

Land and Livestock Management in the Mountains of Maghreb



Flicker images

Pedro Fiz Rocha Correa



WAGENINGENUR
For quality of life

Preface

This report was written as a thesis for the Master Management Economics and Consumer studies at the Wageningen University. For my Master Internship I had the opportunity to spend three months working for the Mountain Partnership Secretariat (MPS), placed at the UNFAO headquarters in Rome, Italy. During this internship I had the possibility to work on a report about mountains and climate change for the 4th Regional Meeting of the Mountain Partnership, focused in the Near East Region. Among the topics undertaken by this event, the Dryland Mountain Ecosystems in the Maghreb and their management appeared as the best topic for my thesis.

The elaboration of this report was quite difficult since there was not much information available from the studied area, and the author was not able to visit the Maghrebian Mountains. However, thanks to the great help of Olman Serrano (team manager of the MPS) and Dr. Thomas Hofer, among other UNFAO officers and contacts in the Maghreb provided, it was possible to obtain accurate information and scopes from the region. Also my supervisor Dr. Jack Peerlings was decisive in finalising this thesis, with his comments and inputs the work became much easier.

Long time passed since the beginning of this thesis, the support of my family and Isabel was decisive during this almost one year. Special mention deserves two mountainous people that with their enthusiasm and passion made this report worth, Pedro de Coladas and Manuelín d'Ordeiro. To all of them, thanks.

Pedro Fiz Rocha Correa
Arnhem, April 2013.

Summary

There is still little known about the effects of global change. Dryland Mountains are the ideal laboratory to isolate and study the variables influencing both the climate change effects and the direct human impacts. This study tries to delve into one of the most fragile kind of ecosystems all over the world.

Which are the main factors these fragile ecosystems deal with? And how policies attach the situation? The UNFAO implemented some projects in the area to face the effects of global change.

Pastoral communities are the natural keepers of these ecosystems, and remain among the most politically and economic marginalized groups. Transhumant cultures find themselves facing insecurity in multiple dimensions, including land, political, legal, food, environmental and physical insecurity. Pastoral marginalization comes from global processes involving structural adjustment, policy modernization and economic liberalization. These global processes boosted the sedentarization of nomadic and semi-nomadic populations together with their herds, generating conflicts between land uses and sustainability.

Common property resources (traditionally managed by customary law) are commonplace in the Atlas Mountains, and unclear private user rights for individual farms encourage short-term resource exploitation rather than long-term conservation. Moreover, changes in land tenure alter the behaviour of individuals and local communities, leading to land degradation (e.g. overgrazing following the settlement of nomads). Key constraints stemming from the lack of tenure, promotion of privatization, food insecurity and minimal health and educational services must be addressed to ensure that the synergistic relationship between livestock-based livelihoods and environment could be productive and sustainable.

Key words: Dryland Mountain Ecosystem, agro-pastoralism, Atlas range, land tenure, Berbers, climate change.

List of figures

No	Title	Page
2.1	The main Mountain Ranges in the Maghreb	
2.2	Berber distribution map	
2.3	Main Mountain agglomerations in the Atlas range and sub ranges	
2.4	Tunisian farm characteristics	
2.5	Tunisian farm characteristics	
3.1	Some comparative data of Maghreb countries	
3.2	Map of Morocco regions	
3.3	Tunisian regions	
3.4	Map of Algeria.	
3.5	Trade in Agriculture products	
3.6	Food needs coverage by product	
4.1	Projects site distribution	
4.2	<i>Juniperus thurifera</i>	
4.3	<i>Juniperus oxycedrus</i>	
4.4	<i>Atriplex</i>	
4.5	<i>Agdal</i>	
4.6	<i>Khettara in the dessert</i>	
4.7	<i>Khettara operation</i>	
4.8	<i>Wadi</i>	
4.9	Hamada crossed by agdal	

Table of contents

Preface	2
Summary	3
List of figures	4
1 Introduction	7
1.1 Background of the research	7
1.2 Research Objectives	10
1.3 Theoretical framework.....	10
1. Outline of the thesis	12
2. Maghreb Description.....	13
2.1 Society and economy	13
2.2 Migration.....	15
2.3 Maghreb Mountains: uses and characteristics	16
2.4 Agro-pastoralism	17
2.5 Land property and management	18
2.5.1 Traditional land management.....	18
2.5.2 Land tenure and structure	19
3. Mountain Policy Tools.....	22
3.1 General overview	22
3.2 General overview on Mountain policy tools in the Maghreb	24
3.3 Morocco	25
3.3.1 Policy	25
3.3.2. Morocco Policy analysis	27
3.4. Tunisia	29
3.4.1. Policy	29
3.4.2. Tunisian Policy analysis	31
3.5 Algeria	33
3.5.1 Policy	33
3.5.2 Algerian Policy analysis	35
4.-UNFAO projects in Maghreb Mountains.....	38
4.1 Ecosystem Based Adaptation	38
4.1.1 General background	38
4.1.2 Ecosystem Base Adaptation in Azilal - High Atlas	40
4.2 Climate-Smart Agriculture.....	45

4.3 Globally Important Agricultural Heritage Systems.....	45
4.3.1 General background	45
4.3.2 Imilchil-Amellagou mountain oasis Pilot Project	47
4.4 GLOCHAMORE research strategy	52
4.4.1 General background	52
4.4.2 The Biosphere Reserve of the Oasis du Sud Marocain (Morocco).....	54
4.5 Other UNFAO initiatives not performed in the Atlas	55
4.5.1 Livelihood Adaptation to Climate Change.....	56
4.5.2 Voluntary Guidelines to Improve Governance of Tenure of land, Fisheries and Forests	57
5. Conclusions, discussion and recommendations.....	58
5.1 Conclusions.....	58
5.1.1 Answers to the research questions	58
5.1.2 Overall conclusion	61
5.2 Discussion	62
5.3 Recommendations	63
5.3.1 Recommendations for further research	63
5.3.2 Recommendations for further actions in the Maghreb Mountains.....	63
Bibliography	66
Appendix 1	70
Agenda 21.....	70
Section II	71
Chapter 13	71
Section II CONSERVATION & MANAGEMENT OF RESOURCES FOR DEVELOPMENT	75
Chapter 14.....	75
Appendix 2	77
Some Definitions	77
United Nations Framework Convention on Climate Change:	77
Convention on Biological Diversification	77
United Nations Convention to Combat Desertification	78
Mountain:.....	79
Dryland Mountains.....	80

1 Introduction

In this thesis the focus will be on livestock and land property management in the Maghreb mountainous countries. This introduction will start with the background of this research.

In the second section the objectives are formulated. In the following section the research objective is operationalized into research questions. The last section of this introduction will contain an outline of the thesis.

1.1 Background of the research

Since the “Earth Summit” took place at Rio de Janeiro (Brazil) in 1992, awareness of environmental issues has experienced a fast evolution, acquiring more presence at the global political Agenda. Special mentioning deserve the different conventions created to cope with the effects of climate change, highlighting the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversification (CBD) and the United Nations Convention to Combat Desertification (UNCCD) (see appendix 2).

Climate change effects are a reality nowadays, and its impacts are specially perceptible in the most vulnerable ecosystems. Among them, mountain ecosystems are particularly sensitive.

Agenda 21 in its chapters 13 and 14 (see appendix 1), recognizes the importance of mountains as fragile ecosystems that represent around 24 per cent of the planet’s surface, being home for more than 10 per cent of the world population and serving as key storehouse of water, energy and biodiversity for 50 per cent of the world.

Mountains exist in many regions of the world. They occupy very different positions on the globe and they differ in shape, extension, altitude, vegetation cover, and climate regime. They will therefore be affected differently by climate change. However, they share some common features relating to climate change:

- Mountain areas have a marked and complex topography and so their climates vary considerably over short distances.
- Temperature changes with altitude. The impacts of a warmer climate are different for different elevations. Areas at the snow line or freezing line will be affected particularly heavily, as they might undergo a shift from mainly snow-covered to mainly snow-free. For example, every degree Celsius increase in temperature will cause the snow line to rise on average by about 150 m, and even more at lower elevations. In such regions precipitation will change from snow to rain. The decrease in snow cover will lead to an

above-average warming of mountains, because snow-free surfaces absorb much more radiation than snow-covered surfaces.

- Melting of glaciers and permafrost will trigger the release of loose rock and soil and exacerbate the danger of rock fall, debris flows, and mud flows. A specific risk is the build-up of glacial lakes and the threat of lake outbursts, which could result in destruction of property and death.
- Mountains themselves play a major role in influencing regional and global climates. They act as barriers for wind, which induces enhanced precipitation on the windward side, and reduced precipitation and warmer temperatures on the leeward side. Changes in atmospheric wind flow patterns may induce large and locally varying precipitation responses in mountain areas, which could be much stronger than average regional climate change (IPCC 2007a).

This general situation is even worse with regard to the world's dryland mountains (definition in appendix 2). Drylands are a vital part of the earth's human and physical environments. They encompass grasslands, agricultural lands, forests and urban areas. Dryland ecosystems play a major role in global biophysical processes by reflecting and absorbing solar radiation and maintaining the balance of atmospheric constituents (Folliott 2002). They provide much of the world's grain and livestock, forming the habitat that supports many vegetable species, fruit trees and micro-organisms.

Rural people living in drylands are arranged roughly into nomadic, seminomadic, transhumant, and sedentary populations. Nomadic people are found in pastoral groups which depend on livestock for subsistence and farming as a supplement. Following the rainfall, they migrate in search of pastures and water for their animals. Seminomadic people are also found in pastoral groups which depend largely on livestock and practice agriculture at a base camp, where they return for varying periods of time. Transhumant populations combine farming and livestock production during favourable seasons, but seasonally they migrate along regular routes when forage for grazing diminishes in the farming area. Sedentary farmers practice irrigated agriculture.

