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Contribution to the Study of Quantitative and Qualitative Aspects of Steppe Formations for the Characterization of Desertification in Semi-arid Environment: Saida, Algeria

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ABSTRACT: In semiarid regions such as Saida, the steppe ecosystem is currently submitted to desertification under the combined effect of human activity and climate change. Our study is a contribution to the assessment of the biodiversity of steppe formations through a phytoecological diagnosis at the South zone of the wilaya of Saida.To achieve the objective of this study, a methodological approach based on studies of multifarious types. Thirty floristic and soil have been made to end better now characterize the floristic richness, biological type and soil type. The sampling technique is between purposive sampling and a statistical sampling to two degree (transect surveys). The period of fieldwork is the spring season of 2012.The results obtained clearly show that vegetation cover and soil are the subject of an alarming deterioration that results in a very advanced stage of desertification. This results in a drop in agricultural production and installation of non-palatable species by livestock.

Key words: Desertification, Biodiversity, Phytoecological diagnosis, Saida, Algeria

INTRODUCTION

The Convention to Combat Desertification and the United Nations Environment Program (UNEP) define desertification as "land degradation in arid, semiarid and dry sub-humid areas resulting from various factors, including climatic variations and human activities" (UNEP, 1997). Desertification of a medium results in profound changes in the biophysical properties of the soil, resulting from the combined effect of natural or human-induced factors (Cornet, 2002). This phenomenon pulls its origins from several factors . While land degradation can be mapped, physically observed and monitored, this paper claims that land degradation can only be explained and understood at levels where hidden social, political and economic structures are analyzed (Andersson *et al*., 2011 in Easdale and Domptail, 2014).

The wilaya of Saida, like different steppe provinces of Algeria is confronted with the phenomenon of desertification, which results in a dramatic deterioration of the various components of the ecosystem, flora, fauna and soil. This process is accentuated by the day by the coupling of poverty and drought in these fragile environments. The High Plains Algerian steppe regions are essentially pastoral vocation. Today they are experiencing a sharp deterioration resulting in reduced biological potential and the rupture of ecological and socioeconomic equilibrium (Nedjraoui, 2004).This situation leads to the disappearance of forests and the abrupt appearance of scrub and shrubland, neglect dangers that cause these situations to public health, ecosystems, the living and the economy, all these causes are responsible for the rapid deterioration of the risk zones reflecting the acceleration of desertification in the province of Saida.

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MATERIALS & METHODS

In order to develop such a well detailed as possible approach, a set of desertification indicators were selected which are: The state of the vegetation cover, land use, soil type and morphology, climate data and the socio-economic data.

The study area covers the territory of the four communes: *Moulay Larbi*, *Sidi Ahmed*, *Maamora* and *Ain Skhouna* with an area of 3300 km^2 (Fig.1). It mainly characterized by semiarid conditions. This territory frame in space defined by Longitude 0°8' W to 0°8' E and by Latitude 34° to 35°.

Our study zone is considered that an especially important area to study because land degradation and desertification already pose serious ecological problems. The objective of this study was to assess the actual state of the phenomenon of desertification. And clearly identify the factors that negatively aggisent on accelerating this phenomenon.(Fig.2).

