Farm and land system dynamics in the Mediterranean basin: Integrating spatial scales, from the local to the global one

Title of article:

"*Ecological monitoring and adaptation of livestock systems after rehabilitation of degraded rangelands in Algerian steppe*"

Authors:

Bouchareb B[1,3], Huguenin J[2], Nedjraoui D[3], Hammouda R[3], Kanoun M[4], Julien L[2] , Capron J.M[2]

1. Ecole Nationale Supérieure Agronomique EL Harrach 16200 Algiers Algeria.
2. UMR SELMET CIRAD, Montpellier, 34 000 France.
3. University USTHB Bab Ezzouar Algiers Algeria.
4. Institut Nationale de Recherche Agronomique, Algiers 16200 Algeria. **Contacts :** b.bouchareb@ensa.dz / johann.huguenin@cirad.fr

Abstract:

The Algerian steppe covers 20 million ha. It is a bulwark between the desert and the coast of Mediterranean. The livestock of the area is about 20 million head sheep. This ecosystem has undergone many disturbances: desertification, overexploitation of rangelands, fragile soils, degradation of the vegetation, the use of rangelands for growing crops, and weather extreme situations are more frequent. Considering these constraints, the breeders try renewal and increase their livestock and for produce also some crops.

The breeders try strategies to adapt to change and uncertain disturbances, like climate, resources, and public policies with their operations. For example, some authorities are trying to provide solutions for a population living almost entirely from the livestock. Some restorative solutions in degraded rangelands have been tested with the breeders.

These experiments of rangeland have been followed (studies ecology) for six years (floristic annual change and weight). The rest of the study focuses on the adaptations of livestock systems in a changing agrarian sector.

We specify that this holistic study (underway) related to the dynamics of the livestock systems is divided into two parts: the first treats the dynamics of vegetation in relation with rehabilitation of rangelands, so that the monitoring was performed by choosing 14 experimental plots with permanent transect lines in order to determine annual floristic evolution and biomass productivity in selected plots ; The second part aims to give an overview of the obvious adaptations of livestock systems Considering all constraints of steppic livestock systems.

The aim of this poster is to present some results related to environmental monitoring with an approach holistic and systemic for provide knowledges relating to the current complex phenomena of mutations of livestock systems in Algerian steppe.

References:

Bouchareb B., (2012). Suivi des actions de lutte contre la désertification: étude expérimentale dans la commune de Hadj Mechri. (W. Laghouat). Thèse de magister U. S. T. H. B, Alger, 120P. [URL 20161006]http://repository.usthb.dz/xmlui/handle/123456789/2206

Jemaa T., Huguenin J., Moulin C.-H., Najer T., 2016. Les systèmes d'élevage de petits ruminants en Tunisie Centrale : stratégies différenciées et adaptations aux transformations du territoire. Cah. Agric. Vol. 25, N°4, 9 p. [URL20161006] http://www.cahiersagricultures.fr/articles/cagri/pdf/2016/04/cagri160018.pdf

Kanoun M., (2016).Adaptation des éleveurs ovins face aux multiples changements d'ordre environnementaux et socioéconomiques dans les territoires steppiques. Cas des agropasteurs de la région d'El-Guedid ; Wilaya de Djelfa. Thèse doctorat. E. N. S. A, El Harrach, Alger, 207p. URL [20161006] http://epe.cirad.fr/fr2/doc/these_kanoun.pdf

Key words: steppe, livestock systems, holistic study, ecological monitoring.

Ecological monitoring and adaptation of livestock systems after rehabilitation of degraded rangelands in algerian steppe

Authors : B Bouchareb, J Huguenin, D Nedjraoui, R F Hammouda, M Kanoun, L Julien, JM Capron
Key words : steppe, Renagelands, ecological monitoring, livestock systems.

