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Effect of Anthropogenic Action And Erosion on The Structural Stability of Steppe Soil (Case of Maamora Area) Saida. Algeria

KEYWORDS: Structural stability, soil, erosion,Maamora, steppe, forest.

Borsali Amine Habib

University « Dr Moulay Tahar », Saïda , Algérie

ABSTRACT *The municipality of Maamora is located to the South of the wilaya of Saïda (Algeria). This is one of the most important dairates of the wilaya on agricultural and forestry plan. Alteration of the structure of the soil poses both agronomic and environmental issues including erosion, surface runoff and ground movement.*

The objective of this work was to study the structural stability of soils of two stations exposed to phenomena of erosion and overgrazing found in these plots and two other stations having granted where defends it y' has no trace of erosion or pastoral pressure. The structural stability was measured according to the procedure proposed by (Le Bissonnais, 1996).

The results show that the structural stability is under the effect of anthropogenic stress (overgrazing) and erosions. From these results, it can be said that implementing defends is a long-term solution for the protection of steppe soil of different degradation.

Introduction

The structural stability is the ability of a soil to retain its arrangement between solid and empty particles when exposed to various constrains . These constraints can be of different kinds and of different intensity (Le Bissonnais, 1996) . They can be related both to particular pedo-climatic conditions and, directly or indirectly, to human activity (Walter, 2002). In a large part of the steppe, overgrazing is the most devastating action on perennial vegetation and the main factor of desertification over the past two decades (Ziad, 2006) . Erosion is another phenomenon of land degradation that affects large areas, especially in the tropical and Mediterranean areas (Ellison, 1947). This phenomenon is the combination of a detachment with a transport of particles by the drops of rain, runoff and wind (Casenave and *al.*,1989). Several studies report a link between structural stability easier to measure, and the sensitivity of soil erosion (Barthès and al., 2001). The steppe space faces, despite all development programmes to the degradation of herbaceous vegetation, alteration of the physico-chemical characteristics of soils, erosion and depletion of the biological potential (Benabdelli ,200). The Maamora municipality in the wilaya of Saïda is a representative example of the steppe areas threatened by erosion. Structural instabilities, soil degradation phenomena and the reduction of plant species in pastoral vocation are the main illustration of the ecological disturbances of this medium.

The objective of this work is to see to it y' has an effect of erosion and the pastoral charge on the structural stability of the soil which is usually manifested by an evolution of the smearing of these soils and resulting mainly from the disintegration of lumps of land (Boiffin, 1984 ; Le Bissonnais, 1996) , and detachment and transport of particles (Spalsh) (Al Durrah, 1982 ; Boiffin, 1984 ; Le Bissonnais, 1996 ; Le Souder and *al.*, 1991) which are phenomena of degradation of soils increasingly observed in these steppe areas. Carried out for this study we took four stations of 400 m² about each, including two located in the alfatiere water and two other forest environments.

Materials and methods

Study area

The municipality of Maamora is located to the South of the wilaya of Saïda. It extends over an area of 127,000 hectares and administratively to the District of El-Hassasna, which is one of the most important dairates of the wilaya depends both on the more agricultural than forest (U.R.S.A, 2006).

From a climate point of view, this area is characterized by the aridity of the climate, the scarcity of precipitation and their irregularities as well as the adverse effects of the sirocco. Average temperatures range from 7 ° C in winter and 27 ° C in summer. As for precipitation, the area receives an average rainfall of 300 mm / year, which justifies the aridity of the climate (B.N.E.D.E.R, 1992) . The wind is an important and harmful factor in this area by its erosive action and movement of sand (quite marked phenomenon of desertification). It acts directly on the ground and on plants, especially in times of sirocco (hot wind from the South).

