

**First Global International Studies Conference at  
Bilgi University, Istanbul, Turkey, 24- 27 August 2005:  
Fourth AFES-PRESS Workshop on Reconceptualising Security:  
“Security Threats, Challenges, Vulnerabilities and Risks”**

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**Mapping Desertification Vulnerability in Morocco**

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**Abstract**

Moroccan Natural resources have a slight resistance to desertification. More than 93% of country is arid and semi-arid. Drought is frequent and severe. Soils are mainly not very developed, shallow (<50 cm), silty-sand, with a low content of organic matter (<3%) and consequently very sensitive to all forms of degradation (mostly water and wind erosion, salinization, crusting, compression). The natural vegetal cover, mainly constituted by steppes and matorrals, is little resistant.

For more than 50 years, natural resources are suffering from an intense degradation. Under the pressure of a fast growing demography, cropping lands (subsidence) are taking the place of forest and range lands. Forests are overgrazed and overexploited, respectively for 3.5 and 3 times their capacities. Surface cover is losing more than 35 000 ha/year. Cropping lands with unsuitable cultural techniques are becoming eroded under the action of aggressive rains and runoff. Dam reservoirs are silted at an unacceptable rate (1.5 % yearly). Desertification is one of the most serious handicaps for the development of the Country. National Agriculture Strategy and National Forest Program developed for 2020 have as a main objective: combat desertification. Morocco signed the CCD and developed a national program to combat desertification. A lot of studies (diagnostic, processes) were necessary to reach this target.

This paper presents a study undertaken to map the sensitivity of Moroccan territory to desertification via three layers: climate, soil and vegetation cover. The climate was featured by an index of aridity. The data (T°C, P mm, ETP mm) of sixty five stations were used. The quality of the soils was determined by the maps of texture, depth, slope and parental materials. The quality of vegetation to combat desertification was determined by its resistance to drought, its fire risk and its capability of erosion control.

More than 2/3 of the national territory has a low climate quality. More than 63% are very arid. The vegetal cover has a low quality to protect against desertification. The most part of Morocco has a low fire risk (94.25%), a low protection against erosion (90%) and a low resistance to drought (75%). More than 40% of soils have a soft parental material. More than 50% are shallow. More than 73% have loamy and sandy textures. More than 80% of the Moroccan soils are vulnerable to desertification. In conclusion, the most part of the Moroccan environment has a low resistance to desertification mainly in the south and near the desert regions. The Government, in a common action (involving population and NGO) has to act quickly and efficiently. Human and rural developments are necessary to combat a deep poverty, the most responsible of deserts spreading and human emigration to Europe. Social security is closely linked to Ecological security.

**Key Words:** Morocco, Mapping, Desertification vulnerability, Climate quality, vegetal cover quality, soil quality.

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## **INTRODUCTION**

Located in the north-west of Africa between the northern latitude of 21 and 36°, Morocco has two maritime faces on the Mediterranean sea (512 km) and Atlantic ocean (2934 km). Having a reputation of contrasted country, Morocco presents a great diversity of landscapes and human societies. It's distinguished from the other maghrebien countries by its high mountains, Rif in the north and Middle and High Atlas in the central part. Those mountains (most part above 3 000 m) divide the country in to two great parts: the north-west region facing the Atlantic Ocean is humid and has some agricultural production potentialities and the South-Eastern region facing the desert and endures its impact.

Agricultural (8.7 millions ha), forest (5.8 millions ha), steppes (3.2 millions ha) and range lands (22 millions ha) only represents 55.3 % of the whole country (71 millions ha). The rest is represented by waste lands. The agricultural production is dominated by cereals (hard and soft wheat), more than 60% of the total surface. The agricultural sector, even it has great potentialities, suffers from many constraints that limit its development: water scarcity, climate severity, unfavorable land tenures, low fertility of lands and inadequate cultural techniques.

All of agricultural lands represent less than 12% of the whole surface with only 13% irrigated. The rest (87%) is rain-watered and is subject as the waste lands also to different phenomena of desertification: water and wind erosion, salinization and sand dunes. 73 % of agricultural lands are concerned with water erosion. More than 93% of the national territory is constituted by arid and semi-arid lands and is suffering from desertification. Land degradation results from climatic changes and human activities (overgrazing, overexploitation). Since the eighties, rainfalls are more irregular and less important. Sensitive lands were spreading out.

For more than 50 years, natural resources are suffering from an intense degradation. Under the pressure of a fast growing demography, cropping lands (subsidence) are taking the place of forest and range lands. Forests are overgrazed and overexploited, respectively for 3.5 and 3 times their capacities. Surface cover is losing more than 35 000 ha/year. Agricultural lands with unsuitable cultural techniques are becoming eroded under the action of aggressive rains and runoff. Dam reservoirs are silted at an unacceptable rate (1.5 % yearly). Desertification is one of the most serious handicaps for the development of the Country. Consequently, the demographic pressure is becoming more intense with dangerous results: desertification of the most part of the country and emigration of population to growing cities (Casablanca, Fez, Rabat) and Europe (Spain, Italy, France, Belgium, Germany, Holland).