Introduction :

The Algerian steppe covers 20 million ha. It is a bulwark between the desert and the coast of Mediterranean. This pastoral territory account about 20 million head sheep. This ecosystem has undergone many disturbances: desertification, overexploitation of rangelands, fragile soils, degradation of the vegetation, Change functions rangeland crops, and extreme weather conditions.

Trials of the rehabilitation of these ecosystems by restorative solutions were undertaken in a participatory process (conducted by a multidisciplinary team) with farmers-breeders complemented by detailed monitoring of the experimental plots. This study reports on some results of the ecological monitoring and aims in the future to give an overview of the obvious adaptations of steppic livestock systems Considering its constraints.

Methodology :

The study was conducted at Hadj Mechri town (33°51' to 34°07' N, 1°20' to 1°44' E). This arid rangeland receives on average rainfall of 350 mm/year, and has an average altitude of 1250 m. Vegetation was studied before, during, and after restoration, and is represented by mixed steppes landscape of *Stipa tenacissima* (facies 1), *Lygeum spartum* (faciese 2), *Stipagrostis pungens* (facies 3).

The monitoring was performed by choosing 14 experimental plots with permanent transect lines. "Point quadrat method" (Daget and Poissonet, 1971) was used to determine annual floristic inventory (species richness and Shannon index), while biomass productivity was estimated by the indirect method of Daget and Godron (1995), and direct cuts (32 m2 per plot), before and after restoration. Pastoral production was expressed as feed units (FU); *i.e.* the energy value provided by 1 kg of barley (averages quality) containing 86 % of dry matter, when ingested, produces 1.65 Kcal of energy (Meyer C 2013).

Among these 14 plots, 7 were very degraded and were treated by planting a mixture of *Atriplex halimus, Atriplex nummularia, Atriplex canescens*, and *Medicago arborea*. Three plots, characteristics of each grassland type (or facies), were selected as untreated controls, whereas the 4 others were treated as exclosures with no grazing. After signing an agreement with 3 farmers to place exclosures on their land and the introduction of forage plants. These experiments of rangeland have been followed (studies ecology) for six years (floristic annual change and weight). The rest of the study focuses on the adaptations of livestock systems in a changing agrarian sector.

The study of breeders strategies relating to livestock systems menagement were done using questionnaire Surveys, results will be explored in futur research.

Results and Discussion

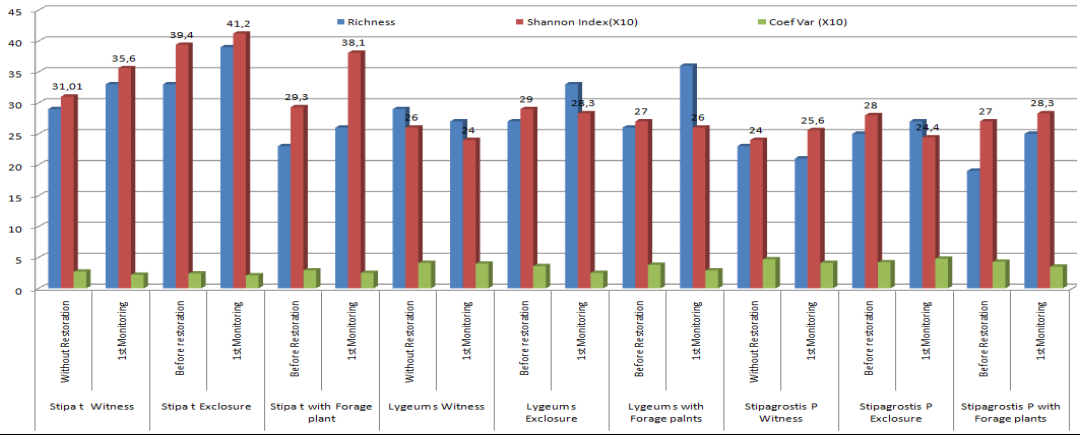


Figure 1 : some values of Richness , Shannon index and variation in different facies with different restorations

The number of species is high in the *Stipa tenacissima* facies, and low in the *Stipagrostis pungens* facies (Figure 1). Exclosure improved species richness in all facies when compared to control, demonstrating that exclosure remains a simple solution for rangeland development.