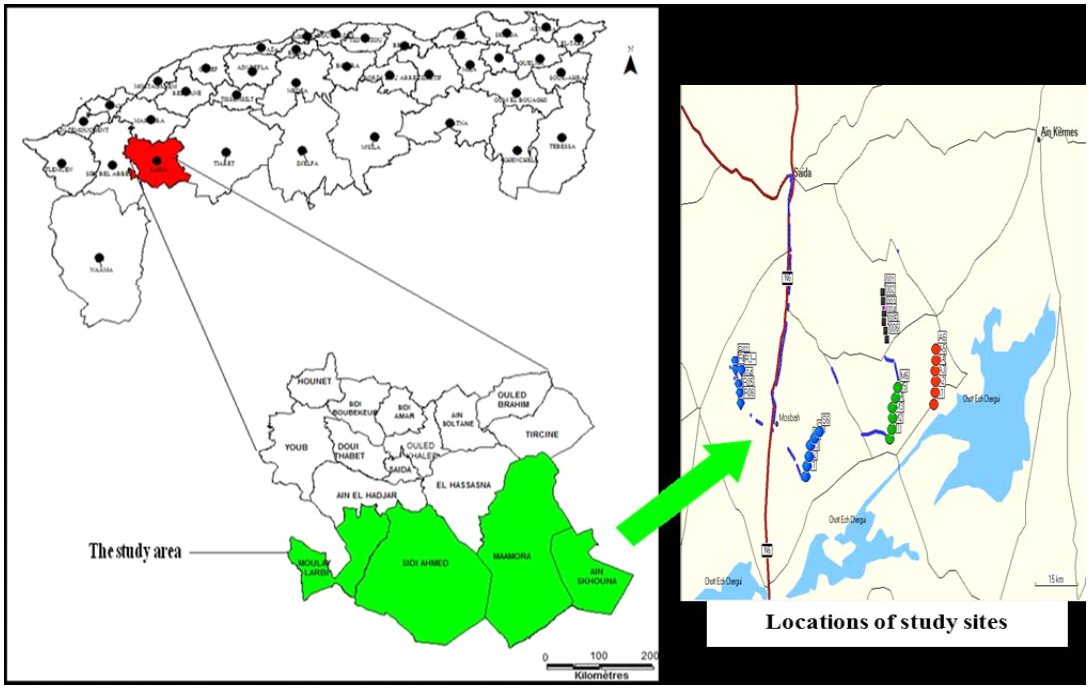

Fig. 1. The location of the study area

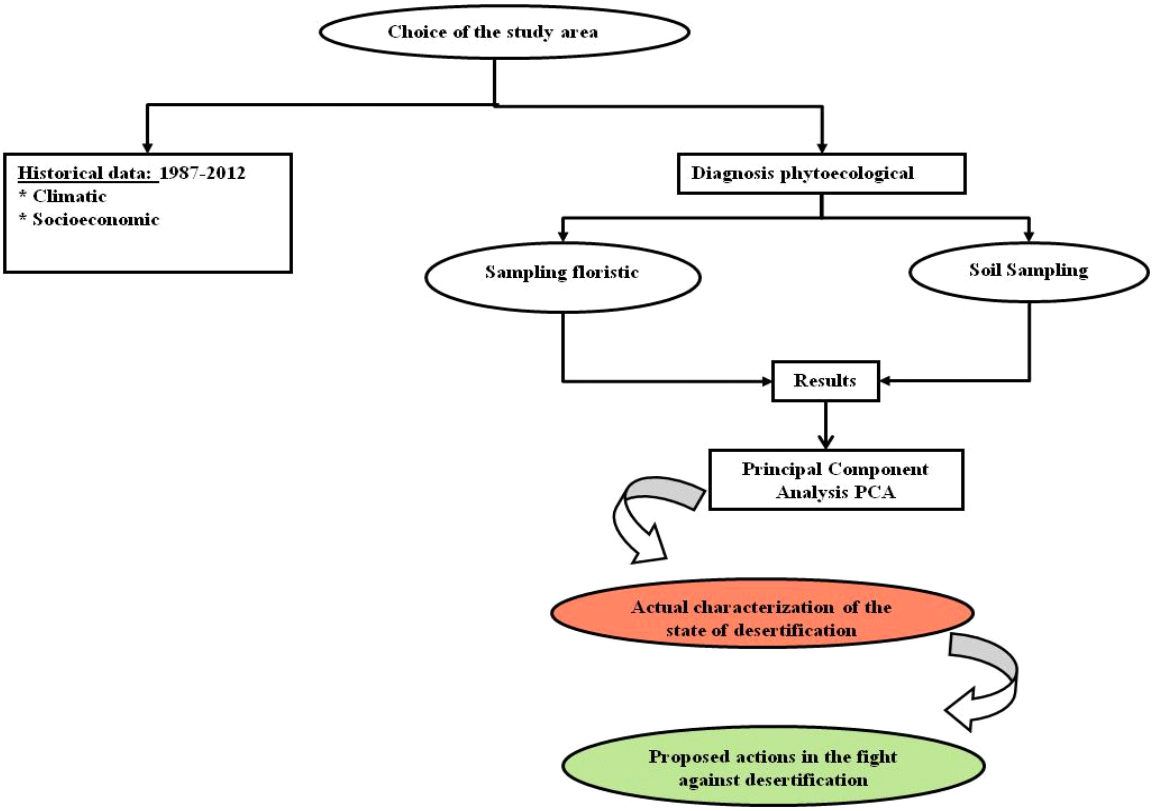

Fig. 2. Flow chart showing all the steps of the study

A total of 30 soil samples were collected and analyzed. Each sample taken is placed in separate bags which containing a label that mentions the number of the record and place. After it was dried and sieved through a 2 mm sieve to eliminate large particles. All analyses are performed to estimate Physico-chemical properties: texture, salinity, organic matter, pH, total limestone and active limestone. The methods used are those proposed in the manual of soil analysis prepared by Aubert in 1978.

The sampling technique is between purposive sampling and a statistical sampling with two degrees (transect surveys). The period of fieldwork is the spring season of 2012, (Gounot, 1961; Godron, 1966; Corre and Rioux, 1969 and Corre, 1970) have emphasized the idea that the study of vegetation must be made manner oriented.

Each survey is to make a complete inventory of all species and thereafter each species in the surveys shall be assigned to four indices: index of cover-abundance, the index of Sociability, Frequency Index and presence index.The minimal area is 100 m², it was the same for the entire study area, Djebaili (1984) used a minimal area equal to 100 m^2 for all of the steppe plant communities and regardless the precipitation conditions and backgrounds. The determination of taxa was made from the new flora of Algeria and the desert areas of work Quezel and Santa (1962- 1963).

RESULTS & DISCUSSION

