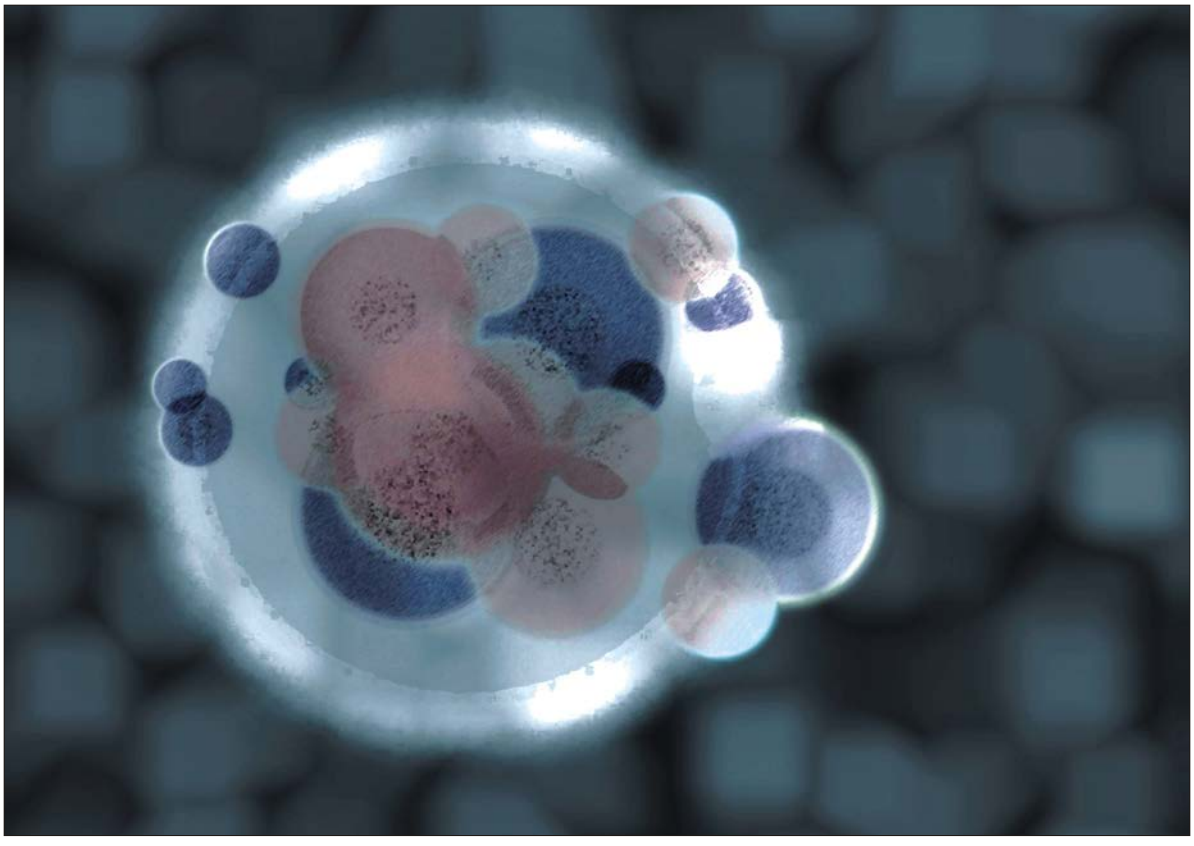

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# Communal Rangeland Rest in Arid Area, a Tool for Facing Animal Feed Costs and Drought Mitigation: The Case of Chenini Community, Southern Tunisia

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**Abstract:** The study was carried out at the communal rangeland in the community of Chenini, Southern Tunisia aiming at assessing the effect of the rest technique on plant cover dynamics and productivity. In both protected and grazed (control) rangelands, total plant cover, species richness as well as biomass production and range value were determined. The results showed considerable and positive effects of protection on the parameters scored. The short term protection (2 years only) permitted an increase of the rangeland production of about 352000 forage units, an equivalent of 352 tones barley. In addition to the conservation of biodiversity and natural resources, the communal rangeland rest may be considered as an interesting technical option and tool to face the increase of animal feeding resources costs and to mitigate drought in Southern Tunisia.