There is still little known about these dryland mountain ecosystems, which represent around one third of all mountains. Their role in fresh water supply, for example, is often much more significant than in wetter areas of the world, with up to 90 per cent of fresh water being provided from the respective mountain systems. Poverty and food insecurity appear to be

even more exacerbated in mountainous dryland areas while more than one quarter of the world's biodiversity hotspots are found in dryland mountain areas, therefore the sustainable management of drylands is essential for ensuring food security and the conservation of biomass and biodiversity of global significance (UNEP 2000). Yet, these fragile ecosystems are under increasing threat from a variety of causes such as climate change, tourism, mining, and even armed conflicts. The populations and natural resources of dryland mountains are unique, both biologically and in their cultural diversity. Because of this diversity of menaces this study will encompass the term *Global Change*. It is important to understand the effects of climate change as catalyser of other factors linked to the regional environment, including human intervention.

Aside from the major contribution of goods and services, the people who live in the mountains are specially outstanding as keepers of traditional culture and language, ways of living and guards of the ecosystems. The remote situation of the mountains favours this protection. However, this remoteness and the difficulties to access to certain goods and services, as well as the absence in the political decision making, carry the mountainous inhabitants into a vulnerable situation. Dryland mountainous populations are frequently some of the poorest in the world, many subsisting with less than US\$1 per day (White 2000).

In order to get a more accurate overview on these factors, it seemed essential to locate the appropriate environment where all of them were present. The extreme conditions of the Atlas mountain range and sub ranges appeared the suitable area to undertake this study.

The Atlas crosses North Africa from west to east over 5.000 Km., with extreme climate conditions and an elevation around 4.000 meters. The Atlas is located in three countries namely Algeria, Morocco and Tunisia. Altogether it forms the Maghreb Region, with notorious conjoint characteristics. Aside the extreme environment the mountains of Maghreb are specially affected by hunger, food insecurity, increasing natural hazards, desertification and water scarcity wars.

This report was born in collaboration with the Mountain Partnership Secretariat, a United Nations voluntary alliance of partners dedicated to improve the lives of mountain people and protecting mountain environments around the world. This partnership is located at the UNFAO headquarters in Rome, Italy. This study is based on a qualitative analysis of the knowledge and synergies gained with the collaboration of diverse UNFAO groups, such as the Forestry division, REDD++, IPROMO, Legal Office and FAOSTAT, all dealing with the preparation of the "fourth regional meeting on adaptation to climate change in mountain areas". This meeting will be

placed in the Oman Mountains and will be centred on the Near East region at the end of 2013,. Therefore, this study has a parallel target, to present the report in this fourth regional meeting as input in different workshops.

1.2 Research Objectives

There is still little known about dryland mountain ecosystems and the challenges these areas are facing. This thesis will focus on the Maghreb Mountains due to their representativeness. Therefore the research objective of this study is:

“Explore which the main factors are affecting dryland mountain ecosystems in the particular case of mountainous Maghreb countries and analysing the policy instruments applied in the region by governments and some UNFAO projects”.

The following research questions are formulated.

Research questions:

1. **How global change does affect these ecosystems?**
2. **Which are the policy instruments used by the Maghreb countries to deal with the situation?**
3. **Which are the policies of International organizations such as UNFAO in the region?**

1.3 Theoretical framework

This section will provide the theoretical basis for the research. The research is based on a review of specialized publications, conferences, workshops and personal interviews with people involved directly in the Region.

Due to the lack and unreliability of the data provided on the area, and the extreme difficulty of itemizing the mountain related data, the analysis will be qualitative.

The theoretical framework consists of criteria to analyse the adequacy of the policies applied in the mountain regions of Algeria, Morocco and Tunisia on the one hand. And on the other hand criteria used to assess the most relevant UNFAO projects applied in the three countries.

As described before “global change” is a merger between climate change and human impact, because of this, it is implicit the climate change mitigation/combat for the adequacy of every analysis.

The Criteria for good policy (Oskam 2010):

- Effectiveness: Effectiveness is the degree to which predetermined objectives are achieved through the use of a certain instrument.”.
- Efficiency: Refers to the cost linked to the use of a policy instrument to reach the predetermined policy goal. These costs can be listed for each individual stakeholder but also for society as a whole. This study will focus on the second, dealing with social welfare cost. Where social refers to the society as a whole.
- Acceptability: Refers to the way instruments are judged by groups of persons who play an important goal in targeting policies (stakeholders).
- Enforceability: Refers to the legal basis of using policy instruments and surely also to the costs of monitoring necessary to detect non-compliance, and the capacity to uphold the rules.

Moreover, this report will include some other specific criteria to assess the impact of UNFAO projects in the region (Comision 2003) :

- Synergy: The fact that several measures/actions jointly implemented have a greater effect than if they were implemented separately.
- Utility: The fact that the impacts observed correspond to sectorial needs and to identified socio-economic problems.
- Sustainability of results: Effects are sustainable when they last in the long term, and after the end of the program.
- Result: The most immediate impact, directly identifiable once the action has been implemented. It occurs as soon as the public intervention has been completed. For instance, when tourist accommodation is created or upgraded, a result would be an increasing accommodation capacity; when transport infrastructure has been created or upgraded the travelling time within or from the area would be reduced.
- Relevance: Appropriateness of the objectives of a program in relation to the sectorial needs and socio-economic problems to which the program should respond.

1. Outline of the thesis

After this introduction to the research

the second chapter presents some background information on the Maghreb countries. It is divided in five sections from which the first three are the Region's Society and economy, Migration and Uses and Characteristics of mountains. The chapter deals with the main features of the area, pointing out the common characteristics and peculiarities of Algeria, Morocco and Tunisia, and serves as basis to undertake the policy analysis. The last two sections deal with two main topics namely land tenure and livestock management.

Chapter three describes the Mountain Policies in the three countries, and provides a policy analysis based on the theoretical framework. Some efforts have been made by the UNFAO in the region; the fourth chapter describes and discusses a couple of projects implemented by this institution.

The last chapter provides the conclusions obtained throughout this study. Also the limitations of this study will be described in the Discussion. The chapter ends with some recommendations both for further research and for direct intervention in the area.

Finally two appendixes are presented. The first one describes the chapter 13 and 14 of Agenda 21, whereas the second includes some essential definitions to support this study.

2. Maghreb Description

The aim of this chapter is to give a general overview on the Maghreb region. Section 2.1 deals with the society and economy of the area, and common and diverse characteristics of the three countries. Section 2.2 explores migration in the Maghreb. The characteristics and uses of the mountains are explained in section 2.3. This section also includes some definitions.

These first three sections give a general understanding about people and mountains in North Africa. Section 2.4 deals with agro-pastoralism and section 2.6 with land property and management .

2.1 Society and economy

The Maghreb is defined as the region of Northwest Africa. This region encompasses the Atlas Mountains and the coastal plains of Morocco, Algeria, Tunisia, Mauritania and Libya, and of the disputed territory of Western Sahara (mostly controlled by Morocco).

The Maghreb mountainous countries, Morocco, Algeria and Tunisia, are partially located in the Atlas and its different sub-ranges, the Tell and the Rif. Mauritania, Libya and Western Sahara, considered also Maghreb countries, will not be taken into account in this study due to the lack of mountains.

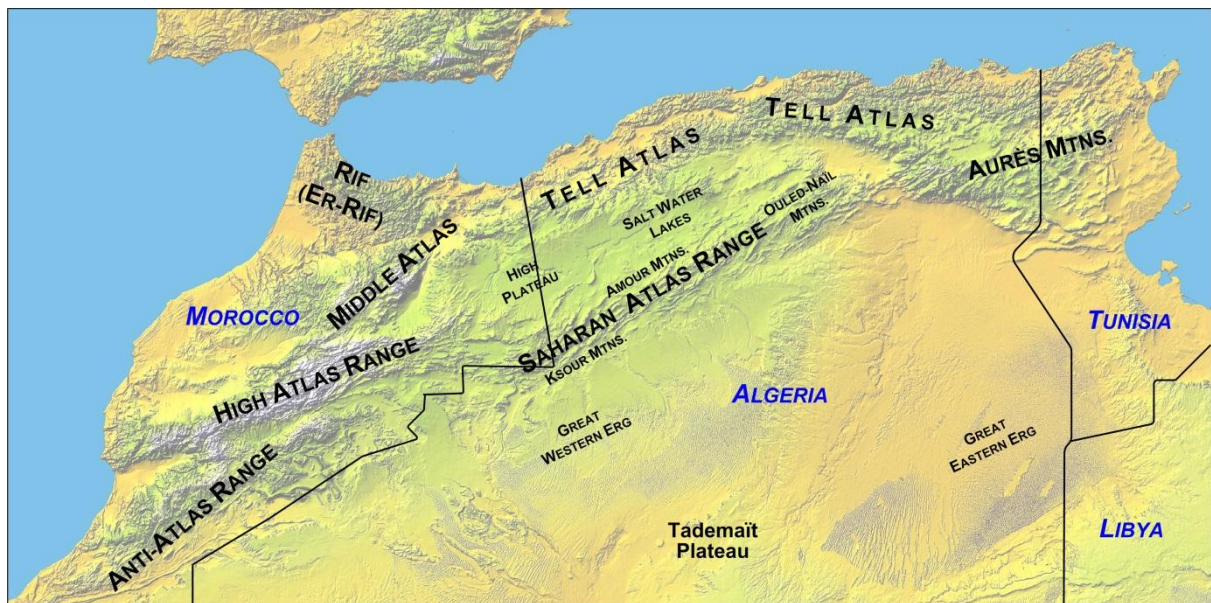


Figure 2.1: The main Mountain Ranges in the Maghreb (Wikipedia 2001)

The Atlas, therefore, forms the spinal cord of the Maghreb region. In Morocco it is divided in Rif range, Middle Atlas, High Atlas and Anti-Atlas. Through Algeria the Tell Atlas and the

Saharan Atlas Range, crossing the country from west to east, form a high plateau between them. Both the Tell Atlas and the Saharan Atlas Range converge at the north west of Tunisia.