National Agriculture Strategy and National Forest Program developed for 2020 have as a main objective: combat desertification. Morocco signed the CCD and developed a national program to combat desertification. The available knowledge of desertification and land degradation, notably by water and wind erosion, sand dune, salinization and water logging, are insufficient and sketchy. A lot of studies (diagnostic, processes) were necessary to reach this target.

To contribute to this objective, this study was undertaken to map the sensitivity of Moroccan territory to desertification via three layers: climate, soil and vegetation cover. Each of them was determined by a specific methodology. The objective is to build an information system as a tool to help decision makers in combating impacts of droughts and desertification.

## **METHODS**

The sensitivity of Moroccan territory to desertification was determined by mapping the quality of climate, soil and vegetation cover. The climate was featured by an index of aridity. The data (T°C, P mm, ETP mm) of sixty five stations were used. The quality of the soils was determined by the maps of texture, depth, slope and parental materials. The quality of vegetation to combat desertification was determined by its resistance to drought, its fire risk and its capability of erosion control.

### **CLIMATE QUALITY**

The climate is at the same time an indicator of vegetation development and of resistance to natural and artificial changes. The climatic environment shows the degree of natural environment sensitivity to anthropogenic impacts and desertification.

The map of climate quality was made on the base of the index of aridity and the index of rainfall. The data (T°C, P mm, ETP mm) of sixty five stations located all over the country were used.

The aridity index (Ai) was calculated by the formula:

$$Ai : S(n=1 \text{ to } 12)(2 \cdot T_n - P_n) \cdot K ;$$

n : is the month n ;

K : is the proportion of months with  $2 \cdot T_n - P_n > 0$ .

#### **Aridity index values Ai**

Index	Ai
1	<50.0
1.1	50 - 75
1.2	75 - 100
1.4	100 - 125
1.8	125 - 150
2	> 150

The rainfall index was fixed as mentioned by the table bellow. The time period of yearly average rainfall data is 1960-1990.

#### **Rainfall index Ri**

Index Ri	P (mm)
1	> 650
2	280 - 650
3	< 280

The climate quality index (CQI) is a combination of the tow cited indexes, aridity and rainfall:

$$CQI : (Ri \times Ai)^{1/3}$$

To map the climate quality, the CQI was ranged as below:

CQi	Values	Description
1	<1.15	High
2	1.15 - 1.81	Moderate
3	> 1.81	Low

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## **SOIL QUALITY**

The Soil quality index was determined using the maps of parental materials, texture, depth and slope. To make those maps, it was necessary to synthesize most part of the pedological studies undertaken all over the country at different scales:

- ✍✍ Exploration studies: Some inventories and preliminary studies at small scales (1/500 000, 1/2 000 000) were made to explore soil and land resources at the national or regional levels during the sixties (Sebou, Moulouya, Oum Roubia, Tensift, Sous-Massa watersheds);
- ✍✍ Semi-detailed studies: Some potential areas for agricultural development were restudied at bigger scales (1/50.000, 1/100.000);
- ✍✍ Detailed studies: To develop some specific projects in pluvial or irrigated areas some studies were undertaken at a much bigger scales (1/20.000, 1/5.000): irrigated agriculture development, regrouping lands, etc.

Other studies were used:

- ✍✍ Agro-ecological zoning: Made at small scale (1/2 000 000) to identify the physically homogenous zones (climate, soils, relief). Some maps were used:
  - ?? Geological Structural map of Morocco (1/2 000 000),
  - ?? Map of Moroccan Bio-climates (1/1 000 000),
  - ?? Map of soils (1/2 000 000).
- ✍✍ Agricultural Atlas of Morocco constituted by 9 maps: Relief, Soils, Yearly Rainfall Average, Water Resources, Forest Lands, Irrigation in Morocco, Rangelands Ecosystems, Agro-ecological Groups, Agricultural Territorial Units.

### **Parent Material index PMi**

This information was taken from the geological map of Morocco. The classification used is given by the table below.

#### **Range of parental materials**

<b>Type of parent material</b>	<b>PMi</b>
Coherent materials: Calcareous, Dolomite, Coherent Sandstone, Calcareous crust, Granite, Quartzite.	1
Medium Coherent Materials: marl and calcareous, Soft Sandstone, Flyschs.	1,5
Soft materials : Marl, Clay, Flyschs, Schist, Sand, Alluviums, Colluviums	2

### **Depth Index Di**

Soil depth in Mediterranean environment (arid lands) has not the same meaning as in humid environment. A depth of 60 cm is important. The depth ranges used in this study are as below.