Figure 1: Situation of the study area

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

Choice of experimental stations

Four stations of 400 m² approximately were selected for this study:

- Station (A) under Alfa degraded and subject to heavy erosion
- Station (B) under Alfa degraded and subject to any trace of erosion.
- Station (C) beneath forest degraded, subject to strong erosion
- Station (D) forestry training non-degraded and without trace of erosion represented in table 1.

The reference to 'Degraded' was used to represent disturbances related to the anthropic action (overgrazing) stations not having received any in defending. The words 'Non-degraded' is linked to plots that have benefit for an upgrade in defends long term over three years.

The defens of a route is a technique that is to ban its exploitation by domestic herds. Grazing of a given space is comparable to an ecosystem that evolves in close relationship with the characteristics of the natural environment that contains it (Floret and *al.*, 1982 ; Noy Meir, 1974).

Table 1. Presentation of study station

	Station (A)	Station (B)	Station (C)	Station (D)
Longitude Latitude Altitude (m)	34 ° 52 ' 48'' 0 ° 32' 07 '' 1100 m.	34 ° 46 ' 39'' 0 ° 34' 27 '' 1080 m.	36 ° 48 ' 52'' 0 ° 39' 28 '' 1112 m.	36 ° 58 ' 18'' 0 ° 28' 17 '' 1134 m.
Depth (cm)	20-25	25-30	50-55	55-60
Anthropogenic Actions	Absent (last in defending more than 3 year)	Overgrazing	Absent (last in defending more than 3 years)	Overgrazing
Signs of erosion	Lack of erosion	Presence of erosion	Lack of erosion	Presence of erosion

The signs of erosion under consideration are the following: crust, pebbles cleared on the ground, topped micro-demoiselles and 10 to 30 cm deep incisions and more that characterize the erosion (Barthès and *al.*, 2001 ; Robert, 1996).

The pastoral care of the commune of Maamora is one of the most important in the wilaya of Saïda and she ranks second after the commune of sidi Ahmed. The following table gives us an insight into this important pastoral charge.

Table 2: Distribution of the sheep population by municipality (DSA, 2012).

Commons	Males	Sheep	Young less than 2 years	Total	Percentage %
Maâmora	5000	35.000	20.000	60.000	14,41

Procedures for sampling

The soil samples were collected in twenty experimental sites, each sample is represented by a composite of Earth taken from each site with the spade for the measurement of the structural stability in the conditions advocated and described by (Le Bissonnais ,1996) conditions and (Le Souder and al., 1991) .

Measurement of structural stability

Measurement of structural stability was performed following the method proposed by (Le Bissonnais ,1996 ; Le Souder and *al.*, 1991).The purpose of this method is to give a realistic description of the behaviour of the soil under physical constraints existing in natural conditions (especially rain) (Abiven, 2004). This measure focuses on three different pretreatments corresponding to different mechanisms of weathering: i/ l ' rapid wetting by immersion (sudden intense rain wetness), ii / mechanical weathering by stirring after rewatering (cohesion of the aggregates regardless of bursting phenomena),iii/ slow wetting by capillarity (slow wetting corresponding to moderate rainfall). The method takes place in 4 phases : i/selection and preparation of aggregates, ii/application of the 3 types of constraints,iii/ screening of samples, iiii/ weighing of fractions and calculating the index of structural stability.

The measurement of structural stability is expressed directly in the form of the diameter Ponderal average (or Mean Weight Diameter MWD) expressed in mm such as:

MWD = Σ (average diameter of a fraction x mass for this fraction)

Statistical treatments

Analyses of variance (ANOVA) to 1 factor were used to test the effects of sources of variation studied on the structural stability of soil. Test post-hoc least differences of Fisher (LSD) was used to make multiple comparisons of means. Where necessary, the data were transformed (i.e. log10 or root square) to meet the conditions of normality and homogeneity of variance required to use these parametric tests. These analyses were performed on Statistica 6.0.

Results and discussion

The results of the measures of the structural stabilities in table 3, represent the mean weight diameter (MWD) of 20 sites of soil samples, for an average of 05 sites for each study site.