Algeria, Morocco and Tunisia are part of the Mediterranean Basin, The Middle East and North Africa (abbreviated MENA, a term widely used by the World Bank), North Africa, Near East (regional category for UNFAO) and Africa. The countries share some characteristics such as culture, resource management and ways of life, language, hazards and territorial profile. Altogether the three countries have a population of more than 77 million people (FAOSTAT 2009), and cover a surface of almost 3 million Km².

There are different political systems in the three countries. The most uncertain nowadays is in Tunisia, with the venue of a civilian rebellion the political structure is still in transition. In Algeria, terrorism is a concern. After the independency, Algeria experienced a socialist uprising that had a strong impact on agriculture, such as a deep agraricultural reform following the communist principles of big state farms in a hyper intensive production system. With the fall of the Berlin Wall, Algeria has been adapting to an open market economy, implementing traditional management systems.

The Tinduf refugee camp for Western Saharan people in the West of Algeria is a sensitive issue in the relation between Algeria and Morocco. The refugee camp is a result of the occupation by Morocco of Western Sahara.

The Maghreb population has two major components, Arabs (arrived from the 7th century on) and Berbers. Berbers are millenarian people with their own culture and languages. They are present in the most inaccessible areas such as mountains, plateaus and deserts all over the Maghreb.

Despite the differences the Maghreb shows an evident unity, in addition to its physical and territorial similarities, the region presents many social and ethnical similarities and a clear parallelism in its cultural and historical evolution (Souvannavong 2005).

Berbers were the original inhabitants of the Maghreb before the invasion of Arabs; nowadays they live from Western Sahara along the Atlas and the Sahara desert till Egypt in the East and till Mali in the South (see figure 2.2). The Tuaregs are the main representative tribe in the desert.

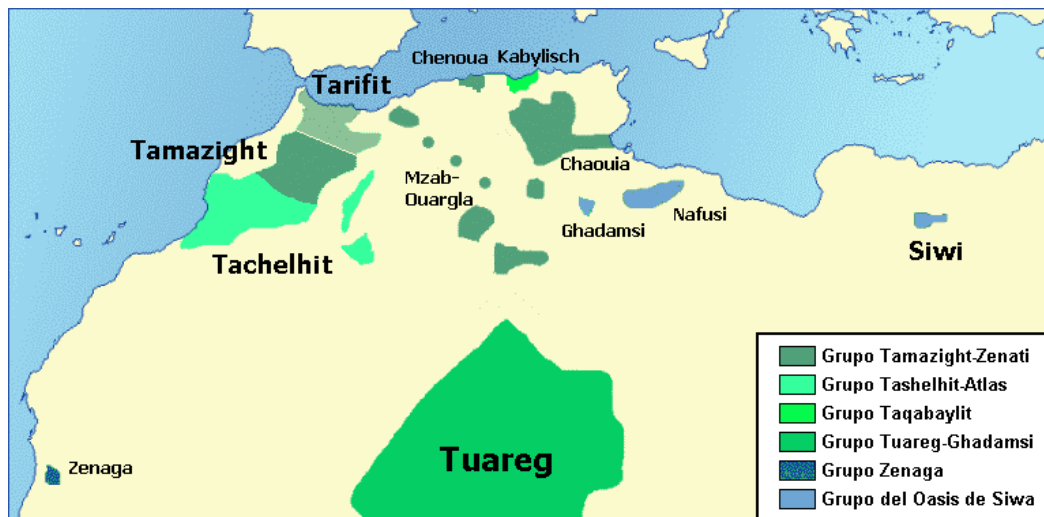


Figure 2.2: Berber distribution map (Wikipedia)

The Atlas Mountains and plateaus formed a refuge and defence against foreign invasions. They also helped to conserve the land tenure and management systems along history.

In the Middle Atlas tensions between Berbers and newcomers resulted in disputes about access to land and other resources. According to the Berbers, land not yet cleared is ancestral land and is their property. However, the newcomers who have settled in the area claim access too, especially those whose main occupation is farming. When one identity becomes dominant social fragmentation rather than integration may result (Venema 2003).

2.2 Migration

Rapid population growth is the most remarkable factor in recent decades. The rates of population growth in mountain areas contribute to more than 1% of the population increase in the three countries as a whole. This rise takes into account the exodus of peasants and artisans to the cities. The army and the administration recruit a significant number of young people. Emigration overseas, despite restrictive measures imposed by Europe, still mobilizes a great number of people. An estimated 150,000 workers (8-17% of the population) from the Rif and eastern regions work abroad (El Hamraoui 1983). This outmigration from the mountains is accompanied by a growing disinterest in agriculture, which revenues are comparatively smaller. The emigrant's earnings are reinvested mainly in the countryside, not in the purchase of land (for which the market is very limited) but in the household and agriculture (i.e. purchase of fertilizer, small-scale irrigation equipment).

Despite the tremendous changes that have taken place in the mountains, it appears that agriculture is far from being in a catastrophic state; and it is adapting to the new economic and social conditions.

Studying the cultivated landscape is a means of judging whether farming is advancing or retreating. On the one hand, there is the creation of new farm land in the forested massifs and in the shrub (ancient trend). On the other hand, there is evidence in some localities of a decline in the area under cultivation and land abandonment; some fields have become wastelands; trees are no longer maintained and their harvest is sporadic; irrigation channels and houses are poorly maintained. This change, however, is variable over time and place (Maurer 1992).

2.3 Maghreb Mountains: uses and characteristics

Although there are similar physical and human characteristics, the Rif, Tell and Saharan Atlas mountains are far from being uniform. The varied topography results in climatic differences: the humid regions of the eastern and western flanks contrast with the central sector of the eastern Rif, where aridity is predominant; and in the north the mountains with maritime influence contrast with the drier mountains of the interior (Maurer 1992).



Figure 2.3: Main Mountain agglomerations in the Atlas range and sub ranges (Google Maps)

From the agraricultural point of view, the regions of old sedentary tradition with private ownership of property contrast with those inhabited by more recently arrived populations who practice pastoral semi nomadism on collective lands and, at the beginning of 20th century, still lived in tents, as in the northeast of the Algeria. The study of Maurer (1992) shows that the

cultural systems are dominated by an extensive grain culture and locally the importance of forest production; in other mountains, where the natural vegetation is better preserved, livestock husbandry is the principal source of revenue. The development of the mountain areas after the Moroccan independence (1956), and in Algeria after the violent upheavals of the liberation war (1954-1962), heralded the end of the old traditional economic system.

There is a basic infrastructure which roads and trails connect the different parts of the Maghreb, including the isolated valleys. An administrative reorganisation multiplied the number of political constituencies and facilitated the dissemination of services and distribution of state spending. Primary and secondary schools have been established, as well as health centres and hospitals. Despite the difficulties due to the isolation of individual communities, electricity and potable water are becoming available (Maurer 1992). An urban infrastructure is evolving with the growth of small towns and the creation of centres, often the administrative seats of rural communities in Algeria and Morocco. Certain agglomerations (see figure 2.3) such as Siliana (2) in Tunisia, El Tarf (3), Mila (4) and Saida (5) in Algeria, and Taounate (6) and Chechaouen (7) in Morocco, are becoming seats of government of the local provinces (*wilaya*). Furthermore, industrial development has led to a network of cities in the valley of the Soummam (8). Everywhere, commercial activities are increasing and adding diversity to the rural and urban markets.

2.4 Agro-pastoralism

The economy in the Atlas ranges and sub ranges is based on a traditional polyculture of grains, trees, livestock in the brushwood, and also forests which deliver timber for construction, fuel for heating and secondary products such as mushrooms, medical and aromatic plants, honey, acorn and cork (Maurer 1992). This agro-pastoralism production system characterizes both the mountains and the high plateaus of the Maghreb.

The diversification of the production maximizes the procurement of resources obtained in the different agricultural subsystems. These subsystems are characterized by altitude, quality and slope of soils and water availability. Usually these subsystems correspond with farming on the slopes around the villages and use of the forest and of the common grazing land nearer the summits or the bottom of the valleys, where the slopes are very steep. Livestock husbandry is an important source of income for farmers and, in certain mountain areas with abundant cover of natural vegetation, represents the primary source of wealth. Cattle and goats are more numerous in the humid regions than sheep, because they are better adapted to dry

mountains. But this traditional husbandry is stagnating. When it is not integrated with crop cultivation, husbandry survives in communal range land (the stubble fields, the fallow lands, the forests, or the brushwood) where overgrazing is becoming a serious problem (Maurer 1992).

The system of farming practiced is represented mainly by extensive sylvopastoral small ruminants (13 million head) of local breeds well adapted to their environment. Farms are small and the farmers are poorly organized. Livestock products are the main outputs of grazing lands in mountains and plateaus, and livestock production continues to be the fastest growing agricultural subsector in the region (Naggar 2000).

Livestock is both from a social and economic point of view critical to rural livelihoods. Grazing animals is the principal practical method of exploiting natural vegetation in dryland environments. Pastoralism is considered the most economic, cultural and social appropriate strategy for maintaining the well-being of communities in dryland landscapes, because it is the only one that can simultaneously provide secure livelihoods, conserve ecosystem services, promote wildlife conservation and maintain cultural values and traditions (ILRI 2006, UNDP 2006).

Aside from this, sylvopastoralism systems are highly resilient and recover quickly from common disturbances such as fire, herbivore pressure and drought. These aspects have great significance for the global system, especially in the context of climate change (Constance Neely 2008).

2.5 Land property and management

2.5.1 Traditional land management

There is a great contrast between areas where intensive farming dominates and the mountain areas where exploitation is extensive.