Shannon index was highest in the *Stipa tenacissima* facies (Figure 1). It was highest in the exclosure plots for *Stipa tenacissima and Lygeum spartum facies*, reflecting the impact of exclosure on potential to improved grassland condition. Since the coefficient of variation of Shannon index indicates the level of stability of each facies compared to the richness, the *Stipa tenacissima* facies were the most stable.

Despite plantations and exclosure rangelands in Stipagrostis pungens facies, ranglands remain in degradation and restoration did not give improvement of specific richness in this facies

Grassland Production

Production estimated by the indirect method based on the floristic survey, and direct cuts of phytomass, showed an increase in dry matter due to forage planting and exclosure overcompared to the control. Steppes dominated by *Stipa tenacissima* show the best production in the exclosure plots, whereas *Lygeum spartum* and *Stipagrostis pungens* facies produced more feed units when oversown with forage plants. The species responses to various rehabilitations are important for select the best ways of restoration (Figure2).

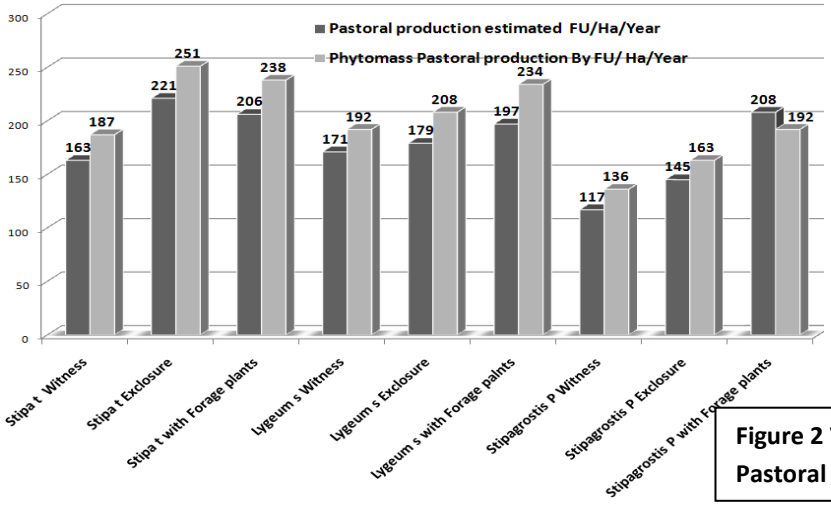


Figure 2 Values of Phytomass and Pastoral production in 3 facies

Conclusion

The management of degraded steppe requires a broad knowledge of existing potentialities and perceptions of changes related to remedial actions chosen.

The protected zones administrated by pastoralists gave excellent regeneration showing that exclosure was as effective as oversowing in increasing biodiversity and provisions of livestock feed resources.

Restoration of original faices (*Stipa and Lygeum*) was effective in increasing biodiversity and provisions of livestock feed resources unlike facies of *Stpagrostis* which shows only weak primary productivity improvement, due to pastoral plants.

Since the results in this study reflect change over only ecological monitoring, other kind of knowledges are needed to understand the functioning of local livestock systems and detect which strategy is most applicable to rehabilitate the degaded rangelands of the algerian steppe

References

Bouchareb B., (2012). Suivi des actions de lutte contre la désertification : étude expérimentale dans la commune de Hadj Mechri. (W. Laghouat). Thèse de magister U. S. T. H. B, Alger, 120P.

Daget Ph and Godron M (1995) Valeur alimentaire de la végétation. In Pastoralisme, troupeau, espaces et société. Hatier ed. Paris, pp. 241-246.

Jemaa T., Huguenin J., Moulin C.-H., Najer T., 2016. Les systèmes d'élevage de petits ruminants en Tunisie Centrale : stratégies différenciées et adaptations aux transformations du territoire. Cah. Agric. Vol. 25, N°4, 9 p.