The climate is semi-arid with cool winter. Precipitation shows an irregular distribution with annual precipitation is 327 mm. The height of the rains diminishes from east to west; it also decreases from north to south. According a month is called dry if the average total rainfall (mm) is less than or equal to twice the average temperature (° C), P = 2T this relationship helps establish pluviothermic diagrams where the temperature is raised to a double standard that precipitation (Bagnouls and Gaussen,1953). (Fig.3).

Climate study shows that a set of climatic factors come together to contribute to desertification because of too harsh climatic conditions of aridity and cause low and erratic rainfall cold accompanied by a long period of drought making it difficult to rainfed. Temperatures and thermal amplitudes are also high, which has negative effects on water and soil humic water balances. Then add the impact of strong winds affecting the area in spring and accentuate the harsh climate they do not find any obstacles to hinder.

For the pedologist the desertification can be defined as the reduction or destruction of potential

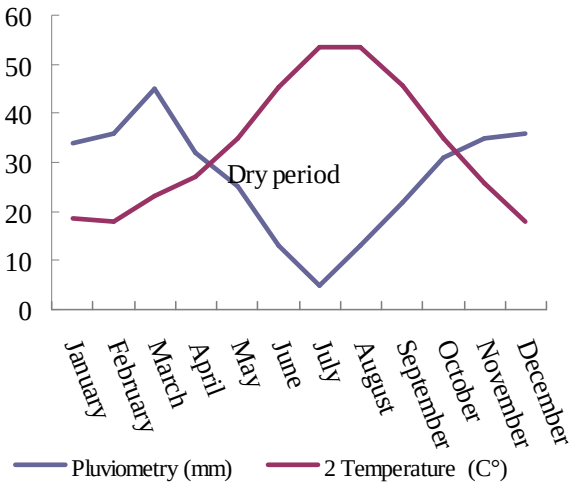

Fig. 3. Ombrothermic diagram of Bagnouls and Gaussen of the study area

of soil fertility; (lower rate of organic matter, structural degradation, loss of soil thickness, salinity; resulting in the formation of a desert landscape (Halitim, 1988). The soil results (Table 1) only confirm the previously existing studies, which indicate that these steppes are characterized by a remarkable weakness essential to the genesis and poor structural stability, this is due to the weakness of the biological activity and that evapotranspiration is greater than rainfall. These factors have a negative impact on the development which accelerates desertification.