The traditional plough is still widely used assuring good soil protection. When conditions allow, several channels converge at the lower ends of the parcels of land, draining the excess of water and facilitating its flow. The hoe is the only tool used on the steepest slopes. The harvest is often done in cooperative teams of harvesters working with sickles. The transport of harvested crops is carried out by donkeys or mules to the threshing areas. The scarce returns are subject to climatic hazards. In all three countries the absence of modern equipment adapted to mountain environment is remarkable (Maurer 1992). The tractor is more common

in Algeria and Tunisia, where the slopes are not too steep, than in Morocco. Mini-tractors, which are extremely useful and are widely disseminated in the European mountains, are not widespread.

2.5.2 Land tenure and structure

The average size of farms in the Maghreb mountains is small (2-5 ha), and broken into innumerable parcels. The agriculture practiced with this land structure does not supply enough food for people, forcing them to search for additional employment abroad. Small scale industries such as wood, leather, jewellery, arms manufacture, pottery, and basket weaving have an important significance (Maurer 1992). There are traditional trading routes through the mountains, from the high plains and interior basins to small Mediterranean ports in Morocco and Algeria. However, despite the proximity of the coast, the mountain people have always turned their backs on the sea.

Traditionally among nomads, land is not commercially transacted and is property of the tribe, while tents and animals are recognized as private property. Land is available to individuals temporarily, even when it is cultivated. Within the tribal area (*dirah*) land is allocated among clans and the chief of the clan usually allocates land temporarily among members.

“There is a “contextual” concept of tenure that distinguishes between rights of access and rights of disposal, and the emphasis is on the kinship network rather than on individuals” (Forni 2003).

The old system of farming is disappearing and is replaced by a new type of contract, according to which the more or less absentee owners give their lands for cultivation to associates against payment in kind in the form of a proportion of the harvest (i.e. share cropping). The agricultural sector continues to develop, but the price of labour is increasing rapidly to the point that workers must be hired from neighbouring regions (seasonal labour). The social classes of the agricultural world are stratifying (figure 2.5) and the income gap widens between those whose primary income is still derived from traditional agriculture and those who invest in new technologies and activities.

A general overview on the different farm structures (figure 2.4) gives the idea that small farm holders tend to diversify crops and livestock searching for the family members subsistence, whereas big farm practice an intensive agriculture where cereals and fodder are mainly

destined to livestock feed. The productivity per hectare decreases as the cultivated surface increases.

The population is being dispersing into hamlets and isolated houses, as an expression of the loosening of the former group life. Similarly, the change toward urbanization with the development of small centres and cities shows another form of detachment from the land (Fontaine, 1983).

The lack of a clear division in the property rights combined with the loss in the recognition of traditional land management due to the changes in the society during the last decades, bring the ethical dilemma of “the tragedy of the commons” (Hardin 1968). Where the common use is understood as the possibility of practice all privileges without attending the obligations. This leads to an over exploitation of the natural resources without a counterpart of maintenance.

The evolution of tenure in the Maghreb, more specifically in Algeria and Tunisia, has progressed through opposing phases and conflicting policies. In Algeria, the trend has changed from state confiscation and the experience of self-management, to privatization and state withdrawal (Rae 2002).

In addition, the rise of landlessness has been continuous, accompanied by growing rural unrest in the whole region. This situation is linked to overall development strategies and is affected by exogenous factors such as stricter European migration policies, blocking the entrance of emigrants.

Categories	Production system characteristics	Constraints	Objectives	Strategies
G ₁ Micro-farm (<10ha)	<ul style="list-style-type: none"> -Cereals dominate the cultivated surface (60-70%) -5 to 10 sheep and goat heads -Low equipment -Extensive production system -Family labour; no hired labour -Cereal production for self-consumption 	<ul style="list-style-type: none"> - poor soils -large families (8 members) -High level of family consume -low agricultural income -weak and unstable non-agricultural income 	<ul style="list-style-type: none"> -maintain a large family 	<ul style="list-style-type: none"> -95% of families recourse to external labour (migration) -increase the sheep/ goat herds
G ₂ Small farm (10-31ha)	<ul style="list-style-type: none"> -Tendency to production system diversification 	<ul style="list-style-type: none"> -Large family (9 members) -high manpower 	<ul style="list-style-type: none"> -cope with high income necessities -labour creation for 	<ul style="list-style-type: none"> -50% of farm households recourse to external

Land and Livestock Management in the Mountains of Maghreb

	<ul style="list-style-type: none"> -Low developed livestock (1-2 cattle + 15-30 goat/sheep) -Low equipment -Low intensive system -investment in broilers 	availability mainly directed to the farm	family members	labour -Introduction of new productions (broiler) -Diversification of crop system (more surface designed to market sale products)
G ₃ Medium farm (31-100 ha)	<ul style="list-style-type: none"> -Intensive and diversified production system -developed livestock (2-7 cattle + 20-70 sheep/goat) -many farms equipped -farm investments 	<ul style="list-style-type: none"> -large family (12-15 members) -High manpower availability, non-working -low non-agricultural income (<30 % of total) 	-cope with high income necessities	<ul style="list-style-type: none"> -increase arable land -diversification -crop intensification and fattening livestock -sale activities development in the region or village.
G ₄ Big farm (>100ha)	<ul style="list-style-type: none"> -system mainly based on cereals -less diversified and more intensive and mechanized Importance of sheep 200-400 heads -every farm equipped -High income and mainly derived from agriculture -Important investments not linked to the farm -Use of hired manpower 	<ul style="list-style-type: none"> - nested zones - succession problems -Lack of basic infrastructures (electricity, water, roads). This does not encourage young citizens to form part of the farm household 	-accumulate in agricultural sector to invest in village services	<ul style="list-style-type: none"> -Big non-diversified and intensive crops -sheep/goat livestock growth -high agriculture equipment

Figure 2.4: Tunisian farm characteristics (Mohamed Ha MMam 2002)

Total agricultural production, by farm holder and by ha of Useful Agricultural Surface					
Categories	Animal production By percentage	Vegetable production By percentage	Total agricultural production (GI=100)	Agricultural production By ha. (GI=100)	Agricultural Income by person included in the farm household (GI=100)
G ₁	34	66	100	100	100
G ₂	35	65	256	75	179
G ₃	43	57	2116	66	221
G ₄	33	67	3320	49	1591
Total	36	64			

Figure 2.5: Tunisian farm characteristics (Mohamed Ha MMam 2002)

3. Mountain Policy Tools

This chapter describes and analyses the mountain policy tools applied in the Maghreb so far. It starts giving a general summary on the main features of the Atlas region in section 3.1 based on (Mohamed Ha MMam 2002; Souvannavong 2005; Kradi 2012). In the next sections a detailed description of policies applied in each country and a corresponding policy analysis is given.

3.1 General overview

History

Morocco, Algeria and Tunisia were colonized by Phoenicians, Romans, Turks (small presence in Morocco), France and Spain (Morocco). The independence processes started in the 1950s, the Independence war of Algeria is worthwhile mentioning, it lasted for more than 8 years and caused a remarkable loss of lives.

From 1989 on, the Arabic Maghreb Union was established among these three countries plus Libya. Some characteristics of the three countries are given in figure 3.1 and discussed next.

Agriculture:

- Agriculture is an important economic sector in the three countries (especially in Morocco with more than 30 per cent of the population working in the sector).
- High trade balance deficit in agricultural products (more than 30% in the three countries).
- Great differences between urban and rural regions.
- Water resources are limited, especially in Algeria and Tunisia.
- Climate change effects are jeopardizing the sustainability of agricultural production systems. The climatic forecasts in Morocco show a progressive process of increasing aridity due to a decrease in precipitation caused by an increase in temperature of 3 degrees Celsius, rising to 5 degrees in some mountain areas (Balaghir 2009).
- The major part of Maghreb farms are small (<5 ha) or very small (<0.5 ha) subsistence farms. In an average year, off-farm work is necessary to satisfy the family necessities. Non-agricultural activities are scarce in rural areas (mainly needlework and handloom handicraft for women).

Mountain characteristics:

- Morocco is characterized by high altitude mountains (between 1200 and 2000 meters);
- Algeria is characterized by plateaus (between 500 and 1200 meters);
- Tunisia has a lower mean altitude, but is characterized by steep slopes;
- Mountains are the Independence fighting symbol. Mountains host ancestral nationalism;
- Berbers are the major representative tribe.

Population:

- Large families (10-15 members);
- Young population;
- Strong population growth;
- The sedentism process is taking place at an increasing speed especially in Algeria and Tunisia;
- Big social differences.

Synthesis:

- Mountain areas and the Mediterranean watershed have had different development processes, because of the different impact of colonization periods in the coast and in the interior;
- After the Independence of the three countries, mountain areas have gained increasing presence on the political agenda, causing deep changes in its socioeconomic structure;
- Among the changes towards “modernization”, the Moroccan mountains appear a step behind its neighbours.

Given the previous and what was mentioned in the previous chapters, this study considers the Atlas massive a unique case for analysing mountain development policies.

Year 2007	Morocco	Tunisia	Algeria
Surface (x1,000 Km²)	446	164	2,380
Inhabitants (millions)	32	10.5	36
Independence year	1956	1956	1962
Political regime	Monarchy	Republic	Republic
GDP/Inhabitant (US Dollars)	4,196	7,281	7,658
Human Development Index	0.654	0.769	0.754

Figure 3.1: Some comparative data of Maghrebicountries (UNDP 2008)

3.2 General overview on Mountain policy tools in the Maghreb

Recently development strategies for rural and remote areas, including mountain areas, have gained an important place in governmental institutions responsible for agriculture, rural development and environmental protection. Strategies have been translated into policies and programs for mountain areas development, which contain sustainable development principles and mechanisms.

Tunisia has implemented a National program called Agenda 21 and several local Agenda 21 programs in mountainous territories (see appendix 1). In Algeria the Ministry of Agriculture and Rural Development has activated a sustainable rural development strategy that recognizes mountain territories as a main target, including elaborated tools for ensuring coordination mechanisms, monitoring and evaluation systems, and democratic and participatory processes (Virginia Belsanti 2005).