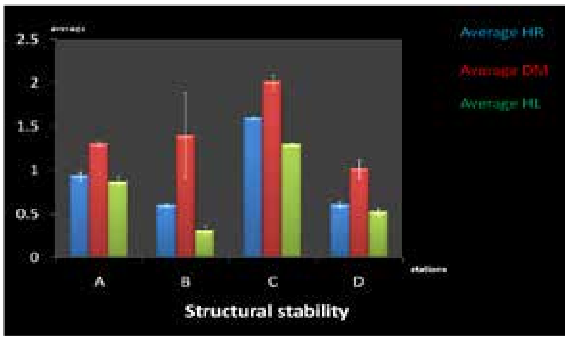
Table 3. Structural stability on the basis of the (MWD)

	Station (A)	Station (B)	Station (C)	Station (D)
Humidifying fast (HM)	0,93	0,60	1,60	0,60
Mechanical weathering (DM)	1,30	0,99	2,0	1,01
Humidifying slow (HL)	0,88	0,30	1,29	0,52

Different types of structural stability are evolving over time. The variations are most important for rapid wetting and mechanical weathering tests (figure 2). In the classification drawn up by (Le Bissonnais, 1996; Le Souder, 1991), soils of stations (B) and (D) corresponds to the «unstable» stability class associated with busy smearing and frequent risk of runoff provisions.

Figure 2: Average structural Stabilities by station

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X



However soils of the station (A) correspond to the «moderately stable» stability class, to provisions to frequent smearing and variable runoff risk depending on the climatic and topographic parameters.

Soils of the station (C) correspond to the class of stability 'stable', occasional smearing and limited runoff risk provious.

The statistical study shows that for values of the indices of instability the highest average of these indices is that the second test (DM), the lower one third test (HL).

This result shows that it is energy mechanical, applied only in the second test, that apart most soil as the shown (Saidi, 1999) in are the structural stability.

The set of values of these indices show that on average more stable soils are located in stations (A) and (C) that have granted defends in at least three years therefore with no trace of erosion and overgrazing, while the most volatile is located in stations (B) and (D) not having received any in defends with traces of erosion apparent and significant anthropogenic action including overgrazing.

The observation of these results show a close relationship between the structural stability and the phenomena of erosion and overgrazing with nevertheless generally average deviations showing a medium variability including among samples from a same plot for station (B).

Table 4. Analysis of variance of the structural stability

Structural stability	Source	DDL	Sum of squares	Mean of the squares	F	Pr>F
Humidifying fast (HR)	Model Erreur Total Corrected	3 16 19	3.300 0.017 3.317	1.100 0.001	1018.573	< 0,0001
Mechanical weathering (DM)	Model Erreur Total Corrected	3 16 19	2.625 1.027 3.652	0.875 0.064	13,633	0,000
Humidifying slow (HL)	Model Erreur Total Corrected	3 16 19	2.797 0.033 2.830	0.932 0.002	450.435	< 0,0001

On all plots studied, correlations are found between structural (HR, DM and HL) stability parameters and parameters of erosion and overgrazing. Thus the analysis of variance of the first (HR) index shows a significant difference (F = 1018, 573, Pr < 0.0001) between the different stations. As regards the second index (DM) there is a most important significant difference (F = 13, 633; Pr < 0, 000) that the first index. The last index (HL) also indicates a significant difference (F = 450, 435; Pr < 0.0001) between stations.

Table 5. Analysis of the differences between the terms with a 95% confidence interval Code / Tukey (HSD)

Structural stability	Modality	Estimated average	Groups
Humidifying fast (HR)	C	1.600	A
	A	0.936	B
	D	0.608	C
	B	0.602	C
Mechanical weathering (DR)	C	2.008	A
	B	1.398	B
	A	1.300	B
	D	1.014	B
Humidifying slow (HL)	C	1.294	A
	A	0.870	B
	D	0.522	C
	B	0.306	D

For the (HR) code of Tukey (HSD) for this index shows a correlation between stations (C) and (A), (A) and (B) and (D, B) and (C).

