



Desertification of arid Rangelands in Morocco

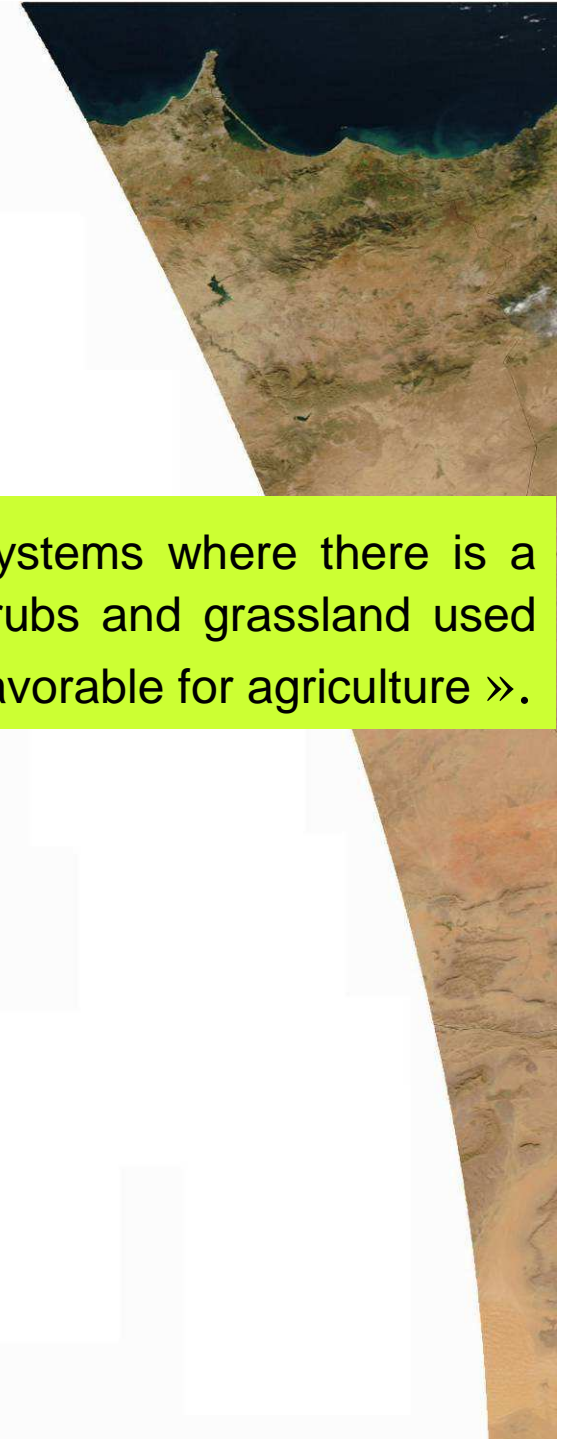
H. Mahyou, B. Tychon, R. Balaghi, J. Mimouni & R. Paul

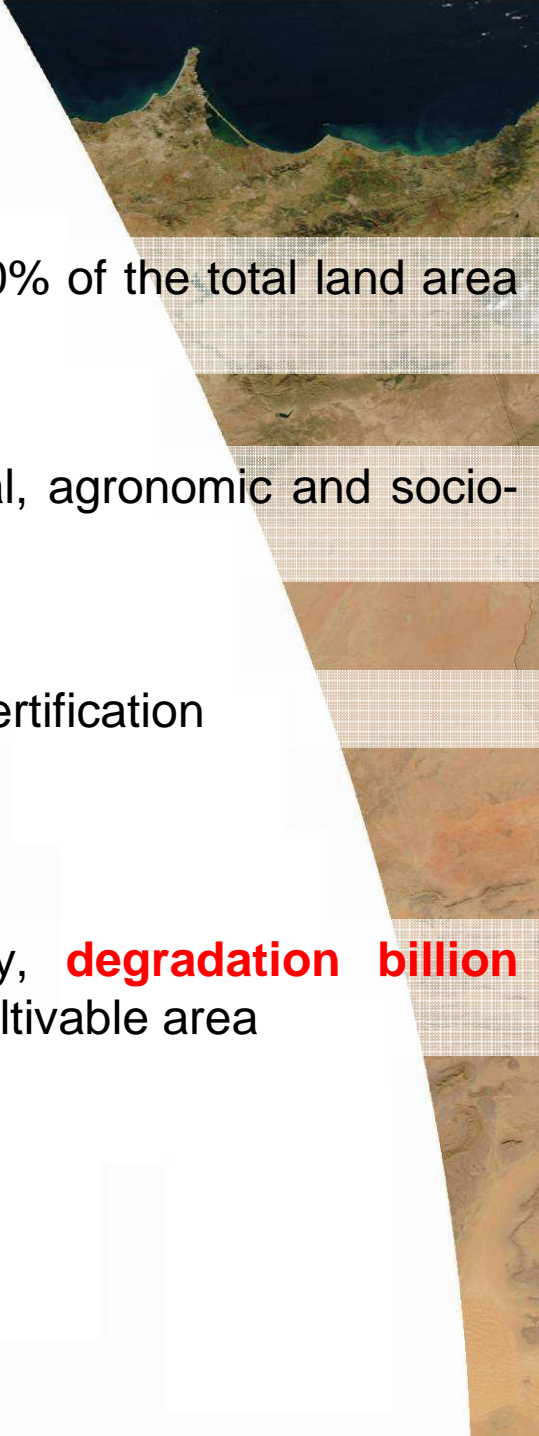
TROPICULTURA, 2010, 28, 2, 107-114

Introduction

Definition of rangeland

« Rangeland or natural arid pastures of Morocco are ecosystems where there is a natural or semi-natural vegetation composed of steppes, shrubs and grassland used primarily for livestock production, climate and soil are very unfavorable for agriculture ».





● Most rangeland are in arid and semi-arid (cover more than 40% of the total land area of the globe)

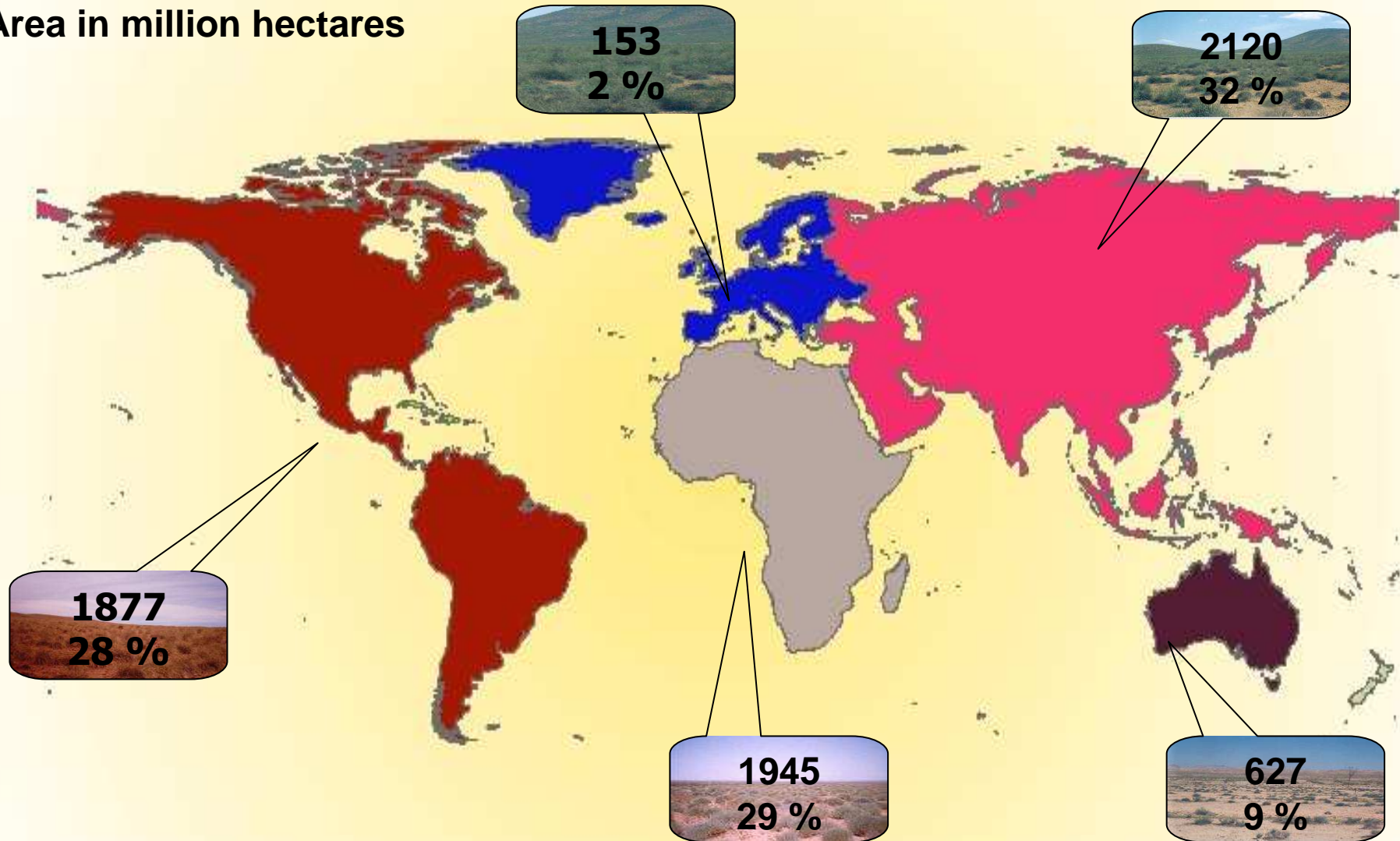
● Rangelands play an important role in terms of environmental, agronomic and socio-economic development.