**Key words:** Communal rangelands, plant cover, production, rest technique, Southern Tunisia

## INTRODUCTION

Disappeared from other areas of Tunisia, natural rangelands, mainly those communal, are still the dominant land use in the southern part of the country (under arid and desert climate). These rangelands suffer since some decades from severe degradation due the deep socioeconomic changes as expressed by the appearance of the agropastoral society instead of the former pastoral one. Traditional grazing systems (transhumance and nomadism) which had historically allowed for grazing deferment and control of grazing livestock were abandoned (Le Floc'h *et al*., 1999). Almost all rangelands in presaharan Tunisia (mean annual rainfall 100-200 mm) are now grazed continuously without any restriction on stocking rate. Such changes have led to deterioration in rangeland condition. The degradation of soils and the loss of perennial palatable species, mainly grasses, are two of the direct results of recent aggravations from anthropic pressure on arid rangelands of Tunisia (Ouled Belgacem *et al*., 2006a, b; Tarhouni *et al*., 2007a). Overgrazing is the main anthropic factor leading to the deterioration of the perennial plant cover. Its negative effect is excessive removal of the living parts of the high range value species, which may lead to their extinction. This factor is being more harmful when coupled with the climatic aridity effect. In southern Tunisia, drought has become more frequent (Ben Salem *et al*., 2007). Such drought is being different from the cyclic phenomena that the zone had known and could result from a global climatic warming. It has disturbed the normal functioning of the ecosystems and more worsened by human activities. Studies on the quantification of the drought effect on plant cover dynamics are rare (DePauw, 2002).

Within the frameworks of the Mashreq-Maghreb III project (Developing Sustainable Livelihoods of Agro-Pastoral Communities of West Asia and North Africa) and the PRODESUD project (Agropastoral Development and Promotion of Local Initiatives in Southern Tunisia) which is funded by the International Fund for Agricultural Development (IFAD), a Community Development Plan (CDP) of the agropastoral community of Chenini was established through the participative approach. Among the main achievements of this CDP, a community based organization, called Agricultural Development Grouping, was constituted for the management of communal resources and for the first time, the local population suggested the short term protection of the communal rangeland.

The present study is carried out in the collective rangeland of Chenini community, aiming at assessing the impact of rangeland resting on plant cover dynamics and productivity and testing some ecological indicators about drought management and livelihood improvement.

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## MATERIALS AND METHODS

**Study area:** The study was conducted in March 2007 at the Chenini community. The study area is located in the Governorate of Tataouine (Southern Tunisia) and is characterized by an arid Mediterranean bioclimate with a moderate winter. Rainfall is low and sporadic; the mean annual is estimated to be around 100 mm. Temperatures are generally cold in winter and hot in summer with a mean annual of about 20.1°C. The water balance is greatly affected by the low dense soil cover and exposition to winds. Potential evapo-transpiration is estimated around 1699 mm year$^{-1}$ in average (Tataouine meteorological station, 1949-2000 period). Rangelands are dominant the land use and cover about 40,000 ha (53% of the Chenini community area). Most of them (24,000 ha) are communal and subjected to continuous heavy grazing.

As suggested by the community in the framework of the realisation of the CDP, the IFAD project (PRODESUD) put in rest the communal rangeland of Guelb El Fguira which covers 4000 ha for a period going from 2 to 3 years depending on the state of improvement of its productivity.

The experiment was conducted in spring (month of March) 2007, the second year protection, both inside the protected area (P) and in its surrounding area (G) which is subjected to continuous extensive grazing. Plant cover, annual and perennial species covers, species richness as well as rangeland production were the main assessed indicators. The rainfall quantity was very low during the first year (34 mm) and reached 68 mm in the second year.