Kanoun M., (2016). Adaptation des éleveurs ovins face aux multiples changements d'ordre environnementaux et socioéconomiques dans les territoires steppiques. Cas des agropasteurs de la région d'El-Guedid ; Wilaya de Djelfa. Thèse doctorat. E. N. S. A, El Harrach, Alger, 207p.

Meyer C (Ed.) (2013)- Dictionnaire des Sciences Animales.[On line].Montpellier, France, Cirad. [05/06/2013]. <URL : http://dico-sciences-animales.cirad.fr

Ecological monitoring and adaptation of livestock systems after rehabilitation of degraded rangelands in algerian steppe.

Authors : Bouchareb B[1,3], Huguenin J[2], Nedjraoui D[3], Hammouda R.F[3], Kanoun M[4], Julien L[2], Capron JM[2] .

1. Ecole Nationale Supérieure Agronomique EL Harrach 16200 Algiers Algeria.

2. UMR SELMET CIRAD, Montpellier, 34 000 France.

3. University USTHB Bab Ezzouar Algiers Algeria.

4. Institut Nationale de Recherche Agronomique, ALgiers 16200 Algeria.

Contacts : b.bouchareb@ensa.dz / johann.huguenin@cirad.fr

Introduction

The Algerian steppe covers 20 million ha, this pastoral territory account about 20 million head sheep. This ecosystem has undergone many disturbances: desertification, overexploitation of rangelands, fragile soils, degradation of the vegetation, Change functions rangeland crops, and extreme weather conditions.

Trials of the rehabilitation of these ecosystems by restorative solutions were undertaken in a participatory process conducted by a multidisciplinary team with farmers-breeders complemented by detailed monitoring of the experimental plots. This study reports on some results of the ecological monitoring .

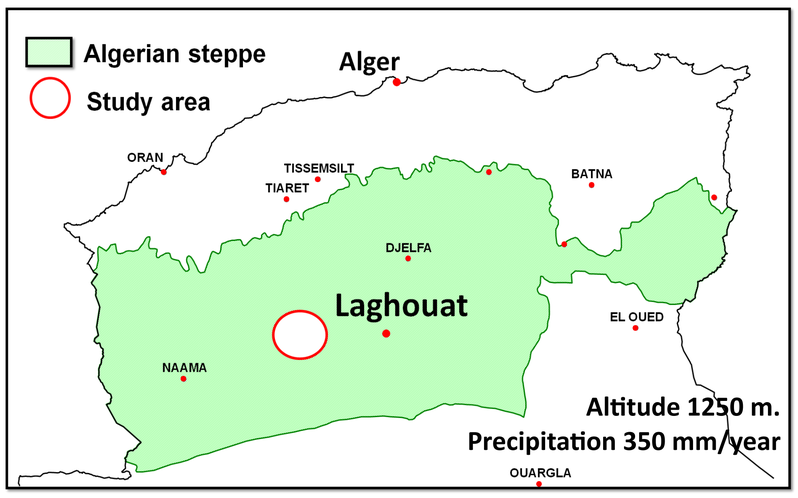
Methodology

The study was conducted at Haj Mechri town, vegetation was studied before, during, and after restoration, it is represented by mixed steppes landscape of *Stipa tenacissima* (facies 1), *Lygeum spartum* (facies2), *Stipagrostis pungens* (facies3). This ecological monitoring is based on qualitative and quantitative study of the vegetation.

- ***14 Experimental Plots*** were chosen : **7 Planted** with *Atriplex (halimus, canescens, nummularia)* and *Medicago arborea*, ***4*** **Exclosure** plots and **3 Intreated** Control plots.

- ***Qualitative Study*** **:** Permanent transect lines. "Point quadrat method" (Daget and Godron, 1995) : Shannon index, Specific Richness, Coefficient of Variation of Shannon Index.