● It is widely recognized that these lands are threatened by desertification

● Most visible consequences of desertification are poverty, **degradation billion hectares of rangelands**, degradation of rainfed and irrigated cultivable area

Distribution of rangelands in the world Adapted by Word Resources Institute (1986)

Area in million hectares



Total = 6,7 billion of which 3.3 billion hectares degraded

Desertification

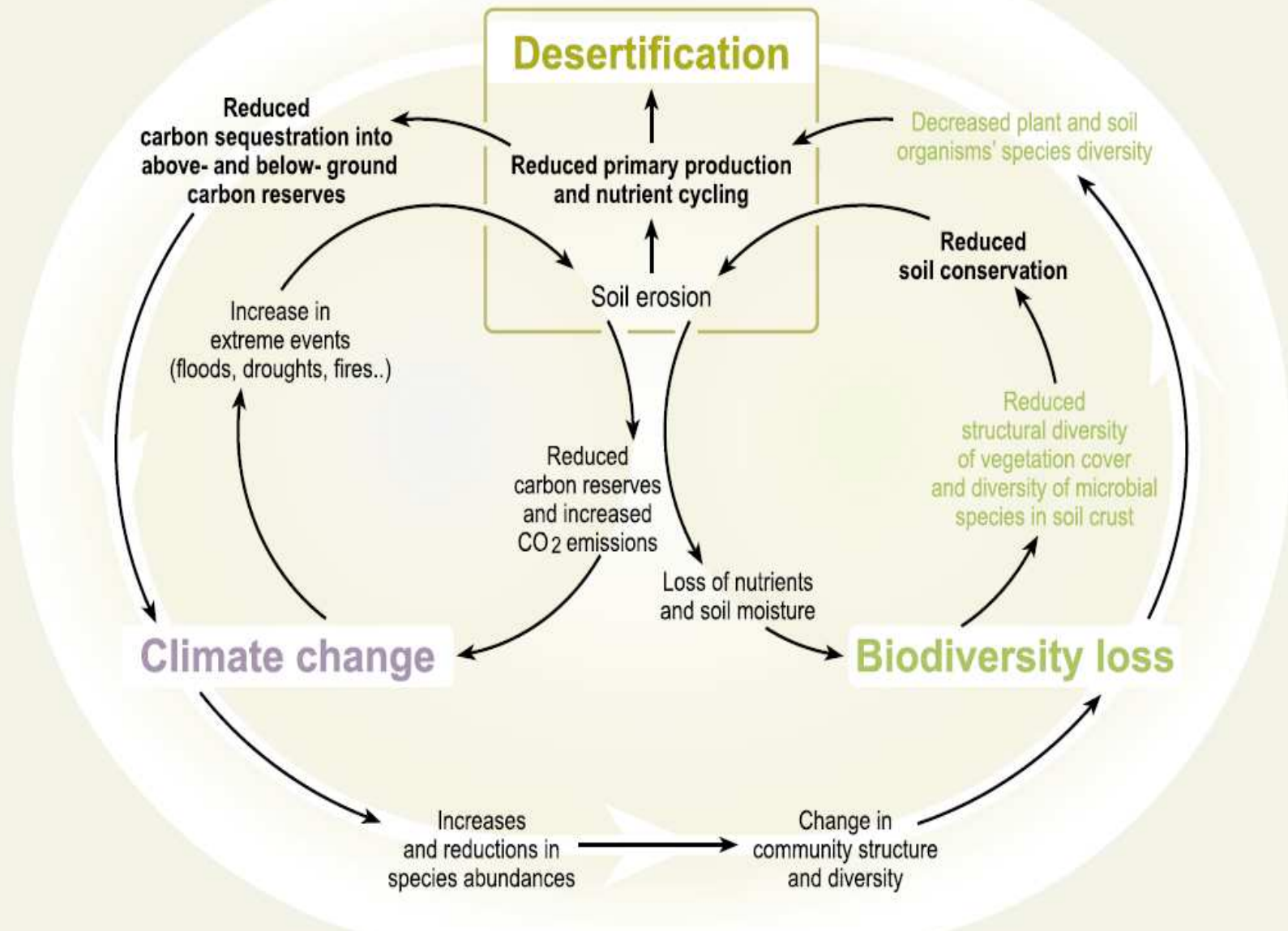
« Desertification means land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including **climatic variations** and **human activities**; ».

"land degradation" means reduction or loss, in arid, semi-arid and dry sub-humid areas, of the **biological or economic productivity** and complexity of rainfed cropland, irrigated cropland, or **range, pasture**, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as:

- (i) **soil erosion caused by wind and/or water**;
- (ii) **deterioration of the physical, chemical and biological or economic properties of soil; and**
- (iii) **long-term loss of natural vegetation**;

UNCCD (1994)

Desertification is closely linked to biodiversity loss and contributes to global climate change.



in green: major components of biodiversity involved in the linkages
bolded: major services impacted by biodiversity losses