For the (DM) the code of Tukey (HSD) shows a correlation between (C) and (A) and (B, A, D) and (B).

For the HL code Tukey correlated also more variable than the first two indices between stations; station (C) with (A) and (B), (D) and (C) and (B) and (D).

Our results shows that the structural stability is under the effect of overgrazing and erosion. Indeed, a rational grazing stimulates plant growth and strengthens the development of roots in mineralizing participating in stability soil (Podwojewski and *al.*, 2002).

Indeed the overall stock of carbon decreases by decrease of the stock biomass and necromass (Hofstede, 1995). Plots that did not benefit from development in defends note a total degradation of the Alfa Tufts, resulting in improper attachment of soils and therefore their stabilities.

Several authors have shown that grazing cattle and sheep produces a regular fires increase and fragmentation progressive grass clumps (Verweij and *al.*, 1992) , sheep overgrazing causes of much more consequential damages both on the vegetation and the behaviour of soils (Podwojewski and *al.*, 2002).

In the first place, Tufts (Calamagrostis SP., Stipa hichu) are fragmented and their size is reduced. When sheep overgrazing develops, sheep dig up the collar of the plants struggling to push back in this steppique environment by their sharp hooves. After a long period without vegetation, soils generally absorb solar radiation which promotes an irreversible drying of the soil. These changes alter the physi-

Volume : 4 | Issue : 10 | October 2014 | ISSN - 2249-555X

cal properties such as structural stability and the capacity of water retention.

Semi arid soils have a significant susceptibility to erosion this susceptibility is significantly higher for soils with overgrazing.Compaction due to soil compaction by animals causes. A very hydrophobic microstructure replaces a stable macrostructure, producing a reduction of the infiltration capacity of the soil, increasing the risk of runoff and erosion (Podwojewski, 2007).

In the early stages of degradation, this Hydrophobia first affects the only parts bare between Tufts, Tufts remaining hydrophilic and affects mainly the microaggregates while the macroaggregates remain hydrophillic however, when overgrazing causes a complete bare soil, Hydrophobia remains average between clumps but becomes extreme under the clumps.

The structure is composed exclusively of very hydrophobic microaggregates probably due to water stress allowing more contact between the water in the pores of the soil and from surface water (Podwojewski, 2007).

Note also that the runoff is less important on the soil after defends 3 years, it is clear that the structural stability, permeability,particle size distribution,chemical properties are improved thanks to the protection of these sites.

Conclusion

Steppe space natural resources (soil, water, vegetation,...) have suffered from severe damage several decades due mainly to the combined effects of increasing anthropogenic pressure and antropozoogene and aggravating drought on these ecosystems

The steppe soils have properties making them more or less susceptible to erosion or degradation. Susceptibility to erosion is a compromise between the intrinsic factors of soil degradation and erosion (Podwojewski, 2007). The anthropic action modifies the intrinsic properties of the soils which not controlled often increase the sensitivity a degradation.

The objective of our work was to see the relationship-aggregation overgrazing and aggregation-erosion, comparing the stability of aggregates from the horizon surface erosion and overgrazing action, rated on steppe soil, two levels of investigation, soil under alfa and forest area.

The test that was used to evaluated the structural stability is advocated by Le Bissonnais because it is that which is the most used and most reliable (Saidi, 1999).

Our results show that soils the most stable is located in forest area which have been put in again defends three years. Then come under Alfa soils which are moderately stable, but which are also protected against the harmful action of overgrazing and erosion. This study indicates that steppe soils are very fragile and this vulnerability is accentuated by the anthropogenic action that ceases to grow in this region and the only remaining protection setting in defends for will allow the regeneration of the vegetation and the land reclamation.

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