- ***Quantitative Study*** Biomass productivity with Direct cuts (32 m2 per plot, Meyer, 2013) and indirect methods using floristic survey.



Results and Discussion

The specific Richness is high in the *Stipa tenacissima* facies, and low in the *Stipagrostis pungens* facies (Figure 1). Exclosure improved species richness in all facies when compared to control, demonstrating that exclosure remains a simple solution for rangeland development.

Shannon index is highest in the *Stipa tenacissima* facies (Figure 1). It was highest in the exclosure plots for *Stipa tenacissima and Lygeum spartum facies*, reflecting the impact of exclosure on potential to improved grassland condition. Since the coefficient of variation of Shannon index indicates the level of stability of each facies compared to the richness, the *Stipa tenacissima* facies were the most stable even after rehabilitation.

Despite plantations and exclosure rangelands in *Stipagrostis pungens* facies, ranglands remain in degradation and restoration did not give improvement as redards the specific richness in this facies.

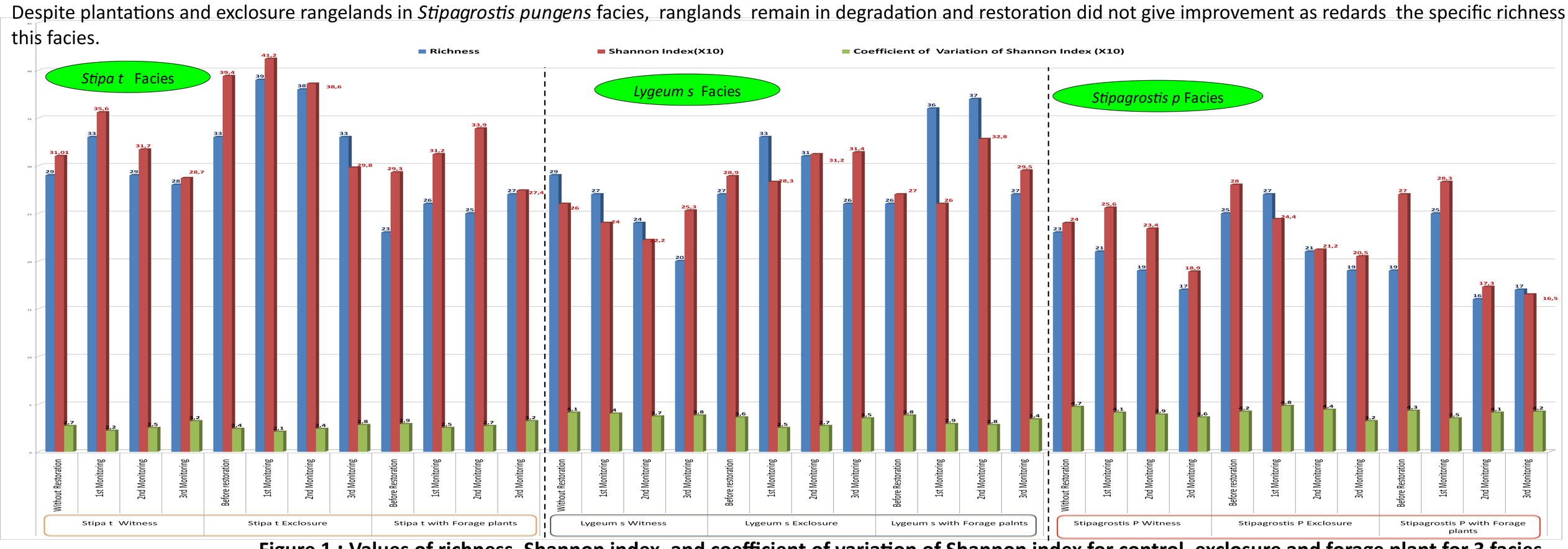


Figure 1 : Values of richness, Shannon index, and coefficient of variation of Shannon index for control, exclosure and forage plant for 3 facies.