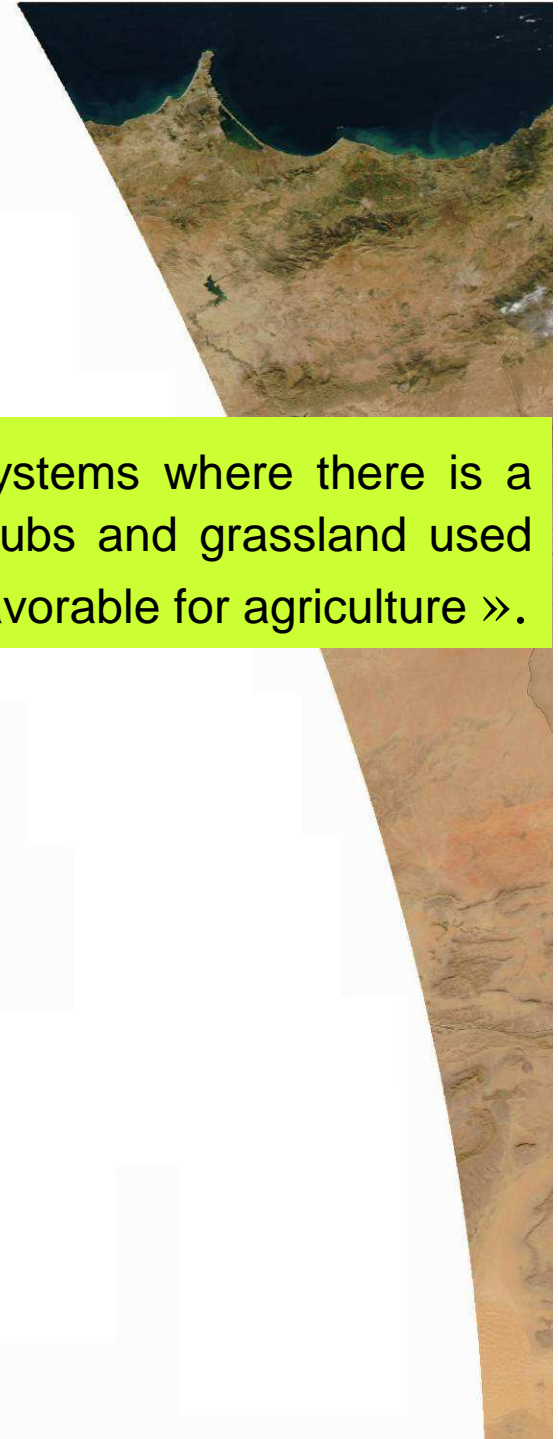
Source: Millennium Ecosystem Assessment

Natural Rangeland and pastoral ecosystems in Morocco



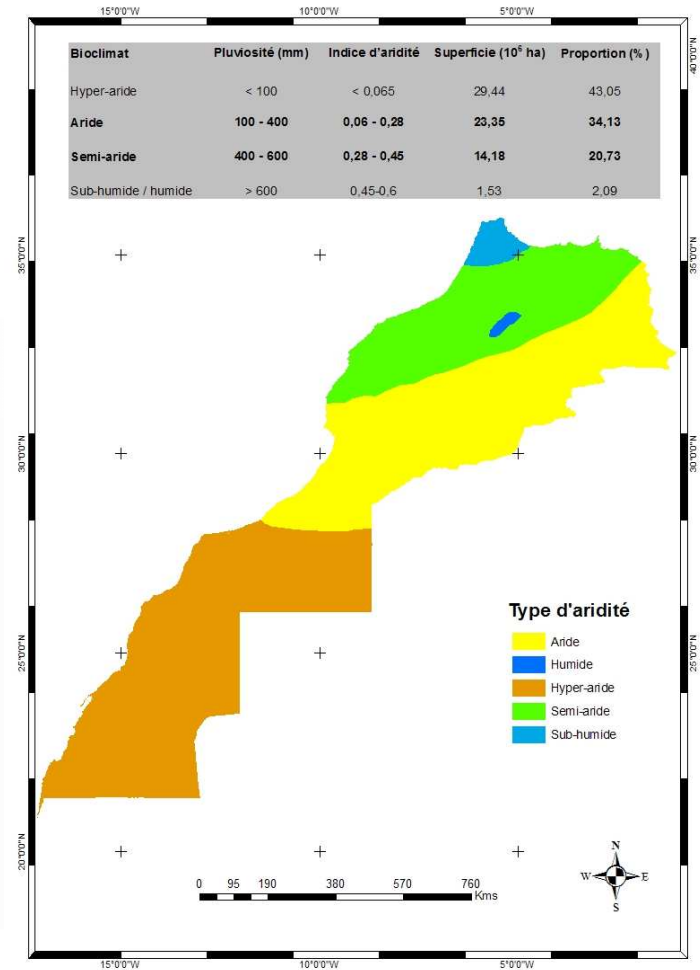
Definition of Moroccan rangelands

« Rangeland or natural arid pastures of Morocco are ecosystems where there is a natural or semi-natural vegetation composed of steppes, shrubs and grassland used primarily for livestock production, climate and soil are very unfavorable for agriculture ».



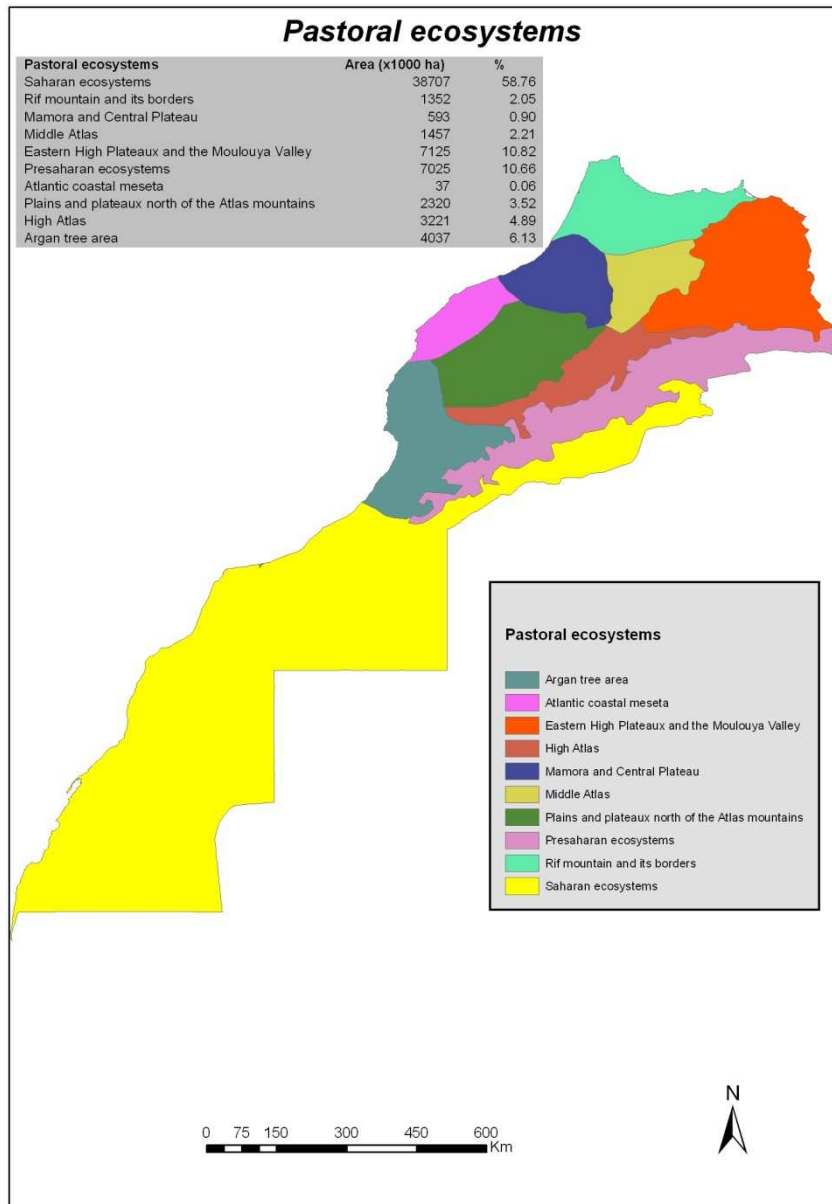
Most of these rangelands are in arid and semi-arid area and are located in areas where isohyets less than 600 mm / year.

Arid and semi-arid represent more than 54% of the total land surface.



Zoning and estimating the area of the aridity in Morocco.
Source: DMN and WMO

Pastoral ecosystems in Morocco



• Ten pastoral zones can be distinguished according to topography, climate, vegetation and use.

• They cover about 82% of the Moroccan arid lands

• These areas represent livelihoods for thousands of people and protect the country from desertification



● Despite the importance of the rangelands and the threat of desertification, **it is surprising that up to date there is no comprehensive assessment of their condition and their evolution**, hindering any plan for desertification alleviation.

Purpose: to present an overview of the threat of desertification in Moroccan arid rangeland, determine the causes and to analyze the consequences based on available information on selected **pilot areas**.

Actual situation of arid rangeland in Morocco





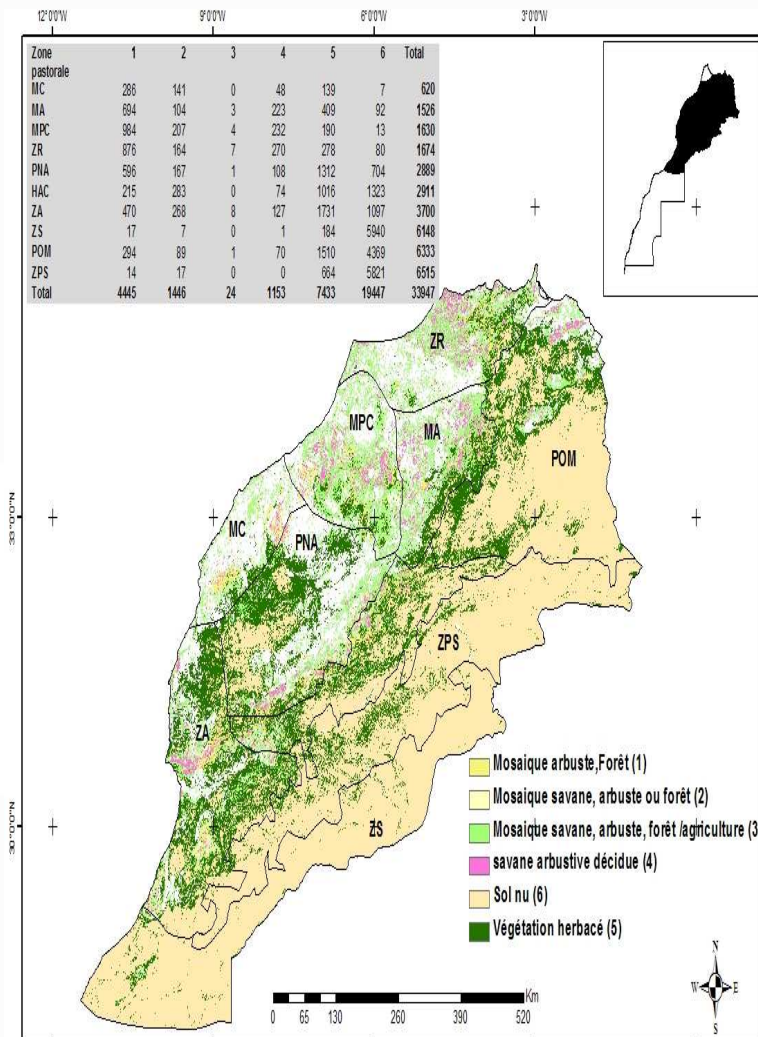
● The **only map available**: "Globcover" developed in 2008, is the only reference land cover to medium spatial resolution which covers Morocco.