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**Depth Index Di**

<b>Ranges</b>	<b>Description</b>	<b>Di</b>
Very deep	More than 1.5 m with a substratum non-penetrable by roots or more than 1 m depth with soft substratum	1
Moderately deep	0.75 to 1.5 m deep with coherent substratum or 0.5 to 1 m with soft substratum	1,33
Little deep	From 0.25 to 0.75 m	1,66
Very little deep	Less than 0.25 m	2

**Texture Index Ti**

Most Moroccan soils contain loam and sand in a great proportion. They are very sensitive to erosion and degradation. Index used in this study to express texture are as below.

<b>Ranges</b>	<b>Description</b>	<b>Ti</b>
Slight to medium texture	Loamy-sand ; Sandy-loam; Balanced	1
Thin to medium	Loamy-clay, Clayey-sand, Sandy-clay	1,33
Thin	Clayey, Clayey-loam	1,66
Rough	Sandy	2

**Slope index Si**

The slope was determined from a digital elevation model at a resolution of 300\*300m.

<b>Ranges (%)</b>	<b>Description</b>	<b>Si</b>
< 6	Slight	1
6-18	Little slight	1.33
18-35	Steep	1.66
> 35	Very steep	2

**Soil Quality Index SQI**

Each soil was affected by an index calculated by the formula:

$$\text{SQI: } (PM_i * Di * Ti * Si)^{1/4}.$$

<b>Soil Quality</b>	<b>SQI</b>
Good	< 1.13
Medium	1.13 – 1.45
Low	> 1.45

**VEGETAL COVER QUALITY**

Vegetation is at the same time the expression and the index of the natural balance of the ecosystems. In fact, the vegetal cover is the first component enduring anthropogenic impacts and its state is related to the process of natural degradation: desertification. It shows indications related to:

- ☞ Environment sensitivity to fire risk;
- ☞ Protection of soil against erosion;
- ☞ Environment capacity to withstand to climatic changes;
- ☞ Vertical structure of vegetation.

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To determine the vegetal cover quality index, we used some existing maps, mainly:

- ☒ Range lands map;
- ☒ Agro-ecological groups map;
- ☒ Energetic potential map;
- ☒ Phyto-ecological map;
- ☒ Bio-climate map.

All of these four indexes were determined according to the type of vegetation, the climate and their state (degraded or not).

**Fire Risk index FRi**

Type of vegetation	Description	FRi
Coniferous forest: Cedrus, Pinus sp., Thuya; Annual vegetation	High risk	2
Quercus sp. (Oak Forest), matorrals of broad leaved trees	Moderate risk	1.5
Steppes, Degraded range lands, Agricultural lands	Low risk	1

**Protection against Erosion index PEi**

Type of vegetation	Description	PEi
Natural forests in humid, sub-humid and semi-arid climate,	High protection	1
Matorrals, Argania forests	Medium protection	1.5
Steppes, Deserts, Agricultural lands	Low protection	2

**Drought Resistance index DRi**

Type of vegetation	Description	DRi
Natural forests in humid, sub-humid and high semi-arid climate,	Very High resistance	1
Matorrals of semi-arid climate, Argania forests	High resistance	1.33
Steppes, grass lands (high altitude)	Medium resistance	1.66
Desert, agricultural lands	Low resistance	2

**Vegetal Cover Structure index VCPi**

Type of vegetation	Description	VCSi
Natural forests in humid, sub-humid and upper semi-arid climate,	Very High	1
Natural forest of semi-arid limited	High	1.33
Grass lands of high altitude, Matorrals of semi-arid climate	Medium	1.66
Steppes, desert, agricultural lands	Low	2

**Vegetal cover quality index VCQi**

The vegetal cover quality index is a combination of four other indexes: Fire resistance index FRi, Protection against erosion index PEi, Drought resistance index DRi and the Vegetal cover structure index VCPi.

$$VCQi = (FRi * PEi * DRi * VCSi)^{1/4}$$

The map of vegetal cover quality was made up using the following classification.

Vegetal cover quality	Range of VCQi
Good	< 1.2
Medium	1.2 – 1.4
Low	1.4 – 1.6
Very low	> 1.6

## **RESULTS**

### **CLIMATE QUALITY**

The results show that the most part of the Kingdom (69.50%) has less than 280 mm/year. It corresponds to arid and desert regions. Regions corresponding to semi arid climate represent 23.70%. Sub-humid and humid regions represent only 6.80%.

#### **Rainfall index Ri**

Index Ri	P (mm)	Description	Surface %
1	> 650	Low	69,50
2	280 - 650	Medium	23,70
3	< 280	High	6,80

Regions with low aridity degree, corresponding to favorable climates, are slightly represented. Regions with high aridity degree are more represented (64.40%) and correspond to arid and desert areas. The intermediary zones total 13% of the national territory.