About the floristic results, all surveys include a list of 50 species of flora as was indicated in the fig. (fig. 4a) which shows that the number of recorded species is very important it can reach even more than 30 species in *Moulay Larbi*. The number of species varies from one survey to another (fig.4b), this explains the heterogeneity between municipalities on the one hand and the number of species decreases from north to south on the other hand.

The analysis of the specific contribution of the main species (fig .5a) shows that *Lygeum spartum* and *Astragalus cruciatus* take first place but with no high percentage not exceeding 15%. Second place is occupied respectively by *Atractylis serratyloides*, *Thymelea microphylla*, *Artemisia herba alba* *Launea nudicaulis*, The species which are found in last place are: *Stipa tenacissima*, *Stipa parviflora*, *Plantago albicans* and *Peganum harmala*.

The exploitation of these results shows a large occurrence of undesirable, toxic and desertification indicator species such as *Atractylis serratyloides*, *Peganum harmala* faced with a small contribution

Table 1. Soil physical and chemical properties

Code of the	Thickness (cm)	Sand (%)	Clays (%)	Silts (%)	Texture	Salinity (mmhos)	Organic matter	pH	Active limestone	Limestone total (%)
ML 1	15	41	18	41	sandy loam	0,85	5,02	7,18	0,77	26,09
ML 2	12	31	19	50	sand clay	0,53	4,13	7,32	0,23	16,26
ML 3	7	35	25	40	sandy loam	0,61	4,09	7,43	0,73	23,31
ML 4	12	61	9	30	Sand clay	0,71	3,76	7,12	10,72	11,11
ML 5	10	50	15	35	sandy loam	0,2	4,33	7,16	20,13	25,11
ML 6	7	44	17	39	sandy loam	0,32	3,79	6,87	13,06	24,14
S 1	16	85	10	5	Sand	0,21	0,47	7,11	13	26,29
S 2	14	87	9	4	Sand	0,4	1,01	6,73	4,2	24,04
S 3	5	84	12	4	Sand	0,44	0,53	7,89	9,8	28,13
S 4	15	52	8	40	sandy loam	0,5	4,93	8,32	1,32	29,42
S 5	10	41	14	45	sandy loam	0,49	3,89	8,67	10,77	32,17
S 6	12	36	17	47	sandy loam	0,31	5,09	8,23	9,7	36,01
M 1	13	37	22	40	sandy loam	0,55	3,61	7,97	0,59	5,08
M 2	25	45	12	42	sandy loam	0,22	3,22	8,31	0,3	26,66
M 3	7	37	17	46	sandy loam	0,38	1,73	7,44	0,44	26,19
M 4	15	87	8	5	Sand	0,49	0,1	7,16	3,2	18,86
M 5	16	45	14	41	sandy loam	0,61	3,93	8,13	0,26	25,93
M 6	12	20	16	65	Silt	1,03	3,45	8,36	0,14	24,01
M 7	10	85	10	58	Sand	0,62	0,09	7,15	20,11	6,63
M 8	13	29	37	34	Silt clay	0,73	4,69	8,38	10,19	8,42
M 9	9	29	40	31	Silt clay	0,55	4,37	8,13	0,55	7,1
M 10	12	43	17	40	Sand clay	0,64	4,05	8,15	4,5	12,12
M 11	7	38	21	41	sandy loam	0,43	3,97	8,01	6,2	20,18
M 12	10	25	15	60	Silt	0,86	2,94	6,97	8,32	17,33
A 1	10	73	0	27	Loamy sand	1,59	1,49	6,01	0,6	8,53
A 2	28	72	0	28	Loamy sand	0,96	1,81	6,63	0,1	9,31
A 3	25	66	0	34	Loamy sand	0,98	0,93	6,27	0,4	12,86
A 4	23	70	0	30	Loamy sand	1,31	0,04	6,39	0,1	10,93
A 5	23	65	0	35	Loamy sand	0,79	1,03	6,76	0,2	12,03
A 6	32	68	0	32	Loamy sand	0,83	1,98	6,34	0,1	4,52

of *Stipa tenacissima*, *Artemisia herba alba* and *Stipa parviflora* reflecting the disappearance of these species by anthropogenic action and accelerating desertification.