● Globcover map based on the classification system of land from FAO (LCCS) with a spatial resolution of 300 meters and an accuracy of 73.1% .

<http://postel.mediasfrance.org/fr/PROJETS/Pre-operationnels-GMES/GLOBCOVER/>

Rangeland cover in the arid region of Morocco

Figure: Rangeland cover of arid morocco
Global Land Cover for Africa (GLC 2000) et MARA



MC : Meseta Côtière **MPC** : Zone de la Mamora et Plateau Central **RB** : Zone Rifaine et ses Bords
MA : Le Moyen Atlas **PNA** : Plateaux et Plaines Nord Atlasiques **HAC** : Zone du Haut Atlas Central et Oriental
ZA : Zone de l'Arganier **ZS** : Zone Saharienne **ZPS** : Zones Présahariennes
POM : Plateaux de l'Oriental et Vallée de la Moulouya

Table: Area and percentage of different rangeland types

Rangeland types	Area (X1000 ha)	(%)
Mosaic vegetation (grassland/shrubland/forest) (50-70%) / cropland (20-50%)	4445,9	10,7
Mosaic forest or shrubland (50-70%) / grassland (20-50%)	1445,4	3,5
Mosaic grassland (50-70%) / forest or shrubland (20-50%)	24,2	0,1
savane arbustive décidue	1153,2	2,8
Sparse vegetation (<15%)	7428,5	17,8
Bare soil	19463,9	46,7

Savane herbacée ouverte: *Stipa tenacissima*, *Anabasis aphylla*, *Noaea mucronata*, *Peganum harmala*, *Artemisia herba-alba*, *Thymus spp.*, *Anvillea radiata*, *Launaea acanthoclada*, *Stipa parviflora*.

Savane arbustive décidue : *Argania spinosa*, *Ziziphus lotus*, *Stipa capensis* et *Asphodelus fistulosus*, *Vella mairei*, *Bupleurum spinosum*

Désert rocheux: des steppes dégradées de *Stipa tenacissima*, *Noaea mucronata*, *Lycium intricatum*, *Helianthemum spp.*, *Halogeton alopecuroides*, *Hammada scoparia*, *Aristida spp*

Indicators of rangeland desertification

● The indicators of desertification can be divided into three independent groups: **physical**, **biological** and **socio-economic** indicators.

● The lack of publications on all these indicators of degradation on arid rangeland leads us to approach only the biological indicators mainly those related **to the plant**.

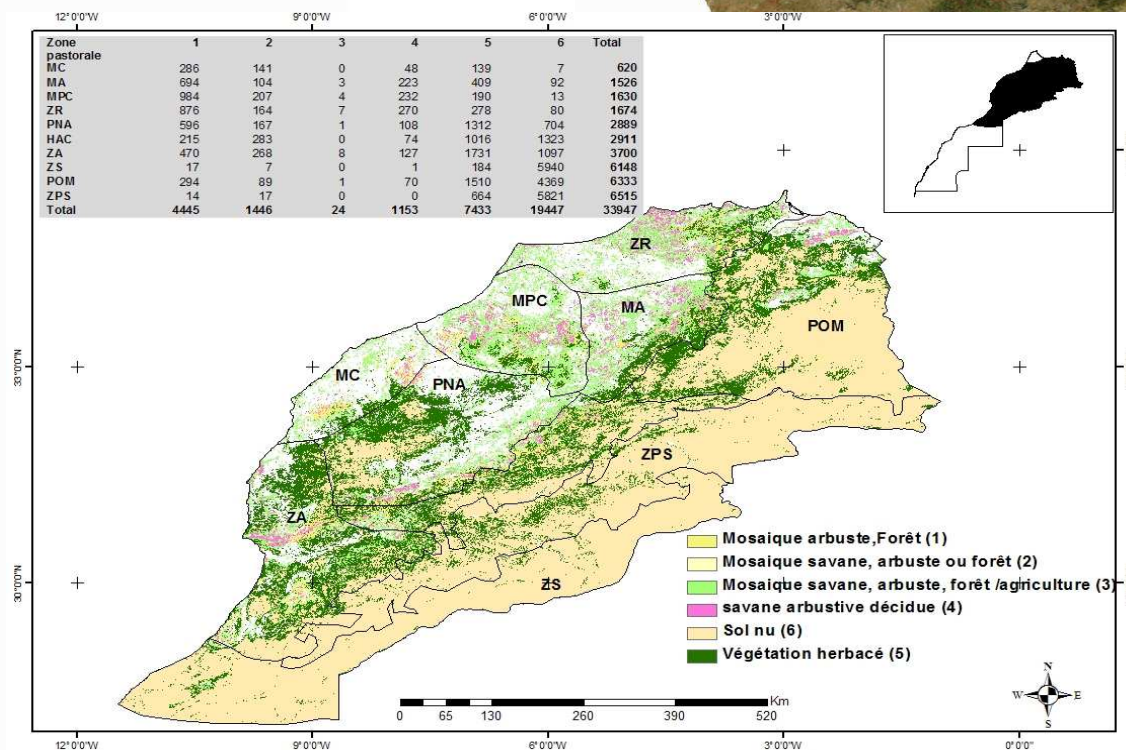


Indicators of rangeland desertification

Reduction of area and the biodiversity

Area desertified in different ecosystems pastoral

	Superficie parcours (x1000ha)	Surface désertifiée (x1000ha)	(%)
Total	33961	19464	57
ZS	6148	5940	97
ZPS	6515	5821	89
POM	6333	4369	69
HAC	2911	1323	45
ZA	3700	1097	30
PNA	2889	704	24
MA	1526	92	6
ZR	1674	80	5
MPC	1630	13	1
MC	620	7	1



Occupation du sol des terres de parcours (en 1000 ha) dans la zone aride.

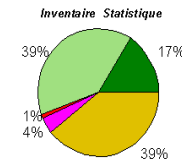
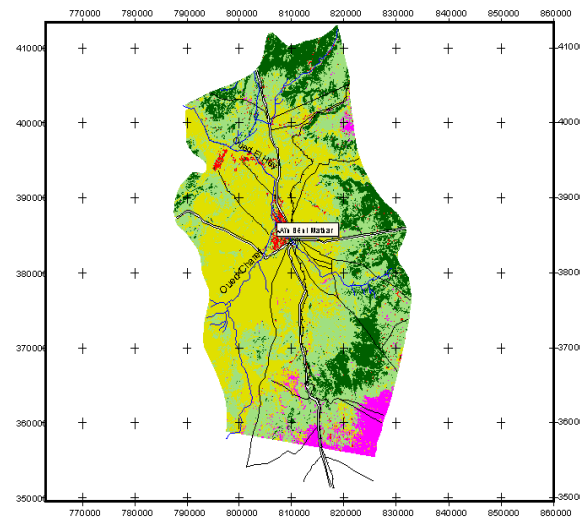
 Bare soils represent **69%** of the surface of the POM

Indicators of rangeland desertification

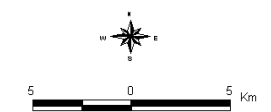
1988

- Analysis of two images satellite Landsat (1988 and 2000) in the pastoral perimeter of Ain Blessed Mathar in the north of the POM.
- Annual loss of 3% of stipa and Artemisia herba alba steppes.
- tendency towards the disappearance of the Artemisia herba alba steppes

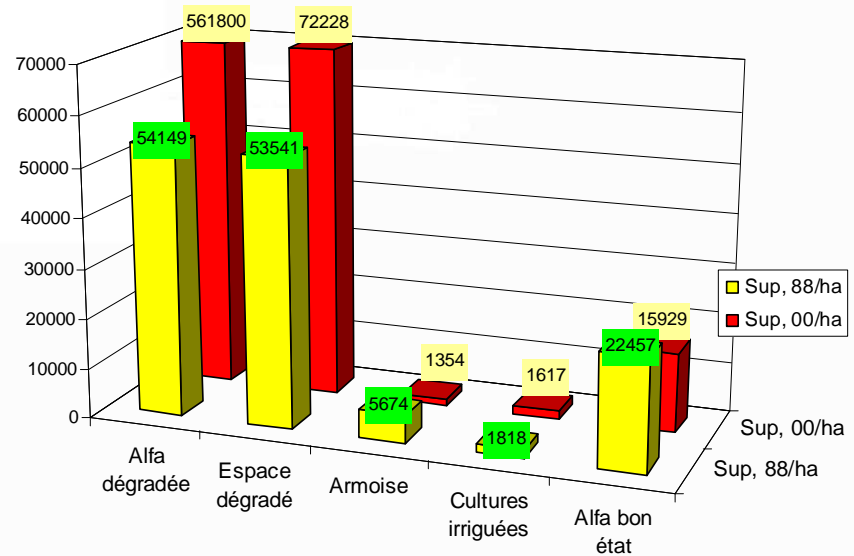
Carte de l'occupation de l'espace de la CR de Béni Mathar (Mars 88)