#### **Aridity Index Ai**

Index Ai	% Surface
1	22,40
1.1	3,00
1.2	3,50
1.4	3,70
1.8	3,00
2	64,40

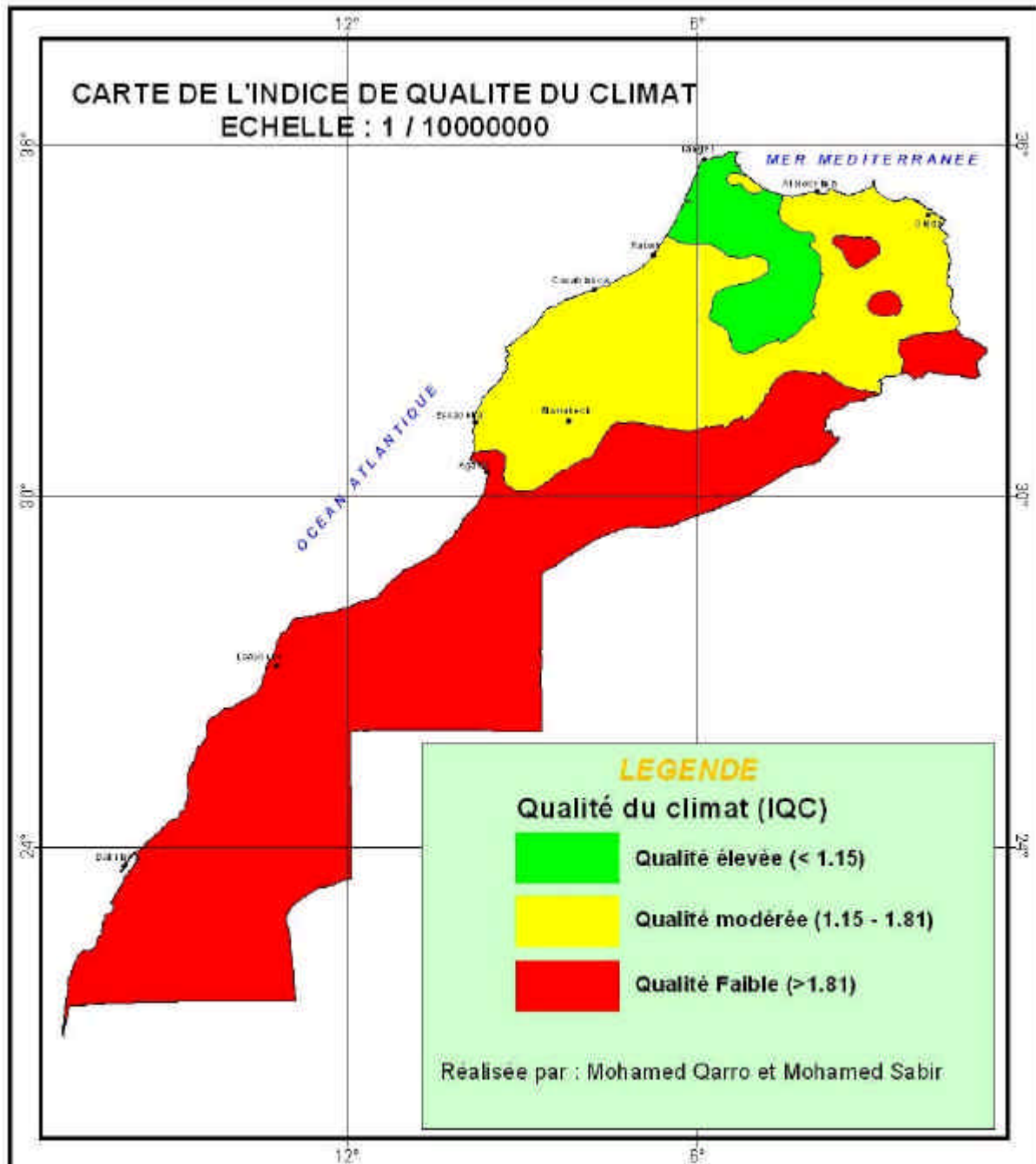
#### **Climate Quality index**

CQI	Values	Description	% Surface
1	<1.15	High	6,82
2	1.15 - 1.81	Moderate	29,64
3	> 1.81	Low	63,54

The results show that 2/3 of the Moroccan territory has a low climatic index. The high climatic conditions are very less represented. This result indicates that the climate allows an intense sensitivity of desertification covering the most part of country. The regions concerned by this phenomenon are located in the south and the south-east. The central part of the country is also sensitive to desertification from the climatic analysis, but less than the south part.

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**SOIL QUALITY INDEX SQI**

**Parent Material index PMi**

The results indicate that the soft materials cover the Great Plains and plateaus, especially throughout the Atlantic coast. The coherent materials, instead, cover the mountains of Atlas, a part of the high Rif, the wide extend of Sahara and the eastern part of the country.