The number of families in the study area is estimated at 22 families (fig. 5b). The most dominant family is represented by *Asteraceae* with 11 species and second class is the family *Poaceae* with 8 species. These two families are characterized by their adaptations to extreme drought conditions.The subdivisions of the Raunkiær (1905) systems are based on the place of the plant's growth-point Raunkiær's life forms: *Phanerophytes*, *Chamaephytes*, *Hemicryptophytes*, *Geophytes*, *Helophytes*, *Hydrophytes*, *Therophytes*.

The (fig. 6) shows that the most dominant life form in the study area is represented by therophyte. This is due to aridity of climate (Aidoud, 1983 and Dahmani, 1997) and also to the perturbation of the medium caused by man and his flock, which is confirmed by Grim in 1977: "This therophytisation is related to environmental disturbances by overgrazing ".

In second place there's the chamaephytes this is due to their adaptation to arid environments as confirmed Ellenberg *et al* (1968): "the chamaephyte are most common in matorrals and are better adapted to aridity".

The Hemicrytophytes are in third place but with a slightly lower rate; this can be explained by poor

(a)

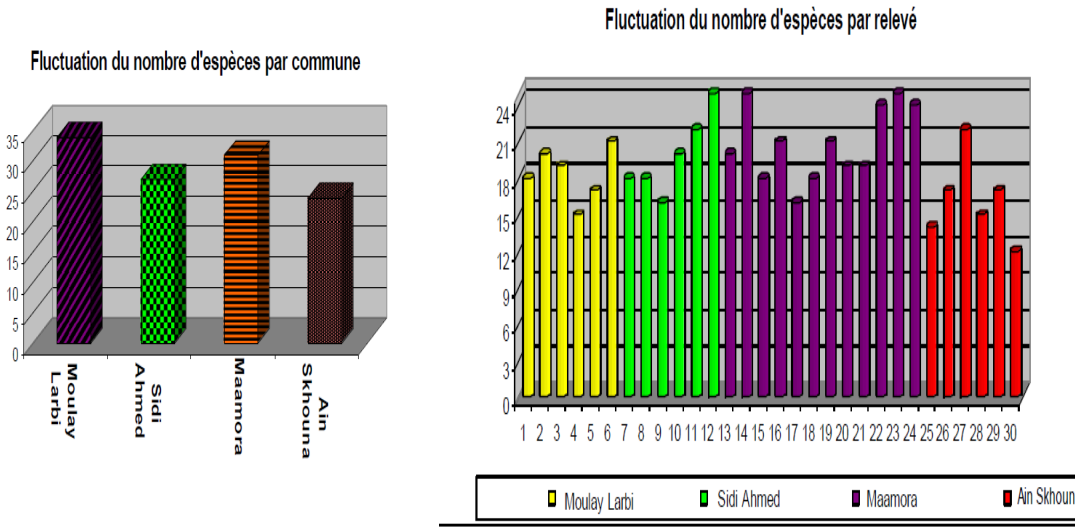

Fig. 4.b. Fluctuation in the number of species by sample

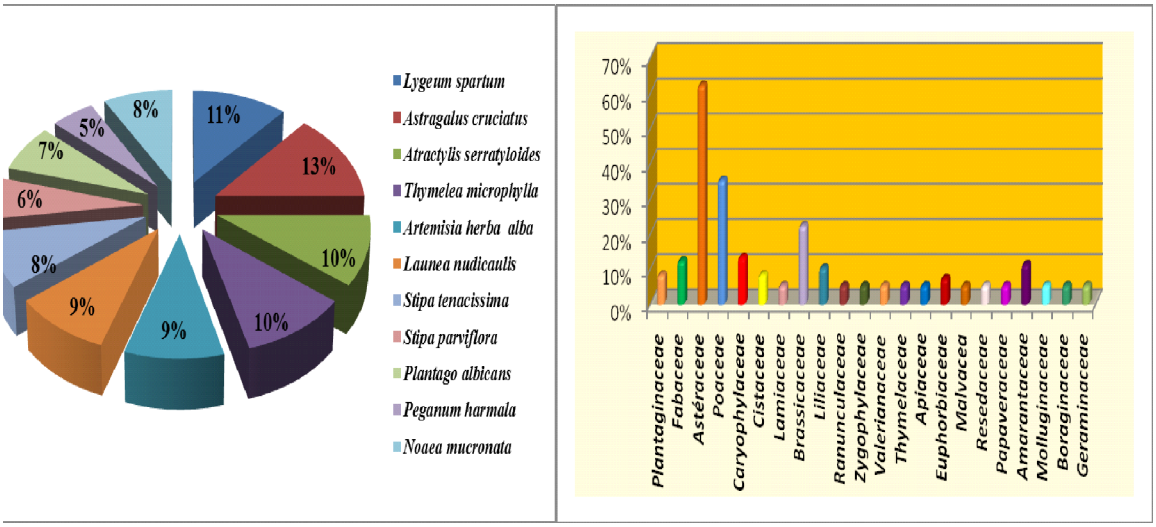

Fig .5.b. Specific contribution of the different families in the stu dy area

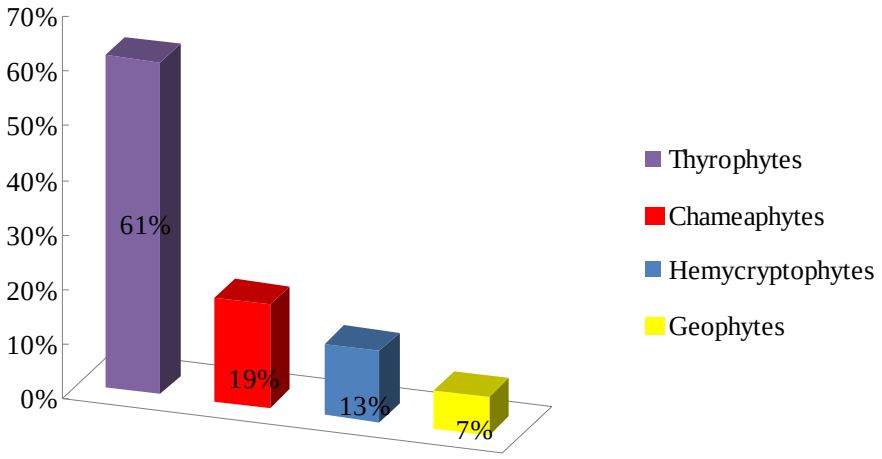

Fig.6. Biological type of vegetation in the study area

soil organic matter; phenomenon confirmed by Barbero *et al* (1989). The Geophytes take the last class, are usually represented by two species are *Stipa tenacissima* and *Lygeum spartum*. Barbero *et al*, (1989) added that the geophytes regress and disappear into the lawns and steppe zones.

Multivariate analysis, broadly defined, is a set of methods to synthesize information from several variables to better explain it. In our case, Principal Component Analysis (PCA) agrees well with our objective so she was used to characterize the ecological affinities between floristic and soil surveys carried out.