Grassland Production

- Increasing in dry matter due to forage planting and exclosure overcompared to the control (Figure2).
- Steppes dominated by *Stipa tenacissima* show the best production in the exclosure plots, whereas *Lygeum spartum* and *Stipagrostis pungens* facies produced more feed units when oversown with forage plants.
- The species responses to various rehabilitations are important for select the best ways of restoration.

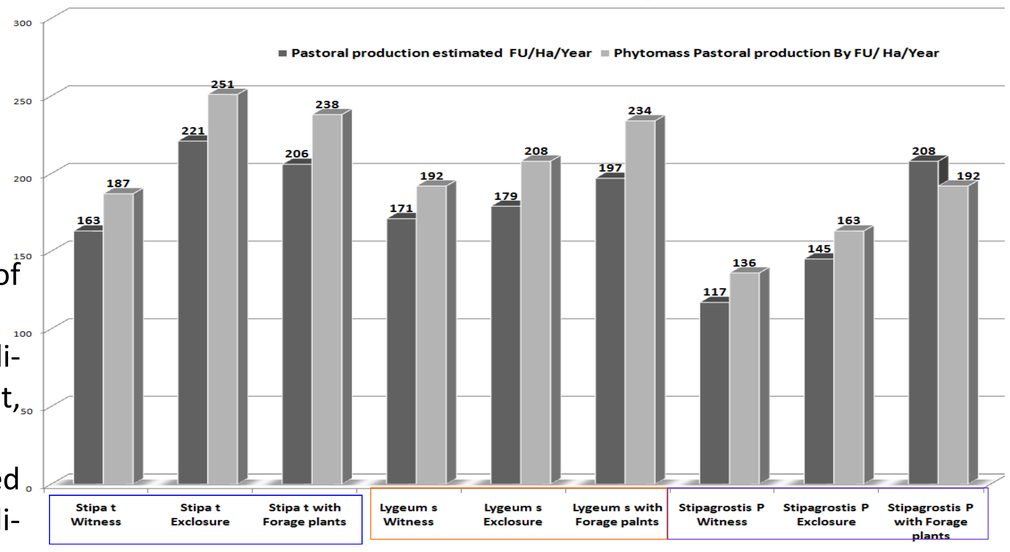


Figure 2 : Values of pastoral production and phytomass pastoral production for 3 facies

Conclusion

The management of degraded steppe requires a broad knowledge of existing potentialities and perceptions of changes related to remedial actions chosen.

Restoration of original faices (*Stipa and Lygeum*) was effective in increasing biodiversity and provisions of livestock feed resources unlike facies of *Stpagrostis* which shows only weak primary productivity improvement, due to pastoral plants

Since the results in this study reflect change over only ecological monitoring, other kind of knowledges are needed to understand the functioning of local livestock systems and detect which strategy is most applicable to rehabilitate the degaded rangelands of the algerian steppe.

References

Bouchareb B., (2012). Suivi des actions de lutte contre la désertification : étude expérimentale dans la commune de Hadj Mechri. (W. Laghouat). Thèse de magister U. S. T. H. B, Alger, 120P. http://repository.usthb.dz/xmlui/handle/123456789/2206

Jemaa T., Huguenin J., Moulin C.-H., Najer T., 2016. Les systèmes d'élevage de petits ruminants en Tunisie Centrale : stratégies différenciées et adaptations aux transformations du territoire. Cah. Agric. Vol. 25, N°4, 9 p. [URL] http://www.cahiersagricultures.fr/articles/cagri/pdf/2016/04/cagri160018.pdf

Kanoun M., (2016). Adaptation des éleveurs ovins face aux multiples changements d'ordre environnementaux et socioéconomiques dans les territoires steppiques. Cas des agropasteurs de la région d'El-Guedid ; Wilaya de Djelfa. Thèse doctorat. E. N. S. A, El Harrach, Alger, 207p. URL [20161006] http://epe.cirad.fr/fr2/doc/these_kanoun.pdf