Morocco, finally, has prepared the rural development strategy 2020 ("Green Plan") and has set up mechanisms for coordination among different governmental bodies and other stakeholders for rural development.

Complementary to these policies on sustainable agriculture and rural development, the Maghreb countries have implemented a number of policies to support the improvement of livelihoods in mountain areas managed by different ministries and governmental bodies. A wide range of policies institutions are in place, whose aims are to improve the access to services and resources, enhance productivity, protect the environment, etc.

Of specific interest for this study is the presence of governmental institutions strongly oriented to mountain issues. In Morocco, the High Commissioner for agriculture and rural development of mountain areas, for water and forestry and combat of desertification, is responsible for the implementation of policies and programs for research and development of mountain areas. Tunisia has the North-West Sylvo-Pastoral Development Office, an inter-governmental institution committed to the development of a specific territory in the northwest of Tunisia, which contains the main mountain areas of the country. It specifically addresses problems of mountain areas, aiming at protecting the environment and facilitating people's participation, and establishing new institutions.

Due to the trans-boundary character of mountain areas the analysis in this study was carried out at the sub-regional level of country.

3.3 Morocco

3.3.1 Policy

In 2008 Morocco launched a strategic Green Plan to develop the agricultural sector that contributes 19% to national GDP, 15% coming from agriculture and 4% from agribusiness. The sector employs over 4 million rural workers and creates about a hundred thousand jobs in the agribusiness sector, according to the Agricultural Development Agency (ADA 2009). The Green Plan defines two different pillars in the area of agricultural development. See figure 3.2 for a map of Morocco.

Pillar I focuses on projects that, in general, depend on private financing and develop a high productive or high value added modern agriculture (milk, red and white meat, cereals in favourable irrigated zones).

Pillar II, aims to improve production in both vegetal and livestock sectors, in unfavourable zones. Pillar II projects are economic viable projects in marginal zones (unfavourable, non-irrigated zones, mountainous zones and oases), that essentially depend on direct aid from the State. They also take into account the conservation of natural resources.

Both pillars have been translated into a set of objectives:

- Increase agricultural production;
- Increase income and employment in the agricultural sector;
- Creation and diversification of economic activities;
- Halt the process of environmental degradation;

Land and Livestock Management in the Mountains of Maghreb

- Renewal of training and establishment of new professional training schemes, including women's schooling and labour integration;
- Participation of the National Agriculture Research Institute (INRA) in mountain agricultural research;
- Improvement of infrastructure and services;
- Correction of regional disparities and gaps.

To achieve these objectives the plan adopted some approaches: integration, territorialization, multifunctionality and the multidimensional approach, participation, implementation of decentralization and deconcentration processes, development of partnerships and contractual negotiation.



Figure 3.2: Map of Morocco regions (lavozlibre.com 2009)

At the decentralized level the the Council and Permanent Interministerial Committee for Rural Development (CIPDR) is represented by restricted provincial committees headed by “*Walis*” (local authorities) that approve the development plans and elaborate financial plans, mobilizing resources, monitoring, and evaluating projects. The Regional Agricultural Directorates (*Directions provinciales de l’agriculture*) and the Regional offices for agriculture support (*Offices régionaux de mise en valeur agricol*) guarantee secretarial services. The creation of the High Commissioner for Water and Forestry and to Combat Desertification (*Haut*

Commissariat des Eaux et Forêts et Lutte contre la désertification, HCEFLCD) shows also the importance given by the Moroccan Government to mountains.

HCEFLCD plans and programs focus on the protection and conservation of natural resources, control of desertification processes, valorisation of local resources, and implement approaches for people participation, and diversification and integration of activities (Kradi 2012).

Plans and programs included deal with forestry, watershed management, desertification, etc.

Other policy measures noted for their impacts on infrastructure and social services include: Program of Grouped Supply in Drinking Water of Rural Populations (PAGER); Global Rural Program of Electrification by the Ministry of the Equipment; Program of Education called "School for all" by the Ministry of Education; Programs of integrated rural development, such as the so called agricultural development perimeters (PMVB) and DRI-Forest.

There is also an innovative pilot project in the Imilchill-Amellagou region, supported by the Moroccan government in collaboration with UNFAO which will be described in the next section.

3.3.2. Morocco Policy analysis

Efficiency and effectiveness

In Morocco the policies related to mountains are linked to the Moroccan Green Plan of 2009. The studies on mountain production systems show the negative externalities like excessive water extraction, earthmoving or mining (Kradi 2012). Also the climate change effects (Balaghir 2009) damage the ecological sustainability of these areas. In the first evaluation report about this green plan (Kradi 2012) the targets are clear, "today there is not a useful and a useless Morocco". In this report it is said that "every region or locality should benefit from the state efforts, encouraging specially the contribution to sustainable development". The main activities of the Green Plan in the mountains are arable farming and livestock, promoting the valorisation of local products, landscape attention and development of ecotourism (pillar II Green Plan).

Morocco begins to realize the importance of mountain ecosystems as strategic ecosystems. Addressing the main local population problems such as poverty, inequality in the resource distribution and a weak Human Development Index.

As indicated above, the Inmilchil-Amellagou Project in the High Atlas, intends to recognize the strategies for the socioeconomic development of mountains, as well as to clarify the means and targets necessary to undertake these strategies.

The Green Plan is still new and the first evaluations, such as the Kradi report (Kradi 2012) do not clarify the degree of success of these projects. In the Kradi report, promoted by the Moroccan government, the targets are specified with regard to the starting point of the Plan, with the aim of increasing the policy efficiency and effectiveness.

From the efficiency point of view it is still too soon to evaluate the plan. The means mobilized by the state in the mountain areas are still testimonial and dependent on the conjunctural political will more than on problems or strategic plans. Apart from this, there are some advances in the information actions to the local population and administration, improvement in the agro pastoral system research, forest sustainability and agriculture (fruticulture) and livestock (boiler, no-land ranching) alternatives. The regional agricultural plan includes attempts to improve the position of women (family planning, health, family nutrition, education). The electrification program started in 1996 is not effective in many dispersed mountain populations yet. Where it is implemented changes in timing activities has taken place, especially in the non-agricultural craft activities. Child education is the main concern for the communities. The road infrastructure is not well developed, hindering the movement of young and children for education. Besides child labour is still essential for many families (water and firewood carriage, herds care). Child vaccination and contraceptives information policies are improving.

Market structures still focus on week markets, with a clear lack of structures to develop other markets (e.g. for refrigerated products).

Local agricultural credit agencies started recently, focusing on microcredits for women.

Acceptability

The social and political organization of mountain areas is based on three levels. First, the traditional social organizations around the local assemblies (*JMAA*) are in charge of regulating the conflicts between crops and livestock, water use and even children's disputes. The local authority (*mokadem*) belongs to the second level, in cooperation with the *JMAA*. The *mokadem* is appointed by the administration and is in charge of administrating the financial resources coming from the administrations. At the third level there is the Governor, an influential person appointed by the government and also in charge of the resources from

administration but with a wider scope. The JMAA does not fit legally within the Moroccan state, thus, making community participation more difficult. The state proposed to generate new local organization structures in accordance to the general state laws known as “wise committee” (*Comité des Sajes*). However the development experts advised to integrate the traditional associations to participate in the development initiatives, instead of creating new local structures.

Moreover, certain Green Plan agricultural proposals met some problems:

- The most important one was related to the attempt to change the transhumance traditional practices and the green corridors management (*agdals*);
- The poor and very poor farm households (>25% of total) do not engage in the general plan. For these people, experts propose subsistence compensations and/or non-agricultural labour plans.

Conclusion: Apart from these problems, the positive women’s attitude towards the plan boosting child education should be mentioned.

Enforceability

The Moroccan state has limited resources (lowest GDP per capita in the Maghreb region).

Their efforts to get a more democratic system (New Constitution in 2011) and its rural strategy (Green Plan 2009) are recent. However, first results are starting to appear. With regard to mountains, traditionally forgotten and isolated, these efforts are still very weak. Aside from this, and as pointed out before, there is a clear incapacity to integrate the traditional production systems, in spite of the efforts made on paper.

3.4. Tunisia

3.4.1. Policy

Sustainable development processes have already touched mountains areas in Tunisia. Since 1995, a “National action programme for the environment and sustainable development for the 21st century” (Blue Plan) for the implementation of Agenda 21 has led to the establishment of local Agenda 21 specialized services in several mountain areas (regions: Bizerte, Jendo, Draham Ain, Siliana, The kef, Zaghouan, Kasserine, Nabeul, Kairouan and Béja, see figure 3.3) that address both sustainable agricultural, rural development and mountain issues.



Figure 3.3: Tunisian regions (lonelyplanet.com 2008)

The National Sustainable Development Commission (CNDD), chaired by the Prime Minister since 1993, includes Government and Parliament members, representatives of the business community, women and youth organizations and other NGOs. The National Observatory for Environment and Sustainable Development (OETD) has been established in 2004 to support decision making of CNDD (Virginia Belsanti 2006).

The mission is to adjust and harmonize the national development programmes, in order to reconcile socio-economic development with the conservation of natural resources. Mountains are also a focus of rural development policies implemented through Integrated Rural Development Programmes. Since the 1990s, these programmes focus on increasing competitiveness of agricultural products, improving the working environment, promoting integration and considering environmental sustainability through a well-planned management of natural resources. There has been a decentralization of responsibilities, involvement of local associations and an enhanced role for NGOs in the whole development process.

The establishment of the North-West Sylvo-Pastoral Development Office (ODESYANO), a public establishment decisive in the development of the mountainous areas of Tunisia, as well as for the methodology used for this purpose. The aim of this Office is to balance the

differences between regions, promoting a rational extraction of natural resources and their protection (l'Agriculture 2001).

Its first objective was at the beginning the conservation of natural resources, particularly soil erosion combat and water retention. However, this approach changed throughout time, focusing on education and improving living conditions.