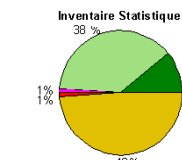
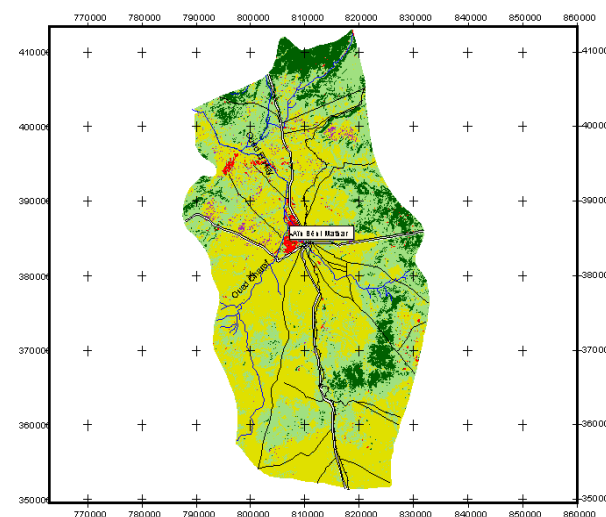
- Légende**
- Route principale
 - Route secondaire
 - Voie ferrée
 - Oueds
 - Alfa bon état
 - Alfa dégradé
 - Culture
 - Armoise dégradé
 - Sol nu avec espèces de dégradation



2000



Carte de l'occupation de l'espace de la CR de Béni Mathar (Mars 2000)

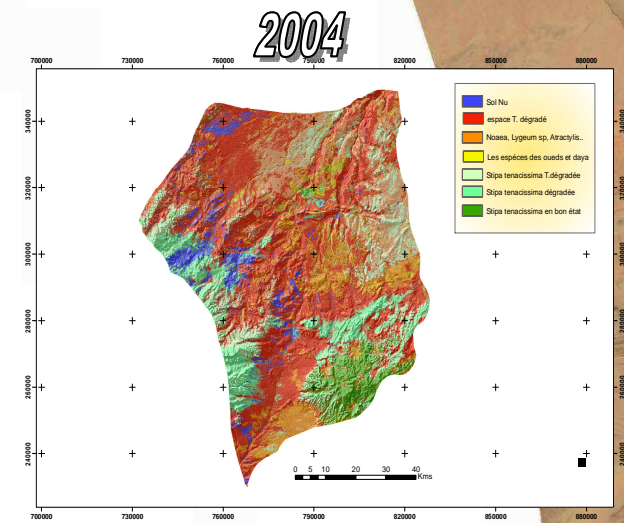
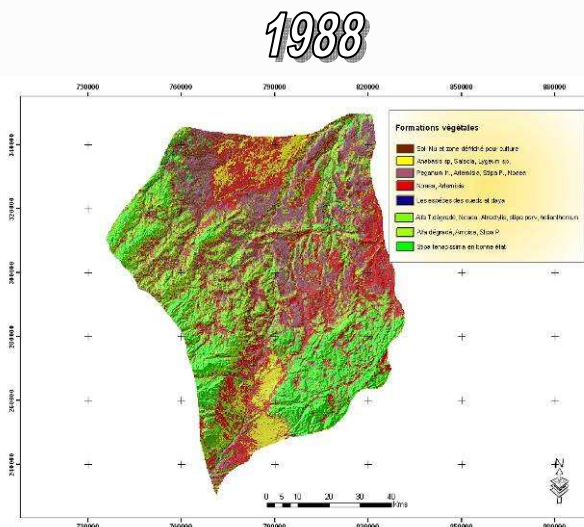
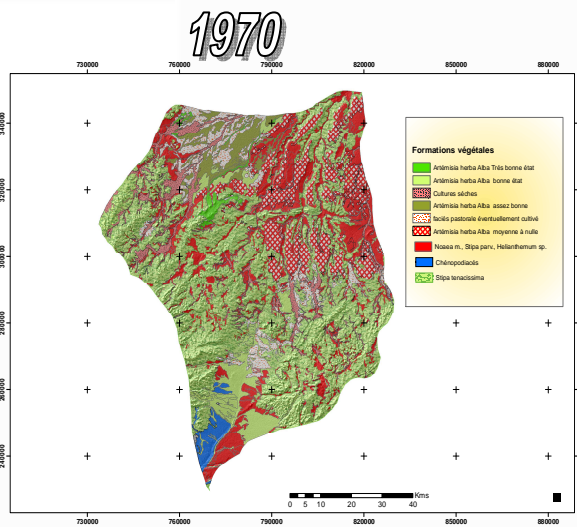


- Légende**
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Indicators of rangeland desertification

● The three periods comparison (1970, 1988 and 2004) respectively by a land cover map and two Landsat satellite images covering 700 000 ha in the south of the POM shows a reduction of surfaces of the steppes and a change in the floristic composition of the various facies

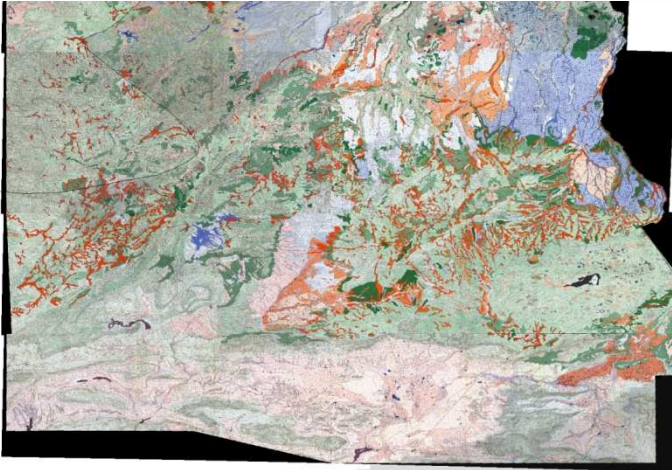


comparaison entre les trois phases

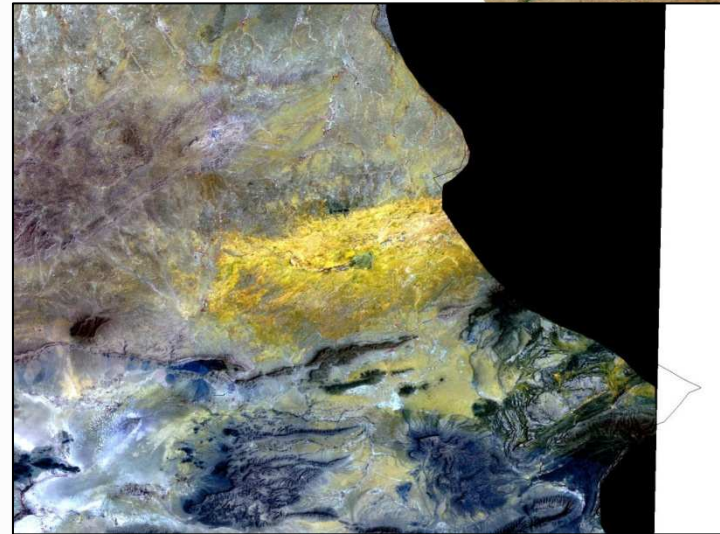
1970	(%)	1988	(%)	2004	(%)
Cultures en bour	0,3	Sol Nu et zone défriché pour culture	4	Espace dégradé+sol nu	58
Armoise	6,7	Anabasis sp, Salsola, Lygeum	5	Les espèces des oueds et daya	3
Armoise + sp des oueds	10,7	Peganum h., Artemisia, Stipa P., Noaea	21	Noaea, Lygeum sp, Atractylis..	10
Faciés pastoral éventuellement cultivé	6,3	Noaea, Artemisia	24	Stipa tenacissima dégradée à très dégradé	23
Noaea, stipa parv, helianthemum	30,2	Stipa tenacissima dégradé à très dégradé, Armoise, Stipa P.	28	Stipa tenacissima bon état	5
Chénopodiacés	1,6	Stipa tenacissima en bonne état	17		
Stipa ténacissima	44,2				

Desertification

1970



2010



Indicators of rangeland desertification

Reduction of the rangeland productivity

Spatial variability of the pastoral production

Zone pastorales	Production Kg MS/ha/an
Zones Présahariennes	300-590
Zone du Haut Atlas Central et Oriental	240-600
Plateaux et Plaines Nord Atlasiques	750-830
Meseta Côtière (MC)	590-883
Zone de l'Arganier (ZA)	inférieure à 200
Plateaux de l'Oriental et Vallée de la Moulouya (POM)	10 et 100