**Measurements and data analysis:** The following observations and measures were carried out:

- In each area (P or G) and due to the diversity of plant communities (4 different rangeland types), 20 m long transects were set up in order to measure Total Plant Cover (TPC) and annual and perennial species cover using the quadrat point method (Jauffret and Visser, 2003). Observations were done every 20 cm, a total of 100 points in each transect. The total plant cover is determined by the formula TPC = (n/N)×100, with n: number of points where the vegetation is present and N: number of total points in each transect (100 points in our case). The same formula is used for the determination of annual and perennial plant covers.
- Both in P and in G, Biomass production was estimated by clipping all vegetation (annual and perennial) within 32 quadrats of 4 m$^2$ in each area. The range value was calculated according to the formula:

$$RV = 0.2\ (\Sigma SI_i \times SCP_i) \times TPC$$

Where:

SI = Specific index of species palatability (varying from 0 to 5)

SCP = Species contribution to total plant cover

All data obtained were subjected to several statistical analyses (analysis of variance and Duncan test) by using the SPSS (11.5) software (SPSS, 2002). The management mode (P or G) was the independent variable while total plant cover, species cover, biomass production and range value were the dependent variables.

## RESULTS

The analysis of variance ($R^2$ = 0.93) of total plant cover produced highly significant differences ($p<0.001$) between the two applied management modes. Total plant cover was higher in P than in G (Table 1). The statistical analysis of the perennial species cover (Adjusted $R^2$ = 0.68) produced significant differences for management mode ($p<0.001$) but the annual species cover seems to be independent on protection ($p<0.0722$).

The results of the species richness of both studied sites show that P presented the highest values of total plant species, of perennials and of perennial grasses (Table 2). The application of the rest technique, coupled with a relatively favourable climatic conditions, has permitted a good regeneration and establishment of seedlings mainly of some perennial grasses such as *Stipa lagascae*, *Penniseteum dichotomum* and *Stipagrostis plumosa*, characterized by their high range value. These species can be considered as protection increasers and heavy grazing decreasers. The number of annual species is comparable for both sites. It seems that these species are more dependent on rainfall availability than on the management mode.

The analysis of variance ($R^2$ = 0.96) of means of biomass production and range value produced highly significant differences ($p<0.0003$) between the two applied management modes. This emphasizes the beneficial effect

Table 1: Variation of Total Plant (TPC), Annual (AC) and Perennial (PC) Covers (%) in relation to management mode of the communal rangeland of Chenini, Southern Tunisia

| Cover (%) | Protected area (P) | Grazed area (G) |
|---|---|---|
| TPC | 52.44±10.25 | 38.66±8.66 |
| AC | 21.22±5.66 | 24.33±4.28 |
| PC | 31.22±6.33 | 14.33±4.88 |

Table 2: Variation of species richness in relation to management mode of the communal rangeland of Chenini, Southern Tunisia

| Species richness | Protected area (P) | Grazed area (G) |
|---|---|---|
| Total species | 52 | 22 |
| Perennial species | 40 | 9 |
| Aunual species | 12 | 13 |
| Perennial grasses | 6 | 2 |

Table 3: Impact of two years rangeland rest (P) on biomass and range value as compared to those of the grazed site (G) of the Chenini communal rangeland

| | Biomass (DM $kg^{-1}$ ha) | Range value (FU $ha^{-1}$ $year^{-1}$) |
|---|---|---|
| P | 2135±226 | 120±22.5 |
| G | 236±58 | 32±13.6 |

of the application of the rangeland rest technique on these pastoral indicators. Table 3 shows that the rest technique induced an increase of about 8 times the aerial biomass production and about 3 times the range value and the forage availability.