3.4.2. Tunisian Policy analysis

In 2002 the United Nations declared the international year of mountains, Tunisia being one of the first countries contributing to this initiative. As explained above, the Tunisian mountains are the least elevated in the Atlas. The strategic orientation of the government on the Tunisian mountains is part of an integrated and global policy for a sustainable management of resources. This policy gives special attention to the integration of the local population in the management of these ecosystems.

Efficiency and Effectiveness

Integrated development programs constitute the main axe in the rural development strategy from 1980s on. In the 1990s these programs are strongly revised specially for mountain areas. The analysis of the programs implemented in the mountain areas shows that the results are positive, especially in the mobilization of water and improvement of living conditions. These results were possible because of the support of an adequate institutional framework (l'Agriculture 2001).

Agricultural development: 50% of the mountain areas can be considered agricultural. However, the vocation of these areas is mainly agro-pastoral. The sedentism and pressure on the green corridors threatens the traditional system equilibrium. In this way, the technicians and development promoters claim for the recuperation of the traditional model in order to warrant its socioeconomic and ecologic sustainability (l'Agriculture 2001).

Water mobilization resources programs have shown a good effectiveness providing 80% of water resources, from which 50% is used by irrigated agriculture.

Forestry programs: Almost the whole Tunisian forest is in mountain areas, it occupies around 1 million hectares from which almost 50 % have a Management Plan. From the 1950's on, forest has experienced a strong degradation. Traditionally, the principal function of forest was

local cattle feeding. The development programs have created 24 protected areas (covering a surface of 80.000 ha).

The National Program Fund is oriented to poor populations, the instauration of this fund was reinforced by the creation of a state secretary, has accelerated the improvement of the basic infrastructures such as water, electricity, roads, health, education, etc.

This fund, reinforced by the integrated development programs, contributes to the creation of extra agricultural revenues.

Promotion of women in mountain areas: The eighth plan for woman and family (1992-1996) and later initiatives focused specially on women and their participation in the program aiming to improve their living conditions.

In 1998 a specific plan for rural women was set up. This plan is centred principally on the integration of women in the associative and professional structures, and facilitates their access to services, resources and production factors.

Energy and environment: Tunisia ratified the UN Convention on Biological Diversification (1993). Based in this convention, Tunisia implemented 6 plans and 18 sectorial projects, with the aim of protecting, valorising and promoting biological riches. Mountain ecosystems are included in these projects and plans. With regard to energy, the main source of energy for rural population is forest firewood. Some actions were carried out to substitute this raw material by gas, solar and eolic energy.

Tourism: The ecotourism is expanding. The best results were obtained in Spa stations.

Research: Even before independence Tunisia did relevant research. Mountains have been object of specific researches in agronomy, forestry, ecology, socioeconomic issues, etc. The results have enabled the identification of appropriate animal and vegetable material, the implementation of management plans and sustainable planning, a thematic complete cartography (geology, soil, vegetation, water, etc.) and identification of archaeological locations.

Acceptability

In the rural development strategies of Tunisia the importance given to local actors should be mentioned. The legislation intends to incorporate traditional customary law. Moreover, the regional decentralization policy, seeks for more power for local organizations. Nowadays

various NGOs work in integral development programs. These programs are supported by European funds with the partnership of the Agricultural Ministry.

Some results (Mohamed Ha MMam 2002) show a positive local participation, highlighting the scarce participation of poor agricultural families.

Enforceability

Among the three countries analysed, Tunisia is by far, the state most advanced in the design and application of specific mountain strategies.

3.5 Algeria

3.5.1 Policy

Agriculture is an important sector in Algeria, representing 25% of the labour force and contributing close to 10% of GDP (Laoubi 2012). There are various factors affecting agriculture specially desertification, water scarcity, growing urbanization and demographic pressure. The productive land area per capita has dropped by more than 72%, from 0.73 ha per capita in 1962 to 0.20 ha per capita in 2000. See figure 3.4 for a map of Algeria.

The coordination of rural development policies is assured through the High Council for environment and sustainable development (*Haut Conseil de l'Environnement et du Développement Durable (HCEDD)*), an interministerial body whose task is to control the integration of decision-making in environmental and sustainable development.

Concerning rural development, the Ministry of Agriculture has set up a National Strategy for Sustainable Rural Development (PNDAR) in July 2004. The aim is revitalizing the Algerian rural areas, valorising the cultural, natural and economic diversities of the different populations. The Strategy takes into account the territory specificities, and mountains are recognized as specific ecosystems, together with Steppe and Sahara.



Figure 3.4: Map of Algeria. Source <http://www.historycentral.com> year

The principal axes of the strategy consist of the establishment of local partnerships and balance among territories, the support to the starting of economic activities, the valorisation and sustainable management of natural resources and social and economic synergy and coordination among actions.

To implement the strategy a number of tools have been implemented:

- Mechanisms for consultation and decision making;
- Funding mechanisms for activities in rural areas;
- Tools for programming and managing rural territories;
- Monitoring and evaluation systems to support decision making processes;
- Supportive legislations and regulations.

The innovative aspects of this new PNDAR strategy consist of 5 points:

- Project promoter is the core element ;
- Implementation of services other than agricultural ones: crafts, habitat, health, environment and culture;
- Involvement of all the associations in the rural territory;
- Decrease of the importance of public services;
- Extension to all rural populations willing to take part in the process in an innovative way.

From the organizational point of view, starting from the local level up to the highest levels, responsibilities are identified around the following functions:

- Facilitation;
- Technical support and financial assistance;
- Coordination of activities and creation of a network among the different stakeholders.

The main institutions concerned with mountain issues are:

- High Council for environment and sustainable development (HCEDD);
- Ministry of agriculture and rural development;
- Ministry representative of rural development;
- Ministry of hydraulic resources;
- General Direction of forest;
- Ministry of territorial management;
- National institute of agriculture research (INVA).

About one year after the adoption of the rural development strategy, the need for capacity building and information mechanisms have been identified as a priority for its correct implementation. Programs for training and extension activities have been set up and implemented by different institutions (e.g. INVA).

Other policies and measures that have direct or indirect impacts on mountain areas are: Program of infrastructures; National Plan for Water; National Plan for agriculture and rural development; National Plan of environment and sustainable development.

3.5.2 Algerian Policy analysis

Efficiency and Effectiveness

The main target of the National Strategy for Sustainable Rural Development plan (PNDAR) is to increase agriculture production, reducing the basic food imports and the dependency on external markets for strategic products (see figure 3.5 and 3.6). Hence, the improvement of mountain areas is not taken into account as a specific pillar inside the global strategy. Some studies (Laoubi 2012) point at the poor success and even failure of the PNDAR plan, due to:

- Difficulties with land ownership;
- Limited water availability;

Land and Livestock Management in the Mountains of Maghreb

- Low investments and scarcity of agricultural inputs;
- Bureaucracy, low educational level and agricultural training of farmers.

Some policies, especially directed towards infrastructure, electrification, and the Water National Plan, had positive results.

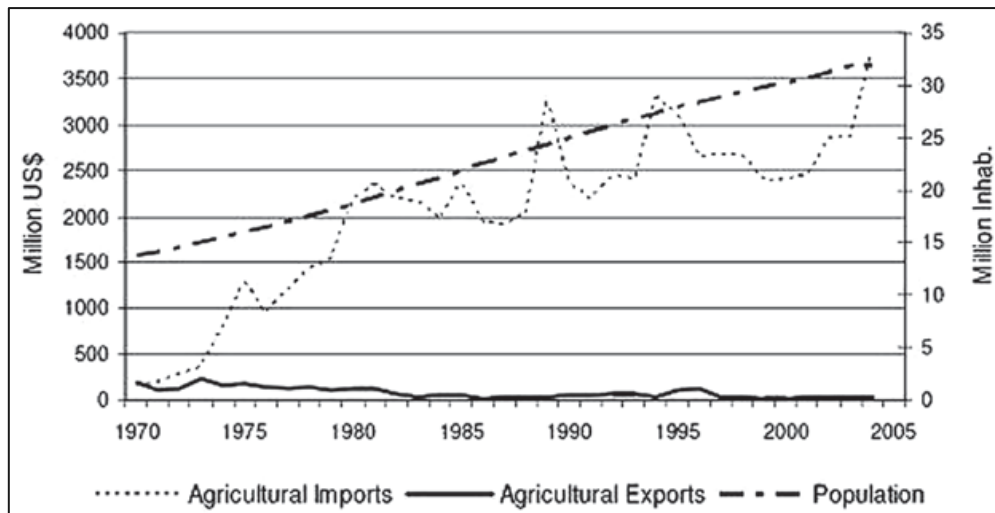


Figure 3.5: Trade in Agriculture products (1970-2005). (Ministry 2008)

Product type	1999 (%)	2004 (%)	2008 (%)
Wheat and wheat derivatives*	32	34	35
Milk and milk derivatives*	39	41	42
Pulse	25	26	30
Meat	80	89	100
Potato	88	94	100
Industrial tomato	100	100	100
Sugar, Tea and Coffee	0	0	0

*Strategic products

Figure 3.6: Food needs coverage by product. Source: Ministry of Agricultural and Agricultural Statistics of Algeria (Ministry 2008)

Acceptability

Some efforts have been made to make local actors participate in the management of the plans applied in the mountain areas. At local level there are coordination agencies, incorporation groups and local farm associations.

This participatory is recent, and is mainly centred on information and mobilization actions.

Also in Algeria, women are especially interested in the topics related to child education and health.

Enforceability

As indicated above, PNDAR plans were characterized by an excess of standardization, centralization and bureaucratization. Thus, their results have been extremely weak in fragile ecosystems. At the moment PNDAR plans are pointing to a change in this paradigm, including a more bottom-up oriented decision making.

In addition to the shortage of governmental resources and the centralized and bureaucratized distribution of these resources, there is an extreme deterioration of mountain areas (overgrazing, public services deterioration, population decrease, inadequate legal regulation of property and local traditional organizations).