Temporal variability of the pastoral production

Tableau: Pluviométrie et productivité des parcours (Kg MS/ha) durant trois années (1970, 1989, 2006) au niveau de l'Oriental

	Annual rainfall (mm)	Production minimum	Production maximum	Production moyenne	CV (%)
1970	122	30	815	272	89
1989	172	25	500	156	71
2006	215	10	100	44	61



Indicators of rangeland desertification

- Starting 1996, the increase in the rainfall is not related to the productivity

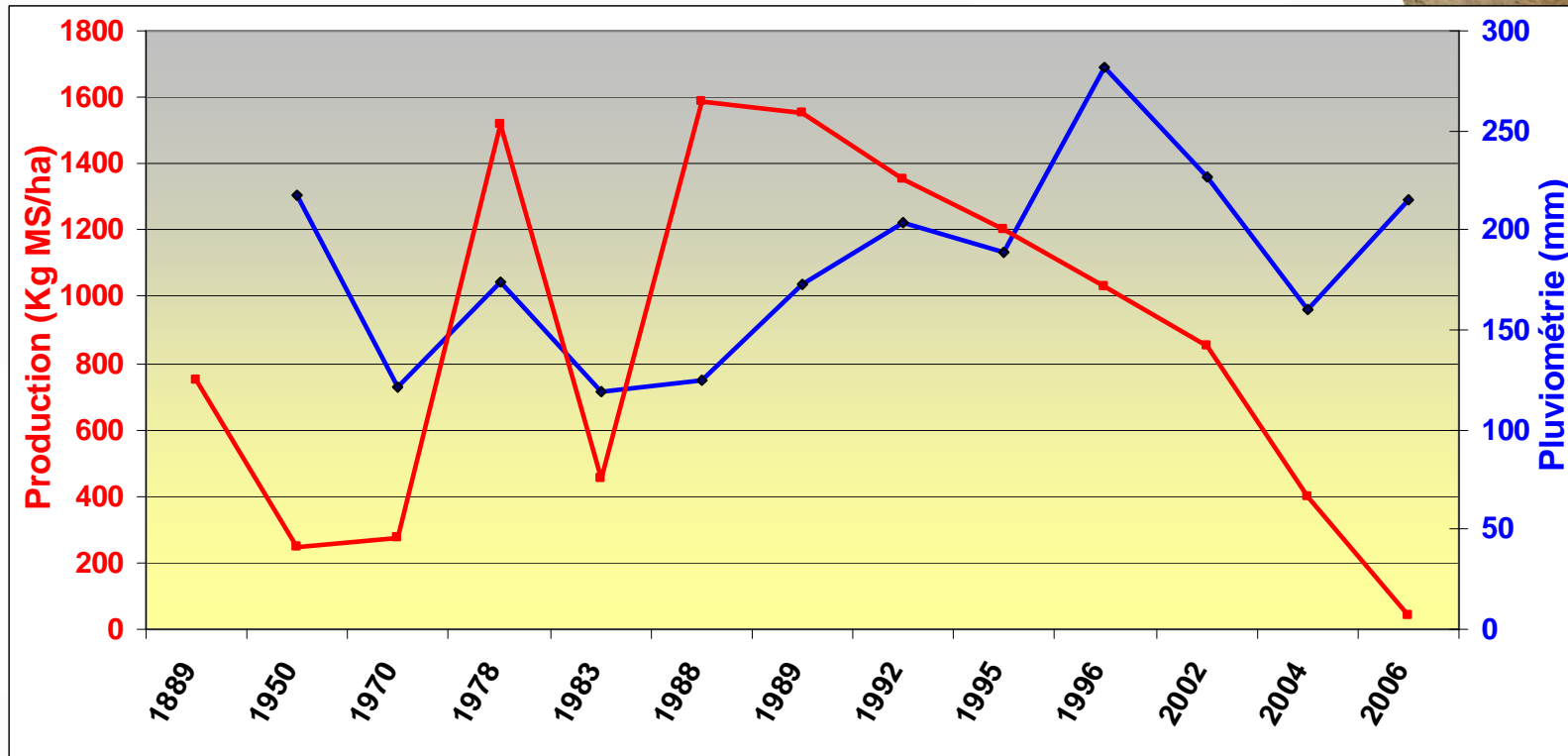


Figure : Variabilité interannuelle de la production des steppes alfatières et de la pluviométrie dans l'écosystème POM.


In general

- Plant cover is generally lower **than 10%** in the majority of the rangeland.
- The forager production varies there between **20 and 60 Forage Units** per hectare.
- The contribution of the rangeland in the forage assessment of the livestock was strongly reduced, passing from 37% to 21% between the periods 1989 to 1992 and 2000 to 2003.

Causes of the desertification

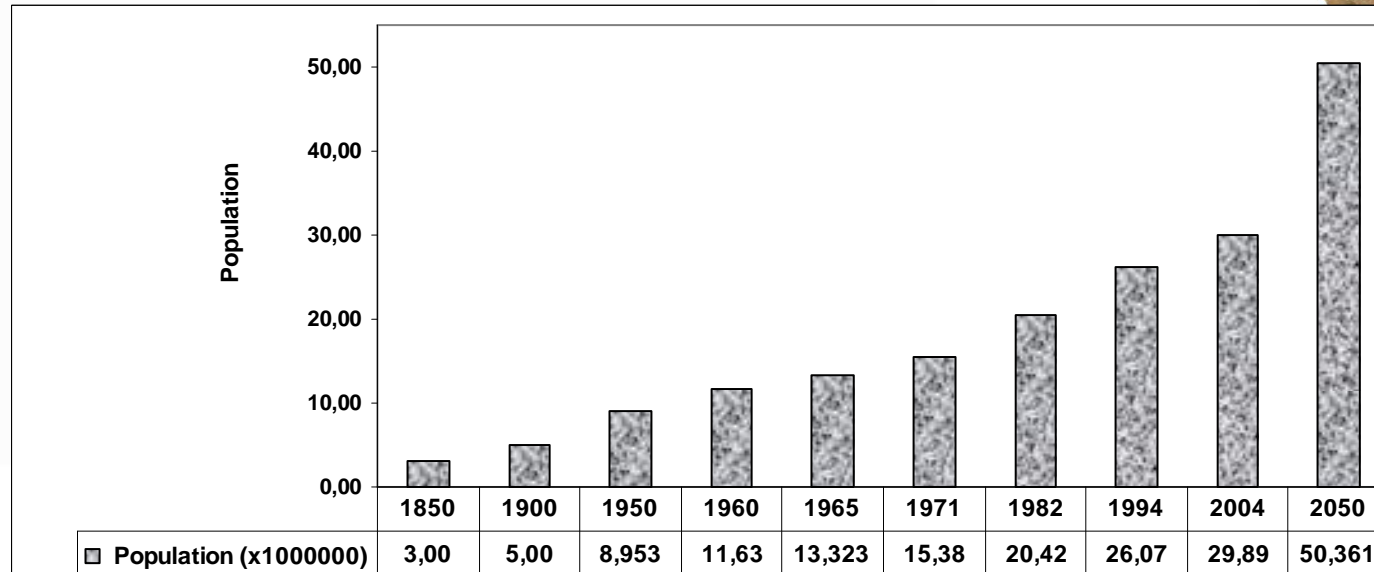


The desertification of the rangelands is caused by a combination of factors which evolve/move in time:

- Indirect factors, such as the population growth, and direct factors, like the practices of use of these rangeland and the climate changes.
- 

Causes of rangeland desertification

Population growth.



● From 1950 to 2004, the Moroccan population **has triplet** and future projections show that it will exceed the 50 million inhabitants in 2050 because of a strong growth

● Change in the mode of consumption and a high demand of the products resulting from the pastoral zones

Causes of rangeland desertification

The current climatic tendencies supports the degradation of rangeland initiated by the anthropic action.

- Spring precipitations decreased by 40% and the number of dry days increased 15 days on average since the Sixties
- A break point in the rainfall time series of Eastern Morocco
- The most important rainfall deficits occurred during spring.
- A rise of 0,5°C for the minimal temperatures and averages since 1936.