<b>Type of parent material</b>	<b>PMi</b>	<b>% Surface</b>
Coherent materials: Calcareous, Dolomite, Coherent Sandstone, Calcareous crust, Granite, Quartzite.	1	41.46
Medium Coherent Materials: marl and calcareous, Soft Sandstone, Flyschs.	1,5	29.98
Soft materials : Marl, Clay, Flyschs, Schist, Sand, Alluviums, Colluviums	2	28.56

**Slope index: Si**

More than 73.6% of the national territory has a slope less than 6% represented by the Great Plains, plateaus and the Sahara. Lands with high slope are located in mountains and their surrounding. The range of hillsides with very steep slopes covers 6%. About 20% of the territory has a slope ranged between 6 and 35%. Those results show that 26% of the territory can generate important runoff if nothing is done to control erosion or if the vegetal cover is cut off.

<b>Slope Ranges (%)</b>	<b>Description</b>	<b>Si</b>	<b>% Surface</b>
< 6	Slight	1	73.60
6-18	Little slight	1.33	11.78
18-35	Steep	1.66	8.48
> 35	Very steep	2	6.14

**Depth Index Di:**

Soils with more than 1.5 m cover only 4.63% mostly located in the north-west part. More than half of the country has shallow soils, mainly in mountains and in regs of the south and east. The most part of the northern region has moderate deep soils.

<b>Ranges</b>	<b>Description</b>	<b>Di</b>	<b>% Surface</b>
Very deep	More than 1.5 m with a substratum non-penetrable by roots or more than 1 m depth with soft substratum	1	4.63
Moderately deep	0.75 to 1.5 m deep with coherent substratum or 0.5 to 1 m with soft substratum	1,,33	9.10
Little deep	From 0.25 to 0.75 m	1, 66	30.65
Very little deep	Less than 0.25 m	2	55.62

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**Texture Index Ti**

Soils with slight to medium texture cover about 73% of the whole country. Soils with tin texture are more less represented. On the contrary, soils with rough texture cover about 22% of the country, specially the regions of Loukkos, Maamora and South-east. The sand of the coast regions is associated with the development of sandy soils. In the south and east, it is associated with active wind erosion responsible for sand dunes formation.

**Range index of texture Ti :**

<b>Ranges</b>	<b>Description</b>	<b>Ti</b>	<b>%</b>
Slight to medium texture	Loamy-sand ; Sandy-loam; Balanced	1	72.74
Thin to medium	Loamy-clay, Clayey-sand, Sandy-clay	1,33	3.48
Thin	Clayey, Clayey-loam	1,66	1.16
Rough	Sandy	2	22.62