4.-UNFAO projects in Maghreb Mountains

This chapter describes some UNFAO programs applied in the Maghrebi Atlas throughout several projects with different approaches. These programs were selected using two criteria, the presence of programs in the Maghreb region and the importance given by the UNFAO (both budgetary and institutional efforts).

The first four sections give an overview of the programs and a description of actual projects placed in the Maghreb Mountains; one of them is a UNESCO initiative, included due to its adequacy and the multiple connections with former programs. A policy analysis on these projects is conducted at the end of each section.

The last section describes two major initiatives of the UNFAO that are not implemented in the area, but both are supported by UNFAO and focus on dryland mountain ecosystems.

The Food and Agriculture Organization of the United Nations (UNFAO) is a specialized agency of the United Nations that leads international efforts to defeat hunger. UNFAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. UNFAO is also a source of knowledge and information, and helps developing countries and countries in transition to modernize and improve agriculture, forestry and fisheries practices, in order to ensure good nutrition and food security for all. UNFAO is active in the region of Maghreb through different programs and projects (UNFAO).

4.1 Ecosystem Based Adaptation

4.1.1 General background

Ecosystem-based Adaptation (EBA) is an approach based in a strategy that integrates the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change. It includes the sustainable management, conservation and restoration of ecosystems to provide ecosystem services.

Ecosystem-based Adaptation contributes to reducing vulnerability and increasing resilience to both climate and non-climate risks (global change), providing multiple benefits to society and environment (IUCN 2009).

There is growing recognition of the need for healthy ecosystems for the adaptation of people to climate change. They provide for example drinking water, habitat, shelter, food, raw materials, genetic materials, a barrier against disasters, a source of natural resources, and

many other services on which people depend for their livelihoods. As natural buffers, ecosystems are often cheaper to maintain, and often more effective, than physical engineering structures. Ecosystem-based Adaptation, offers a means of adaptation readily available to the rural poor; integrating readily into community-based adaptation and addressing the concerns and priorities identified by the most vulnerable countries and people. Examples of activities of Ecosystem-based Adaptation that try to increase resilience and reduce the vulnerability of people and the environment to climate change are:

- Sustainable water management, where river basins, aquifers, flood plains, and their associated vegetation are managed to provide water storage and flood regulation services.
- Disaster risk reduction, where restoration of coastal habitats such as mangroves can be a particularly effective measure against storm-surges, saline intrusion and coastal erosion.
- Sustainable management of grasslands and rangelands, to enhance pastoral livelihoods and increase resilience to drought and flooding.
- Establishment of diverse agricultural systems, where using indigenous knowledge of specific crop and livestock varieties, maintaining genetic diversity of crops and livestock, and conserving diverse agricultural landscapes secures food provision in changing local climatic conditions.
- Strategic management of shrublands and forests to limit the frequency and size of uncontrolled forest fires.
- Establishing and effectively managing protected area systems to ensure the continued delivery of ecosystem services that increase resilience to climate change (IUCN 2009).

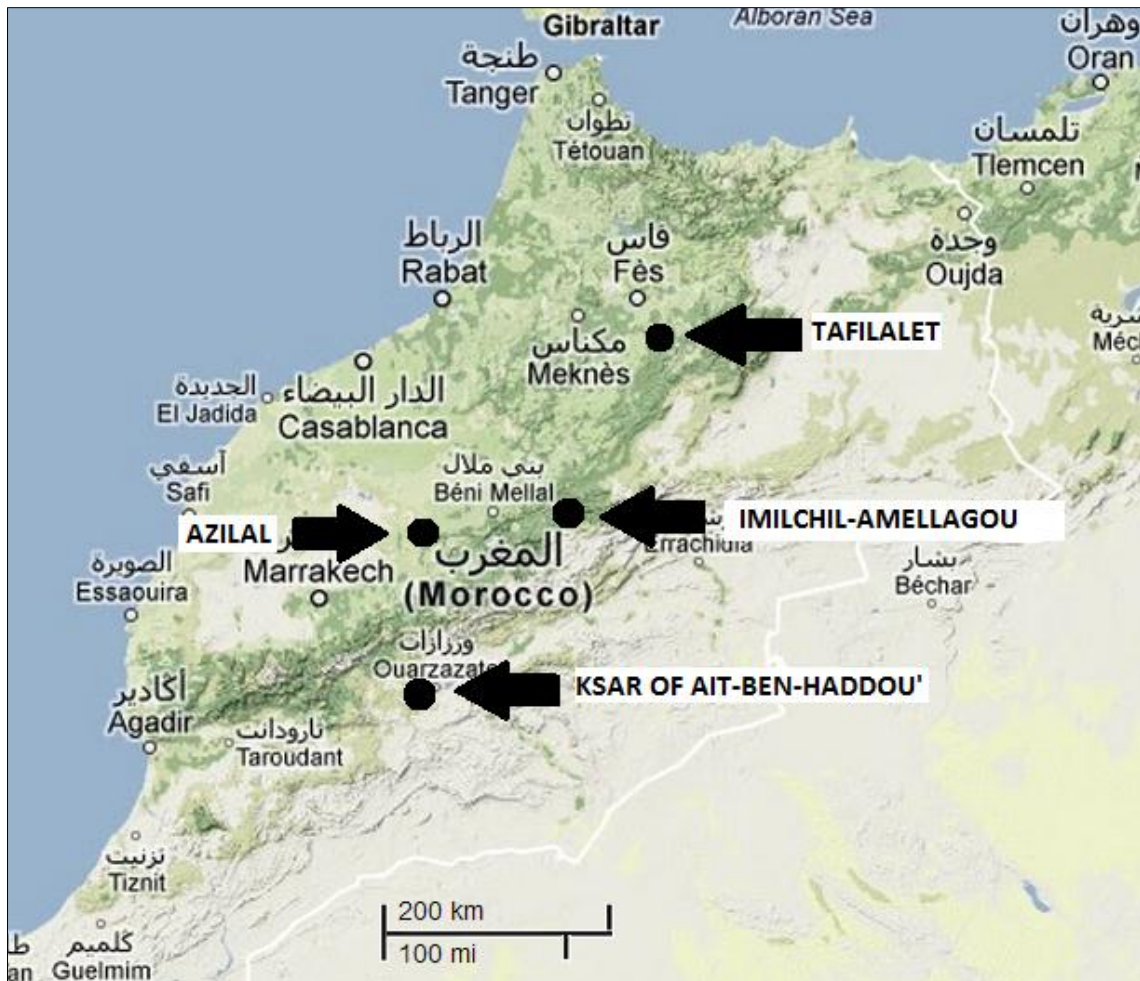


Figure 4.1: Projects site distribution (Google Maps).

4.1.2 Ecosystem Base Adaptation in Azilal - High Atlas

EBA is being implemented in some mountain areas of the Maghreb; one example is a Community Based Adaptation (CBA) project in Morocco with the following components:

“Building the forest ecosystem’s resilience and improving two communities’ capacities to adapt to the effects of climate change, particularly the increase and intensification of drought periods, through a sustainable and integrated farming and forestry strategy in the Province of Azilal-High Atlas” (Zakoura 2009).

The CBA project is aimed at two pastoral communities in the *Azilal* province (Figure 4.1), located in a mountainous region of the High Atlas with terrace farming in the valleys and high altitude forests. The two *douars* (villages) of approximately 2000 people are located on opposite sides of a crest at the summit surrounded by the region's endemic species: *Juniperus thurifera* (Figure 4.2), slopes of green oak and *Juniperus oxycedrus* trees (Figure 4.3).



Figure 4.2: *Juniperus thurifera* (Wikipedia 2013)



Figure 4.3: *Juniperus oxycedrus* (UNDP)

The zone's climate is semi-arid and presents strong ranges of temperatures between very cold winters and very hot summers (up to 40° C). Rainfall amounts to 500 mm on average per year, which is slightly below the national median. The climate changes observed by the communities over the last 20 years include an increase in the frequency and intensity of rainstorms, reduced

snowfall (in quantity and duration), and especially increased drought and reduced water resources.

These changes, which are expected to intensify in the future, are having a direct impact on the communities' strategic resources and living conditions:

- The local ecosystems with great heritage value and strategic significance for the local resources are today showing signs of degradation, which have been challenging their capacity to regenerate and their resiliency toward climate change.
- The *Juniperus thurifera*, which has already been facing the risk of disappearing because of overexploitation and excessive pasture, is severely threatened by the impacts of climate change, which have further reduced its capacity for regeneration and has led to the development of parasites.
- Breeding, the communities' principal source of income, has declined because of several factors, including the degradation of land reserved for grazing, resulting from poor forest management. These threats have intensified with climate change, particularly because of recurrent droughts.

The communities are powerless to face these threats, and have been witnessing the degradation of their environment without being able to find solutions suitable for their needs and that of the local environment.

To meet these needs, the project aims to reduce the communities' vulnerability to the negative effects of climate change and increase the resilience of the ecosystem on which they depend.

The project is implementing sustainable and supplemental forest, fodder and farming management strategies to enable the communities to protect their resources and face the growing impacts of climate change.

Direct *Juniperus thurifera* regeneration activities through in situ plantings of cuttings produced by the Centre for Forestry Research will be undertaken in parcels chosen in consultation with the communities, in order to contribute to the regeneration and resilience of these species.

Moreover, a combination of techniques aiming at improving the currently produced fodder and at producing alternatives, will allow adapting the resources to climate change and variability, to guarantee supply for the communities, and to promote forest protection.

The project relies on two innovative measures of adaptation: planting productive and adapted species, such as *Atriplex* (Figure 4.4), known for its nutritional value for fodder, adapted to high mountain altitudes, and not demanding in terms of water consumption; and shrubs planted in hedges, referred to as “vegetative hedges” to increase short and medium term fodder production, with the idea of reducing congested grazing land in the green oak forest.