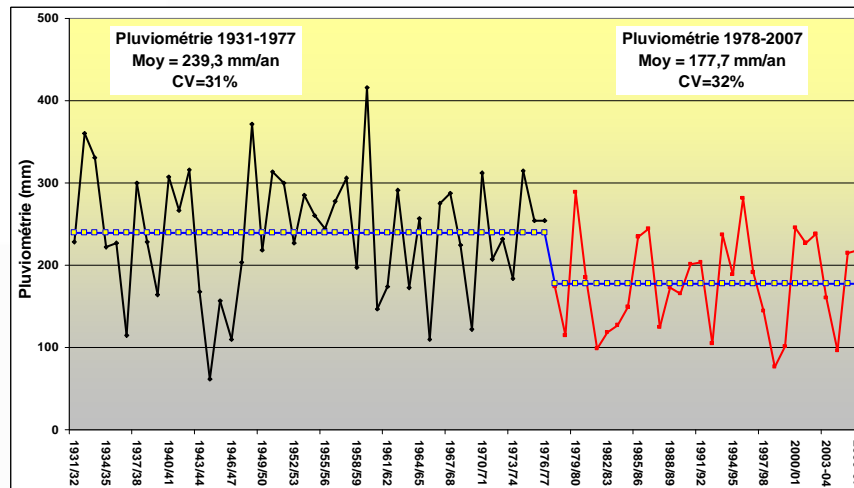
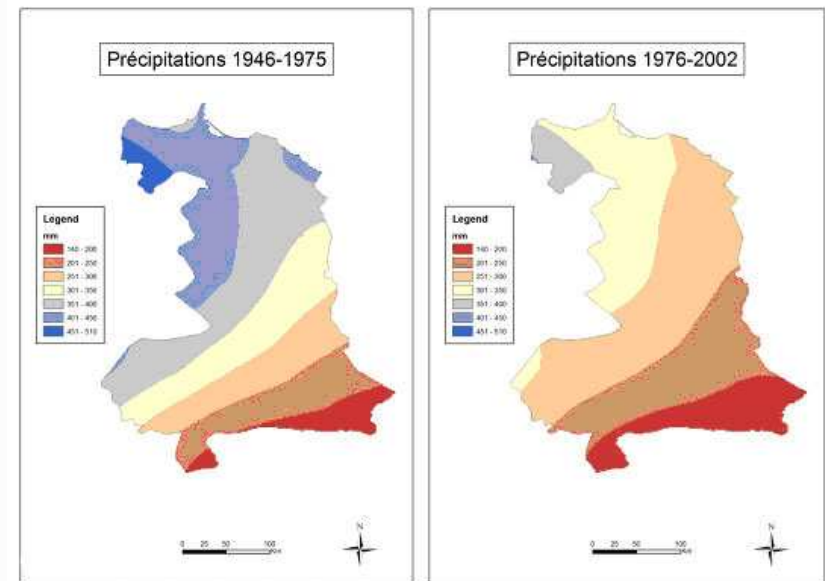


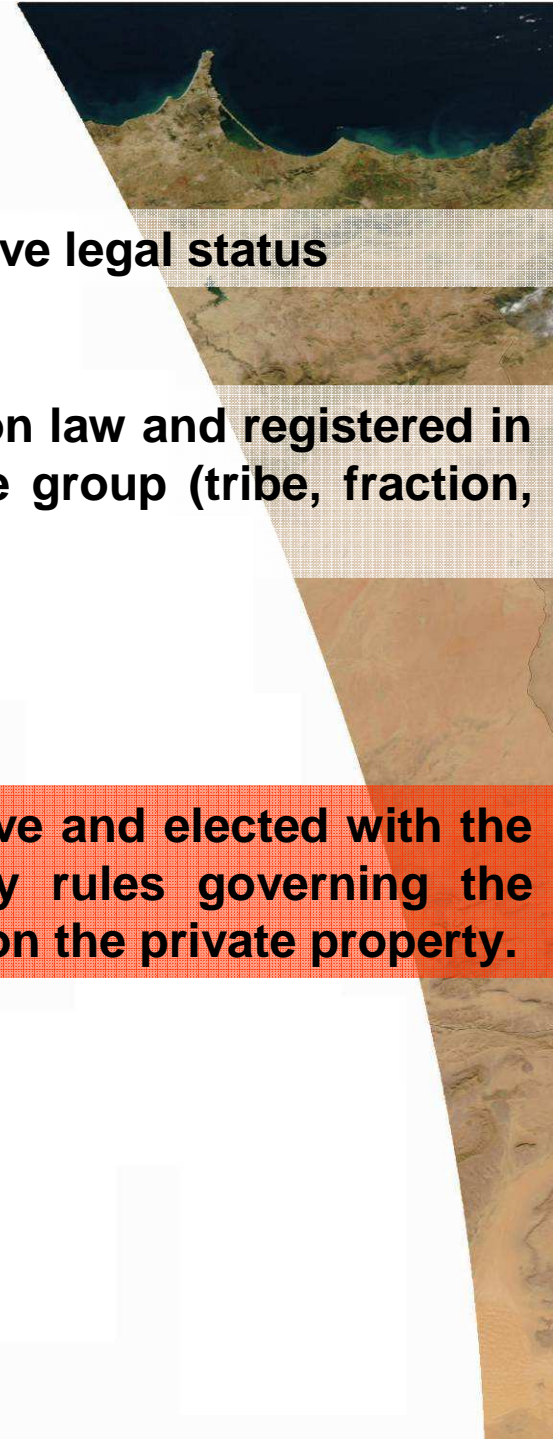
Figure: Variation de la pluviométrie annuelle dans la zone pastorale POM



Causes of rangeland desertification

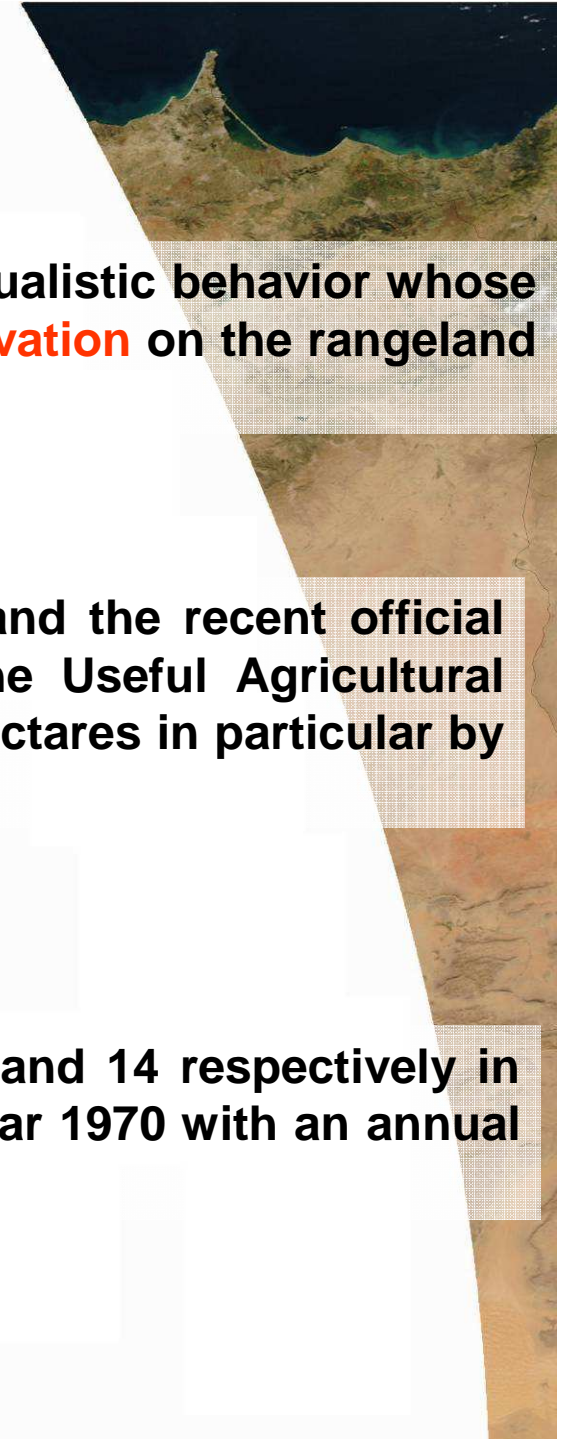
Rangeland cultivation

- The Moroccan rangelands have for the majority a collective legal status
- The rule applied in these area, resumption of the common law and registered in the modern right affirms that it is the membership of the group (tribe, fraction, chalk-lining.) who opens the right to the collective pasture.
- The progressive substitution of the entities administrative and elected with the usual Community organizations blocked the community rules governing the access to the rangeland, for the benefit of the rules based on the private property.