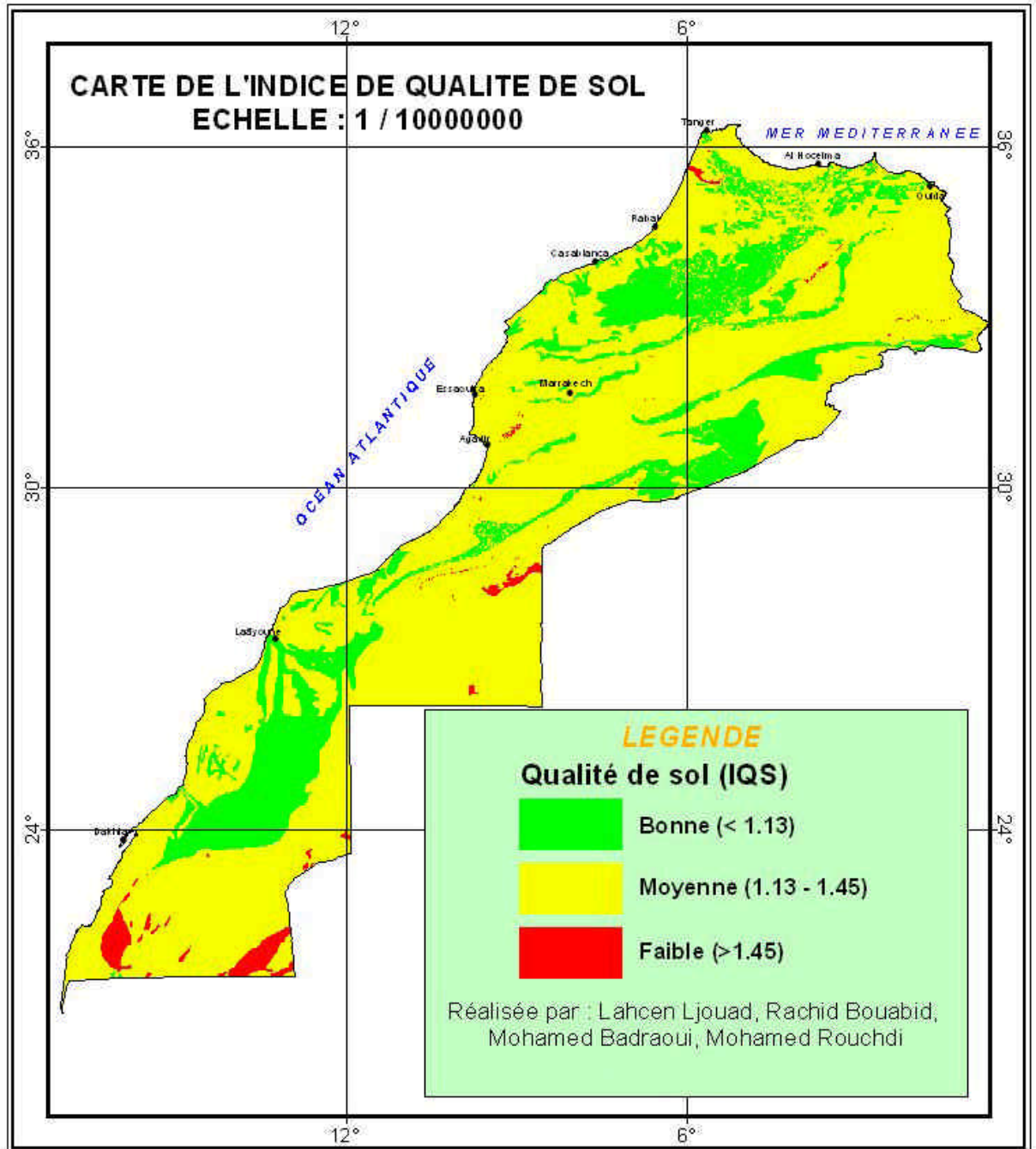
**Map of Soil Quality index**

According to criteria used, about 2% of the national territory has soils with high sensitivity to desertification (index>1.45). About 22% of soils are slightly sensitive to desertification. The most part of soils has a medium sensitivity. This means that about 80% of Moroccan soils are vulnerable to desertification, even the other factors, vegetal cover, climate and management, are favorable. These results are in concordance with the observations made by the National Program to Desertification Control (MADREF, 2001).

<b>Soil Quality</b>	<b>SQI</b>	<b>% Surface</b>
Good	< 1.13	21.69
Medium	1.13 – 1.45	76.32
Low	> 1.45	1.99

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**VEGETAL COVER QUALITY VQi**

**Fire Risk index FRi**

<b>Type of vegetation</b>	<b>Description</b>	<b>FRi</b>	<b>% Surface</b>
Steppes, Degraded range lands, Agricultural lands	Low risk	1	94,26
Quercus sp. (Oak Forest), matorrals of broad leaved trees	Moderate risk	1.5	5,23
Coniferous forest: Cedrus, Pinus sp., Thuya; Annual vegetation	High risk	2	0,51

The most part of Morocco has a low fire risk (94.25%). This result is in agreement with the structure of natural ecosystems and agro-systems and their use. The natural ecosystems are constituted by board leave trees, mainly Oak, green and suber (Quercus sp.) and sparse steppes. Animal overgrazing reduces the density and the cover of yearly vegetation and shrubs. Consequently, the fire risk is lowered. In the agro-systems, biomass production is very low according to the bio climate water balances. Also, this biomass is totally used by livestock. Regions with high fire risk are constituted by conifers (Cedrus, Pinus sp.).

**Protection against Erosion index PEi**

<b>Type of vegetation</b>	<b>Description</b>	<b>PEi</b>	<b>% Surface</b>
Natural forests in humid, sub-humid and semi-arid climate,	High protection	1	6,89
Matorrals, Argania forests	Medium protection	1.5	4,02
Steppes, Deserts, Agricultural lands	Low protection	2	89,09

About 9/10 of the national territory has a low protection against erosion index. This corresponds to desert regions for which the vegetal cover doesn't give a good protection to soils. Cultivated Plains and plateaus have a little vegetation cover during all the year so it covers badly the soil.

The zones with medium protection correspond to Central plateau, the western zone of High Atlas and the north-western zone of Middle Atlas. The natural vegetal is still plus and less covering soils.

The zones with high protection correspond to forest zones : High Atlas, Middle Atlas, Rif and Central Plateau. Natural forests (green and suber oak, thuya, cedrus) are still conserved and allow a good protection of soils.

**Drought Resistance index DRI**

<b>Type of vegetation</b>	<b>Description</b>	<b>DRI</b>	<b>% Surface</b>
Natural forests in humid, sub-humid and high semi-arid climate,	Very High resistance	1	4.63
Matorrals of semi-arid climate, Argania forests	High resistance	1.33	1.04
Steppes, grass lands (high altitude)	Medium resistance	1.66	20.58
Desert, agricultural lands	Low resistance	2	73.75

Only 5% of the national territory has very high resistance to drought. These areas correspond to mountains (High and Middle Atlas) covered by forests with a humid and sub-humid climates.

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The areas moderately resistant to drought correspond to *Argania spinosa* forest (Souss Valley), the south and south-eastern hillsides of High and Middle Atlas and Eastern steppes. These areas are covered by natural species resistant and cover 1/5 of the whole country (Green oak, *Argania spinosa*, *Artemisia* sp., *Alfa* sp., etc.).

About  $\frac{3}{4}$  of the country have low resistance to drought: steppes of the Sahara, plains and plateaus of the north-west zone.

