.9	1.1	122%	0.6%
Oats grain	0	0.6	0.1	0.2	113%	0.1%
Disaster-affected cereals	0	3.5	0.9	1	104%	0.6%
Straw	0.6	23	8.8	8.4	95%	5.9%
Subsidized barley	0	85	41.6	34.7	83%	
Stubble	1.2	21.1	8.9	6.8	76%	5.9%
Green Sorghum	0.1	0.5	0.2	0.1	65%	2.2%
Oat hay	0	7.5	3.8	2.4	64%	2.5%
Barley grain	2.1	65.3	33.4	21.1	63%	22.3%
Green barley irrigated spraying	7.5	85	38.7	23.8	61%	25.9%
Green barley irrigated spreading	12	120	50.6	29.3	58%	33.8%

3. Difficulty to reach feed self-sufficiency

Our analysis identifies forage surpluses only for the years 2009 and 2010. This production context is explained by seasonal climatic conditions strongly favorable to the production of pastoral and spontaneous resources (Kanoun *et al.*, 2015). On average, over the period studied, the forage deficit was estimated to 20% and ranged from 21% to 41% (Fig. 1). The analysis of the information collected from livestock breeders confirms the irregularity of the availability of food resources. Indeed, 95% of livestock farmers testify as to their inability to achieve feed self-sufficiency with spontaneous and cultivated resources.

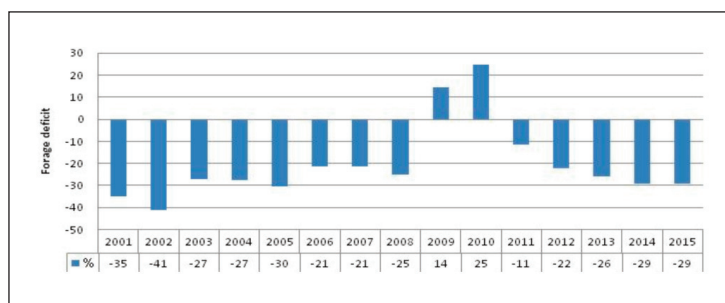


Fig. 1. Evolution of the fodder deficit in the Djelfa region.

Moreover, the coefficients of variation of the various contributions, which vary between 20% and 77%, imply that these feed resources remain uncertain. However, the absence of feed self-sufficiency, causing an increase in purchased does not seem to handicap increases in animal numbers and, consequently, a further increase in their total feed requirements (Fig. 2).

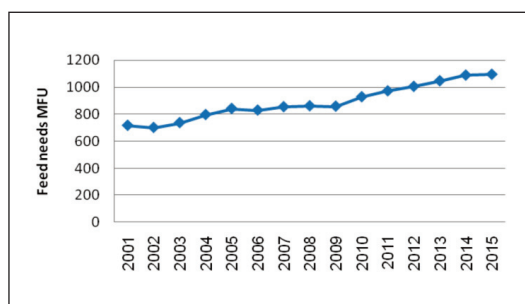


Fig. 2. Evolution of food needs of Djelfa animals.

VI – Conclusion

The challenge for livestock farmers in the Algerian steppe is the sustainability of their livestock, which must evolve in highly changing contexts characterized by increasing climatic, agronomic and socio-territorial hazards. This study showed that livestock farmers have adapted to adversity by adopting strategies based on the diversification of forage resources to increase their feed self-sufficiency. However, these strategies involve risks associated with the lack of good governance of rangeland and cropland. Finally, from a methodological point of view, the work carried out in this study leads us to continue our thinking about indicators that would allow us to better quantify or evaluate, feed availability according to seasons, livestock producers' means, livestock systems, etc.

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