Causes of rangeland desertification

- This change is determined more and more by an individualistic behavior whose most plausible expression is the **the extension of the cultivation** on the rangeland with an aim of appropriate these area individually
- The comparison between the RGA of 1974 and 1996 and the recent official statistics of the Ministry for Agriculture reveals that the Useful Agricultural Surface (SAU) passed from **7.2** to **8.5** then to **9.2** million hectares in particular by the means of the **cultivation of the rangeland**.
- The cultivated area in rangeland were multiplied by 5 and 14 respectively in the south and the north of the POM in reference to the year 1970 with an annual rhythm of 500 ha and 300 to 400 ha



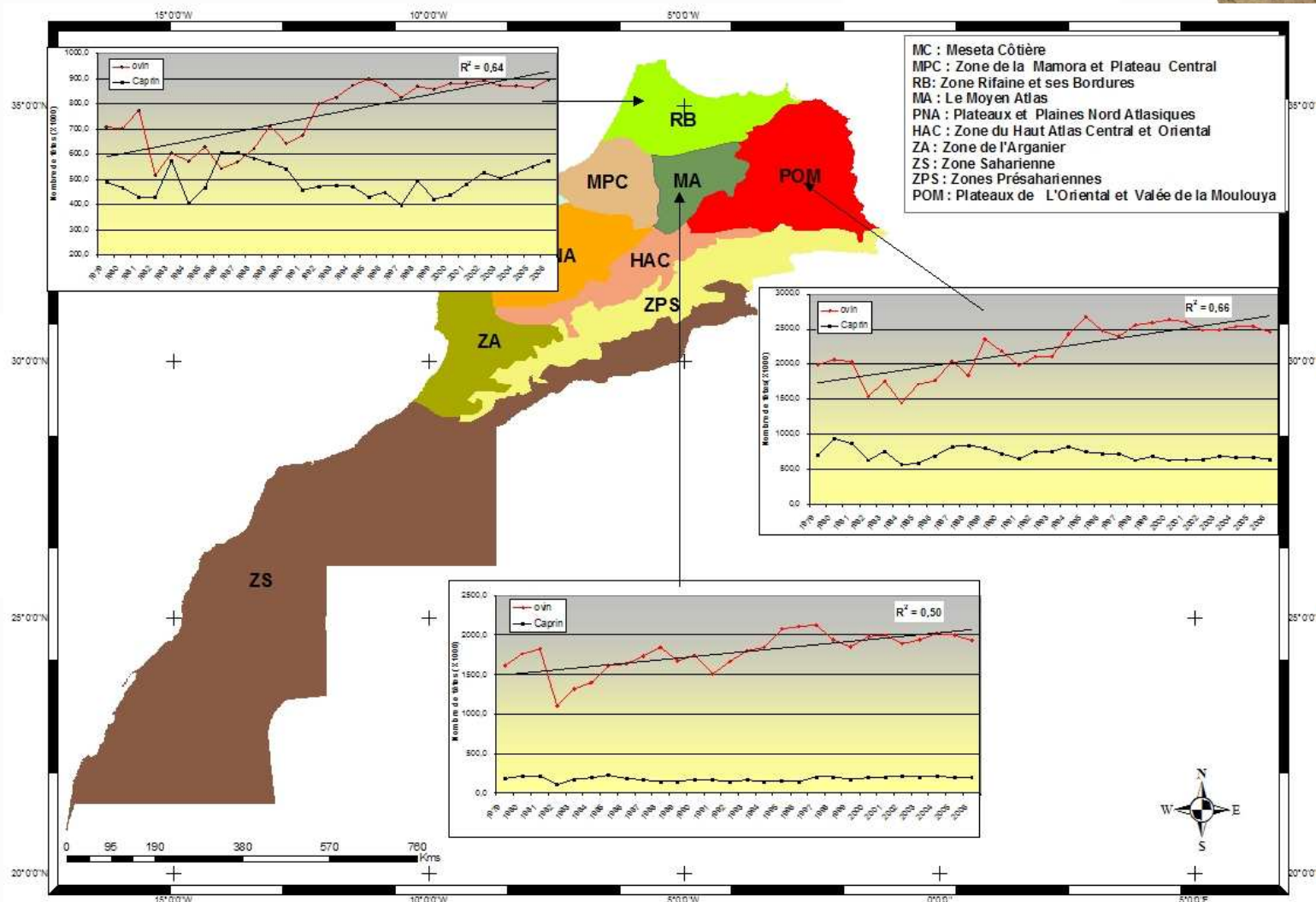
Causes of rangeland desertification

Overgrazing

- The progressive disappearance of the management of the rangeland by the traditional Community organization generated the emergence of a situation of “Common tragedy” where a strong competition on the pastoral resources is noticed between the population of different ethnic groups.
- The rangelands are the principal source of feed for the small ruminants in the various pastoral ecosystems.
- The small ruminants exceed 22 million heads of which 76% are sheep

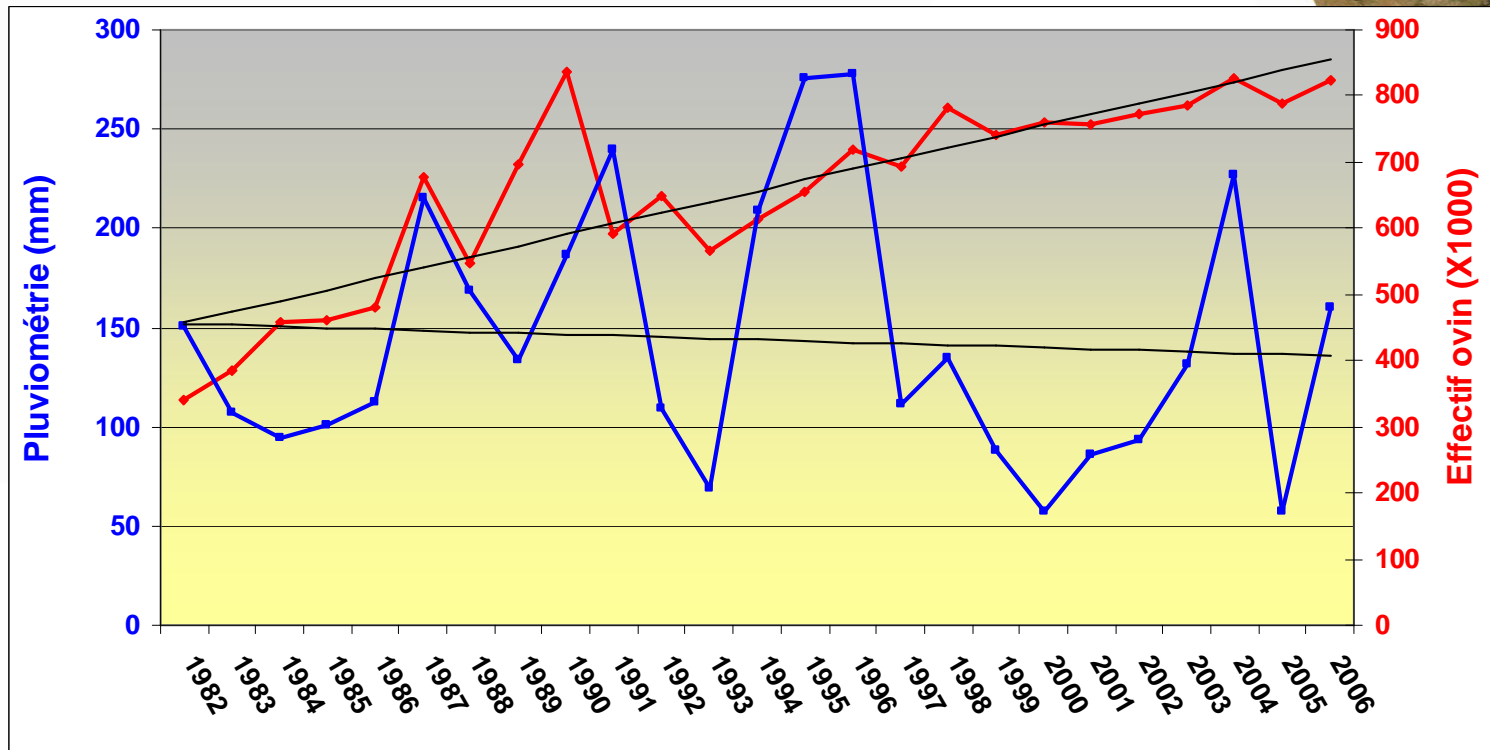


- During the last twenty eight years, sheep livestock population increased, while the goats decreased. The tendencies varied from one pastoral zone to another
- In the rif mountains (RB) known for goat production, sheep population has also increased due to acquisition of commercial feed and reduction of rangeland use.



Starting 1996, the increase in the livestock is not related to the rainfall

Exemple de la province de Figuig est frappant. Malgré une légère tendance de la pluviométrie à la baisse (-0.25%/an), le cheptel ovin augmente de façon extraordinaire, en moyenne de 16500 têtes/an (+4%/an).



During drought periods, the Moroccan government created a “safeguard funds of the livestock” which allowed the population to benefit from subsidized feed.

Use of subsidized feed resulted in more degradation because of concentration of animals on the expense of the mobility.

Conclusion

The available information on selected **pilot areas** shows that these rangelands are threatened by desertification. It's associated with biodiversity loss and contributes to climate change.

Rangeland degradation caused primarily by an overexploitation of pastoral resources and change in the rangeland use..

The establishment of a comprehensive surveillance system based on remote sensing, biophysics and socio-economic data must be envisaged to provide policymakers with an operational tool adapted to the spatio-temporal monitoring of desertification

Thank you