#### **Vegetal Cover Structure index VCPi**

<b>Type of vegetation</b>	<b>Description</b>	<b>VCSi</b>	<b>% Surface</b>
Natural forests in humid, sub-humid and upper semi-arid climate,	Very High	1	2,99
Natural forest of semi-arid limited	High	1.33	0,80
Grass lands of high altitude, Matorrals of semi-arid climate	Medium	1.66	6,53
Steppes, desert, agricultural lands	Low	2	89,68

These results show most of Moroccan territory has a low vegetal cover (90%). These areas correspond to Saharien zones, eastern steppes and Atlantic Plaines.

The areas with very high and high vegetal cover are located in the Rif, High and Middle Atlas and Central Plateau. They are very limited in the space.

Those with medium cover correspond to forest zones and matorrals with semi-arid and arid climates. They are constituted by secondary species like *olea europea* and *lentsicus*.

#### **Vegetal cover quality index VCQi**

The distribution of the vegetal cover quality index, a combination of four other indexes, is given by the table below.

<b>Vegetal cover quality</b>	<b>Range of VCQi</b>	<b>% Surface</b>
Good	< 1.2	4.85
Medium	1.2 – 1.4	2.13
Low	1.4 – 1.6	2.63
Very low	> 1.6	90.39

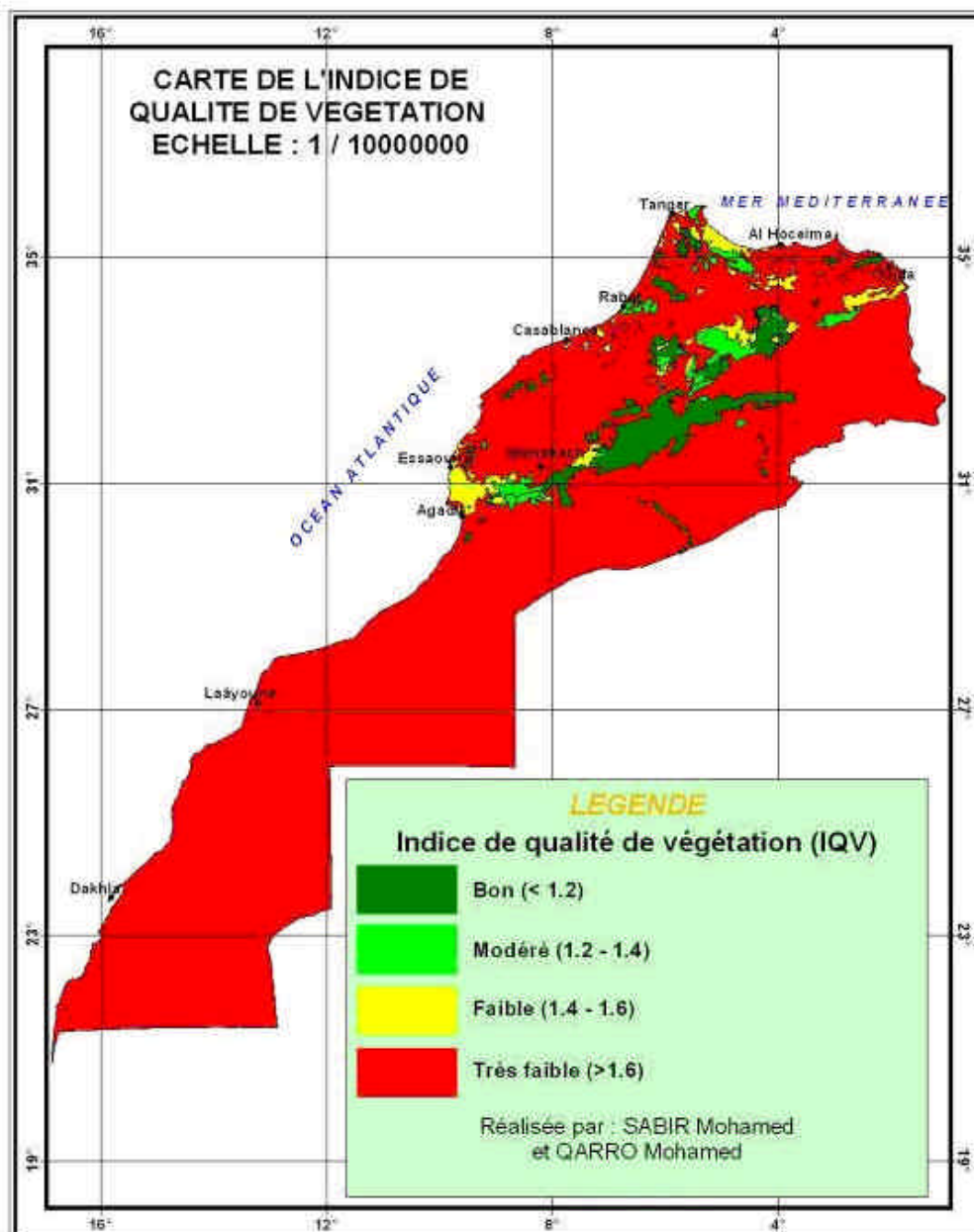
These results show that the Moroccan vegetal cover has a very low quality in protecting against desertification. In fact, 9/10 of the surface have an VCQi greater than 1.6. The vegetal cover is not so developed and so conserved in these areas corresponding to deserts, steppes, matorrals and secondary species. They are associated with saharan, arid and semi-arid climates. The scarcity of water and irregularity of rainfall and poor soils are mostly responsible of this situation.