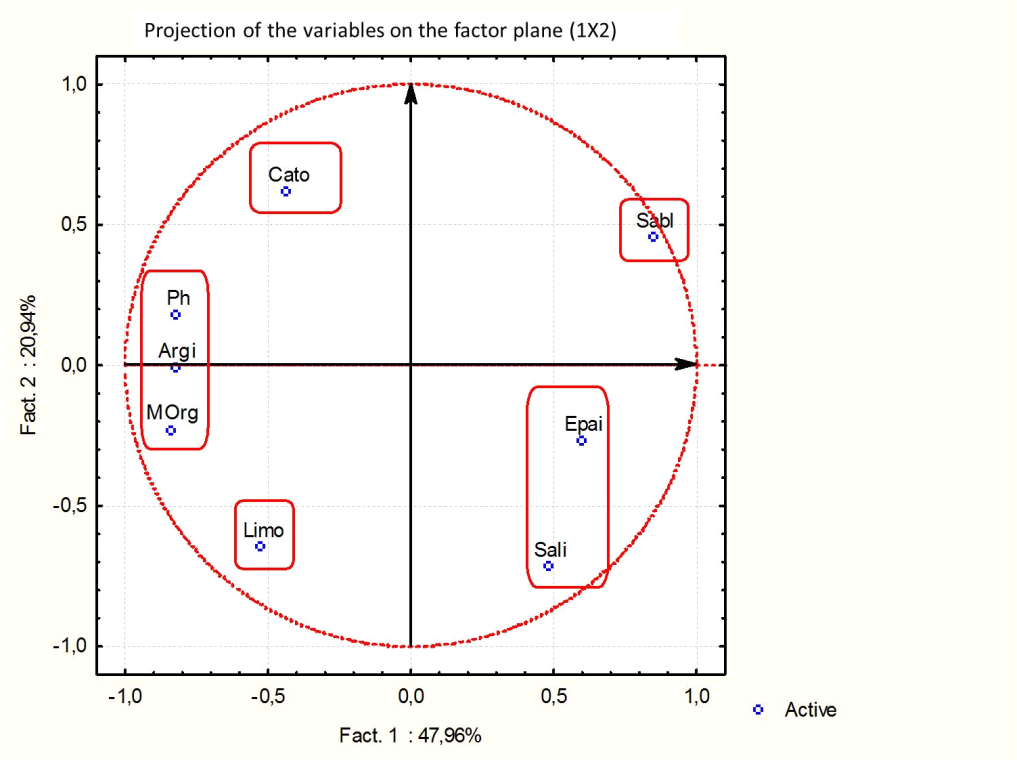

Fig.7.a. Correlation circle

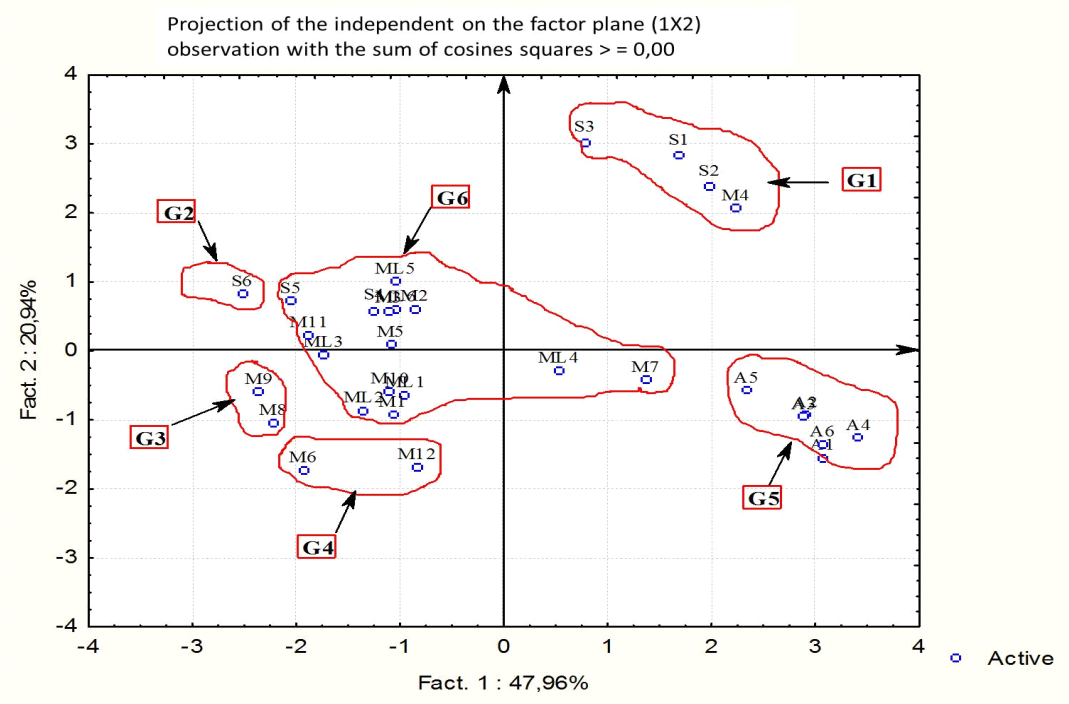

Fig.7.b. Factorial axis

The principal axes separate records in six separate groups, each of which is characterized by the parameters they correspond to the circle of correlations:

G1: the four surveys in this group are characterized by high sand reflecting their exposure to wind erosion especially (removal of fine particles by the wind).

G2: composed of a single survey (S6) is characterized by high levels of total limestone and thin that it can be explained by the slope (5%) that promotes runoff and thus the disappearance of a layer of soil and outcrop usually limestone (fragments of limestone slab).