## DISCUSSION

The impact of the rest technique on the total plant cover was highly significant. These results corroborate those achieved in other ecologically comparable zones (Gallacher and Hill, 2006; Ouled Belgacem *et al*., 2006b) which indicate progressive increase of the Total Plant Cover (TPC) in the protected area as compared to the overgrazed one, characterized by the bare soil extension. In fact, protection permits soil fixation and the improvement of its structure as due to the abundance of litter resulting from trapping plant dead parts (Ould Sidi Mohamed *et al*., 2002). The significant increase of Perennial Cover (PC) in the protected rangeland may be attributed to the development of the vigour of the adult individuals as well as by the good establishment of new seedlings (Ouled Belgacem *et al*., 2006b; Tarhouni *et al*., 2007b). The effect of protection on Annual Cover (AC) is not significant since the abundance of annuals is more dependent on rainfall availability (Westbrooke *et al*., 2005).

The species richness, which simultaneously affects the structure and the functioning of plant communities, is influenced by the rainfall regime and varies from season to other. It is applied as a measurement of biodiversity for the qualitative characterization of the ecosystem since any increase of the species richness may induce the restoration process of the degraded ecosystem (Bonet, 2004; Zhang *et al*., 2005). In arid area, rainfall the main factor affecting the temporal plant distribution. Grazing pressure does not affect the annual species richness variability (Sheuyange *et al*., 2005).

During humid years, a high germination of annuals is observed in all arid areas of North Africa and West Asia however perennial ligneous species seem to have high adaptation towards aridity but to be more affected by disturbances. The richness of therophytes and their abundance often qualified therophytisation indicate their good adaptation to climatic stress. The important and chronic disturbance leads to the decrease of the flora richness and the replacement of perennials by annuals.

Results show that perennial grasses are protection increasers and grazing decreasers (Noy-Meir *et al*., 1989; De-Val and Crawley, 2005) since they are largely more abundant in the protected area. These results are therefore consistent with the results of Floret (1981) who found that restoration was achieved by a constant increase in the density and cover of existing species. Chamaephytes, the most abundant perennial species, can resist intense or frequent disturbances by growing less tall and resprouting and tend to be less palatable than most grasses (Jauffret and Lavorel, 2003). This response is negative because it reflects the concurrent degradation of vegetation cover and soil. The rarity of grasses in the grazed area confirms their weak resistance to continuous grazing. The rarefaction of grasses constitutes, according to several researchers as Van de Koppel and Rietkerk (2000), Hendrickson and Berdahl (2002) and Ouled Belgacem *et al*. (2006b), a good indicator of the state of deterioration of the plant cover.

Results show also a significant increase of the biomass production as well as the range value due to the application of 2 year rest technique. The vigorous growth of existing species and the regeneration of degraded or even disappeared very palatable species are the main reason of the increase of these indicators and the improvement of the productivity.

According to Table 3, the short term protection permitted an increase of about 88 Forge Units (FU) per hectare, which means that this technique induces an added production of about 352000 in the whole protected rangeland (4000 ha). This value is equivalent to a production of about 352 tones of barley. Consequently, with the increase of the prices of feeding resources, mainly barley (which is more preferred by local population as supplementary food for their animals), it seems that communal rangeland rest is an important technical option for the improvement of the productivity. Moreover, such technique may be suggested as a tool for drought mitigation and animal feeding resources cost alleviation in addition to its role in the conservation of biodiversity and natural resources.

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## REFERENCES


Ben Salem, F., M. Tarhouni, A. Ouled Belgacem and M. Neffati, 2007. Impact of drought on plant cover dynamics in two natural areas of Southern Tunisia. J. Biol. Sci., 7 (8): 1539-1544.

Bonet, A., 2004. Secondary succession of semi-arid Mediterranean old-fields in South-Eastern Spain: Insights for conservation and restoration of degraded lands. J. Arid Environ., 56 (2): 213-233.

DePauw, E., 2002. Drought in WANA: Six frequently asked questions. J. Carav. ICARDA., 17 (2): 12-17.