About 2% of the surface has a medium quality and corresponds to degraded forests of High and Middle Atlas, Central Plateau and Rif.

Regions with good quality of vegetal cover to protect lands from desertification represent less than 5%. It corresponds to forest planting developed under sub-humid and humid climates and are still conserved (High and Middle Atlas, Rif): green and *suber* oaks, *cedrus*, etc.

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## **CONCLUSIONS**

The establishment of climate, vegetal cover and soil qualities maps showed that the most part of Moroccan territory is very sensible to desertification. In fact, according to spatial and time distributions of the low rainfall in Morocco, the largest south and eastern regions have a low climate quality (63.54%). The central part also has a medium climate quality (30%). These regions correspond to desert, arid and semi-arid bio-climate environments. The rainfalls are low (less than 280 mm/year), erratic and aggressive.

About 9/10 of the surface have a low vegetal cover quality. The vegetal cover is not so developed and so conserved and corresponds to deserts, steppes, matorrals and secondary species. It is associated with saharan, arid and semi-arid climates. The scarcity of water and irregularity of rainfall and poor soils are mostly responsible of this situation. The vegetal cover, suffering from the shortness and irregularity of rainfall, is less developed and is very sensitive to degradation. It is also under an intense overgrazing and overexploitation and an extended land clearing. More than 35 000 ha are cleared yearly. Overgrazing intensity is more than 3.5 times the natural production potentiality of rangelands. These conditions are in favour of desertification. In general, vegetal cover is becoming less and less efficient in covering and protecting soils from wind and water erosion.

Soils are in the most part of the country shallow, loamy-sand, less developed and with poor organic mater content. Most of theme is developed on soft parental material. The largest part of country is covered by soils with low quality index, mainly in the south, south-eastern and eastern regions. The most part of soils has a medium sensitivity. This means that about 80% of Moroccan soils are vulnerable to desertification, even the other factors, vegetal cover, climate and management, are favorable.

In addition to the potential sensitivity of Moroccan territory to desertification, intense and frequent droughts have increased the impact of population on natural resources since the beginning of 1980. Rural depopulation is increasingly becoming intense. Mountains and rural regions are losing the most important population: young people!

In these naturally handicapped regions, the society is in crisis! It is impossible to continue to live on agriculture and livestock. People are out of credits and training to invent much more intensive farming systems adapted to arid areas. The oldest men and women are tired from managing a severe life environment but viable since many centuries. The youngest were at schools and they are now hanging about the villages. They are thinking about other life environments more generous: Big cities (Casablanca, Fez, Marrakech, Rabat) and Europe (Spain, Italy, France, Germany, NL).

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**REFERENCES**

Badraoui M., Stitou M. (2001). Status of soil survey and soil information system in Morocco.. In FAO ed. Atelier sur les bases de données SOTER dans les pays de l'Union de Maghreb Arabe, Novembre 2001, Rabat, Maroc

Badraoui M., Bouabid R., Ljouad L., Rouchdi M. (2001). Base de données digitales SOTER pour le Maroc. In FAO ed. Atelier sur les bases de données SOTER dans les pays de l'Union de Maghreb Arabe, Novembre 2001, Rabat, Maroc

CE (1999). The Medalus project Mediterranean desertification and land use : Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification. Kosmas C., Kirkby M., Geeson N. Eds. European Commission, Community research (EUR 18882).

Ljouad L., Bouabid R., Rouchdi M. & Badraoui M., 2003. Carte de Sensibilité à la Désertification du Maroc : Couche « SOL ». Projet DIS-MED. MADRPM-OSS Rabat.

MADREF (2001). Programme d'Action National de lutte contre la Désertification. MADR, Rabat

MADRPM (1993). Inventaire des études pédologiques au Maroc, DCFCC/DC, Rabat

MADRPM (1996). Carte pédologique du Maroc. DCFCC/DC, Rabat.

MDCEFCS, 2000. Le grand livre de la forêt marocaine. Rabat.

Qarro M. & Sabir M., 2004. Carte de sensibilité à la désertification du Maroc: Couche "Climat". Projet DIS-MED. MADRPM-OSS Rabat.

Sabir M. & Qarro M., 2004. Carte de sensibilité à la désertification du Maroc: Couche "Végétation". Projet DIS-MED. MADRPM-OSS Rabat.