G3: This group consists of records containing relatively high levels of organic matter and clay (M8 andM9). Generally it is the characteristics of alluvial soils.

G4: the two surveys M6 and M12 are characterized by high levels of silt.

G5: includes six surveys of the municipality of Ain Skhouna characterized on one hand by mildly elevated salt levels because of their presence near the Chott, and secondly by a greater thickness compared to other surveys resulting from the accumulation of sand (the advancement of sand).

G6: includes the remaining surveys that reveal a degradation of soil conditions not reaching the threshold of irreversibility. These soils require proper care for their rehabilitation.

From this analysis it appears that the soils studied are affected by the process of decay, but to different degrees. Some factors responsible for this decline: Silting, this phenomenon is growing more and heading south; Salinity, This process is very marked in the area of Chott Ech Chergui and erosion accentuated by the slope and the absence of vegetation cover (drought and overgrazing).

The study area is characterized by the social constraints that are summarized in the ... Presently political, social and economic globalization is accelerating in the North African drylands, eliciting changes in society, livelihood and land use (Millenium Ecosystem Assessment, 2005). Previous land users are replaced by new ones who have a different cultural and economic background and who often start farming with little or no experience in commercial rangeland management (Falk *et al.*, 2010).

Overgrazing has its share in the degradation of the steppe ecosystem. It is due to the increase in livestock face a reduction forager offer Moreover, exploitation drilling and water points High volume without pastoral organization, causes large concentrations of livestock around boreholes and causes the formation of aureoles desertified on shelves in 5 to 15 km perceptible images satellite (Bouazza,1995).

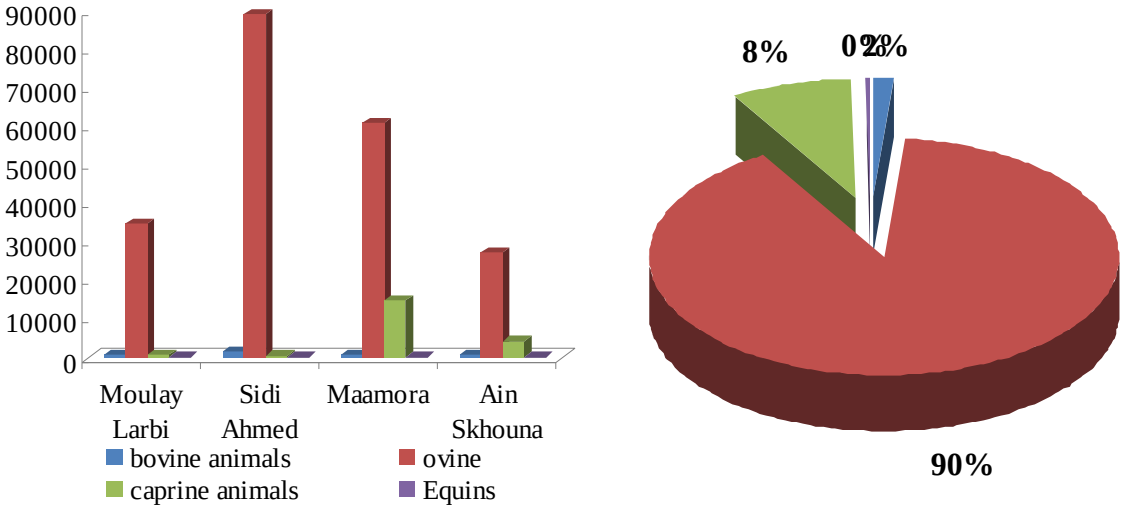

Fig.8. Apportionment of livestock by commune (a) and distribution of livestock in the study area (b)

CONCLUSIONS

As the saying goes “Prevention is better than cure” is as true for the phenomenon of desertification, so it makes sense to prevent this than fighting it. This less costly, requires a series of steps to reduce the severity of the process.

Based on this experiment results and previous research, we should conclude that the study area needs particular importance from the government. On the whole in the fight against desertification driving approach will undoubtedly significant results that are tracked in this study whose it would be very wise to

recommend a good set of response actions: restoration, rehabilitation and reassignment.

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