De-Val, E. and M.J. Crawley, 2005. Are grazing increaser species better tolerators than decreasers? An experimental assessment of defoliation tolerance in eight British grassland species. J. Ecol., 93 (5): 1005-1016.

Floret, C., 1981. The effects of protection on steppic vegetation in the Mediterranean arid zone of Southern Tunisia. Plant Ecol., 46-47 (1): 117-119.

Gallacher, D.J. and J.P. Hill, 2006. Effects of camel grazing on the ecology of small perennial plants in the Dubai (UAE) inland desert. J. Arid Environ., 66 (4): 738-750.

Hendrickson, J.R. and J.D. Berdahl, 2002. Responses of a grazing tolerant and a grazing sensitive grass to water and defoliation stress. J. Range Manage., 55 (11): 99-103.

Jauffret, S. and S. Lavorel, 2003. Are plant functional types relevant to describe degradation in arid, Southern Tunisian steppes? J. Veg. Sci., 14 (1): 399-408.

Jauffret, S. and M. Visser, 2003. Assigning life history traits to plant species to better qualify arid land degradation in Presaharian Tunisia. J. Arid Environ., 55 (1): 1-28.

Le Floc'h, E., M. Neffati, M. Chaieb, C. Floret and R. Pontanier, 1999. Rehabilitation experiment at menzel habib, Southern Tunisia. Arid Soil Res. Rehabilitat., 13 (4): 357-368.

Noy-Meir, I., M. Gutman and Y. Kaplan, 1989. Responses of Mediterranean grassland plants to grazing and protection. J. Ecol., 77 (1): 290-310.

Ould Sidi Mohamed, Y., M. Neffati and B. Henchi, 2002. Effect of the management mode on plant dynamics in Tunisia: Case of the national park of Sidi Toui and its surrounding. Sécheresse, 13 (3): 195-203.

Ouled Belgacem, A., M. Neffati, V. Papanastasis and M. Chaieb, 2006a. Effects of seed age and seeding depth on growth of *Stipa lagascae* R. and Sch. seedlings. J. Arid Environ., 65 (4): 682-687.

Ouled Belgacem, A., M. Chaieb, M. Neffati and J. Tiedeman, 2006b. Response of Stipa lagascae R. and Sch. to protection under arid condition of Southern Tunisia. Pak. J. Biol. Sci., 9 (3): 465-469.

Sheuyange, A., G. Oba and R.B. Weladji, 2005. Effects of anthropogenic fire history on savanna vegetation in Northeastern Namibia. J. Environ. Manage., 75 (3): 189-198.

SPSS., 2002. SPSS: SPSS 11.5 for Windows Update, SPSS Inc., USA.

Tarhouni, M., A. Ouled Belgacem, M. Neffati and B. Henchi, 2007a. Validation of some structural vital attributes of the ecosystem in relation to seasonal drought and animal pressure around watering points in arid area of Tunisia. Belg. J. Bot., 139 (2): 188-202.

Tarhouni, M., A. Ouled Belgacem, M. Neffati and B. Henchi, 2007b. Qualification of rangeland degradation using plant life history strategies around watering points in Southern Tunisia. Pak. J. Biol. Sci., 10 (8): 1229-1235.

Van de Koppel, J. and M. Rietkerk, 2000. Herbivore regulation and irreversible vegetation change in semi-arid grazing systems. Oikos, 90 (22): 253-260.

Westbrooke, M.E., S.K. Florentine and P. Milberg, 2005. Arid land vegetation dynamics after a rare flooding event: Influence of fire and grazing. J. Arid Environ., 61 (2): 249-260.

Zhang, J., H. Zhao, T. Zhang, X. Zhao and S. Drake, 2005. Community succession along a chronosequence of vegetation restoration on sand dunes in Horqin Sandy Land. J. Arid Environ., 62 (4): 555-566.