Figure 4.4: *Atriplex* (naturalistas 2013)

Capacity-building and awareness-raising activities in the communities will provide the technical knowhow to increase the ecosystem’s resilience, improve sources of income, and promote a better understanding of the issues of climate change. This training will also provide inhabitants with the tools required to maintain the plantings and continue breeding activities under good conditions.

A “*Groupeement Villageois de Gestion Durable de la Foret*” (Village group for sustainable forest management) will be formed in each *douar* (village) as a hub for awareness raising and inclusive community mobilization, and to ensure the project’s sustainability. It will be the direct beneficiary of technical training based on two themes: “forest and sylvo-pasture” to change abusive harvesting practices, and “farming” to provide an alternative to foliar feed for

the forest ecosystems. The group will be responsible for relaying this information to the communities.

To guarantee the project's continuity and sustainability, the development of Income Generating Activities (IGA) will be initiated from the first months of the project and following the first community awareness-raising workshop to provide the conditions for implementing innovative artisanal activities using forest resources, in respect of the ecological balance. Particular attention will be given to the *Juniperus thurifera*, which is known for its aromatic and medicinal virtues.

The project will have multiple positive benefits for the communities: local capacity building, mobilization and development of contributions from all, and increased resilience of the ecosystem, which will enable residents to reduce their expenses and reliance on the markets. It will therefore directly allow the communities to reduce their vulnerability (Zakoura 2009).

The project (2011-2013) totals a budget of 155 000 USD. The communities contribute 20,000 USD in kind. The ministry of Water and Forest provides 24,000 USD in kind. Other partners include the US Peace Corps (14,600 USD) and the Embassy of Finland in Morocco (34,000 USD) (Zakoura 2009).

Analysis

Due to the fact this project just started one year ago, it is too early to evaluate it. The plantation of the tree species can be expected to be successful, due to the direct involvement of the Centre for Forestry Research of Morocco. With regard to effectiveness, it seems logic to infer the adequacy of this measure to preserve and reinforce the traditional agro-pastoral system. Threatened on one hand by erosion and increase of temperatures (climate change effects), and on the other hand by overgrazing.

In relation to sustainability of results, this project complies with the preservation principles of sylvo-pasture systems. The acceptability by the local stakeholders seems to be good, as long as the participatory processes play a core role in the project's outline.

4.2 Climate-Smart Agriculture

Climate change poses many threats to agriculture, including the reduction of agricultural productivity, production stability and incomes in areas of the world that already have high levels of food insecurity and limited means of coping with adverse weather. Being able to transform agriculture to feed a growing population in the face of a changing climate without hindering the natural resource base will not only achieve food security goals but also help mitigate the negative effects of climate change. A more productive and resilient agriculture will need better management of natural resources, such as land, water, soil and genetic resources through practices, such as conservation agriculture, integrated pest management, agroforestry and sustainable diets (UNFAO 2012).

This transformation of agriculture is being promoted by UNFAO along with other partners under the term “Climate-smart agriculture”, agriculture that **sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation) while enhancing the achievement of national food security and development goals.**

Analysis

This program is strongly supported by UNFAO, with a budget around 10 million USD (2012), plus another 5.3 million for three projects in Zambia, Malawi and Vietnam.

Despite the great push received from UNFAO, this program is still seeking for partners in the Maghreb region.

4.3 Globally Important Agricultural Heritage Systems

4.3.1 General background

Worldwide, specific agricultural systems and landscapes have been created, shaped and maintained by generations of farmers and herders based on diverse natural resources, using locally adapted management practices. Building on local knowledge and experience, these ingenious agricultural systems reflect the evolution of humankind, the diversity of its knowledge, and its profound relationship with nature. These systems have resulted not only in specific landscapes, maintenance and adaptation of globally significant agricultural biodiversity, indigenous knowledge systems and resilient ecosystems, but, above all, in the sustained provision of multiple goods and services, food and livelihood security and quality of life.

In order to safeguard and support world's agricultural heritage systems UNFAO started in 2002 an initiative for the conservation and adaptive management of Globally Important Agricultural Heritage systems (GIAHS). The initiative aims to establish the basis for international recognition, dynamic conservation and adaptive management of Globally Important Agricultural Heritage Systems (GIAHS) and their agricultural biodiversity, knowledge systems, food and livelihood security and cultures throughout the world.

The GIAHS initiative has identified pilot sites in Peru, Chile, China, Philippines, Tunisia, Algeria, Morocco, Kenya and Tanzania. In these pilot systems dynamic conservation management approaches will be developed and implemented, to assist national and local stakeholders in the conservation and adaptive management of the systems and their components (FAO 2012).

In the Maghreb three projects are being implemented nowadays, two in lowland oases in Algeria and Tunisia and one placed in *Imilchil* and *Amellagou* (Figure 4.1), both communes in the Atlas Mountains of Morocco.

Oases are one of the systems targeted by the GIAHS initiative, and at the same time they are one of Morocco's main national priorities (Pillar II of the Green Morocco Plan). Supported by the International Fund for Agricultural Development (IFAD), UNFAO and the Moroccan authorities jointly identified a region in the Eastern High Atlas: the *Imilchil* and *Amellago* communes, composed of "cold oases connected to community pastures (*Agdals*) (Figure 4.5)".



Figure 4.5: *Agdal* (Mestapha 2013)

4.3.2 Imilchil-Amellagou mountain oasis Pilot Project

Imilchil-Amellagou is composed of valleys, two mountain lakes, plateaus and vast mountain ranges run through by gorges which are well known rock-climbing sites. *Imilchil-Amellagou* may be briefly described as a group of small cold oases, connected to semi-desert and humid rangelands (*Agdals*). Traditional underground channels such as *khattaras* (Figure 4.6 and 4.7), bring water to the (small) plots in the oases; land is managed on specific customary basis (for building as well as cultivation purposes); in particular these *agdals* are collectively managed using a highly elaborate system, which has proven its worth across the centuries. But customary law is no longer being applied at the level of the *agdals*, and a serious destabilization of the pastoral balance is looming.



Figure 4.6: *Khattara in the dessert* (Flowersway 2013)

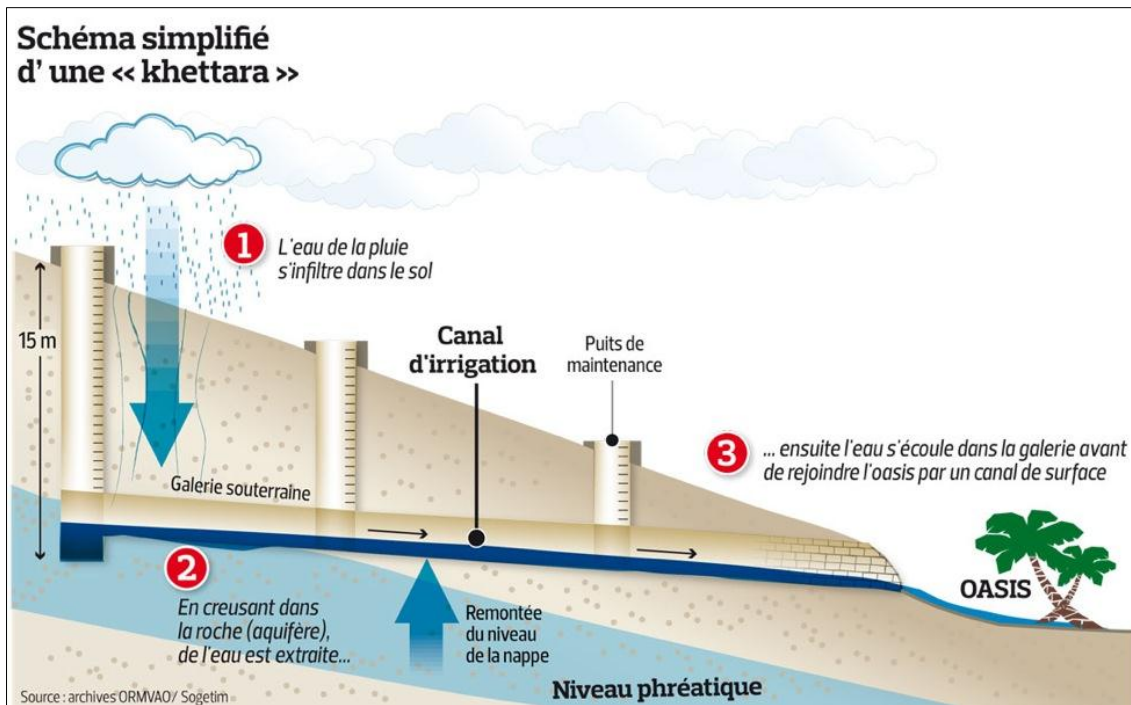


Figure 4.7: Khettara operation (Flowersway 2013)

This site is home to 38,000 people, which have demonstrated considerable ingenious skills to cope with their harsh environment. Because the main constraint for farming is the limited amount of arable land (less than 2 per cent of the whole area), communities cluster around a few arable communal lands that run along the *wadis*, dry rivers that contains water only during times of heavy rain or simply an intermittent stream (Figure 4.8). The woodlands protecting the soils on mountainsides have disappeared in the space of only two generations. As such, erosion is reaching horrendous proportions, resulting in losses of more than 90 ton/ha/year of soil in some areas. Water, on the other hand, is comparatively plentiful, but the *khettaras* and the earthen canals (*seguias*) still require maintenance. Diversification (drip irrigation) is needed to meet new challenges as they arise (Kradi 2012).



Figure 4.8: *Wadi* (Wikipedia 2013)

In 2009, King Mohamed VI visited the area, declaring with this visit the interest of the Moroccan state in this distant and vulnerable region. The new constitution recognizes the *Amazigh* culture (original from the Imilchil-Amellagou region), as cultural heritage to preserve in the Moroccan identity.

With the financial support from the International Development Agriculture Fund (IFAD), this project has the aims to implement a Sustainable Development Model.

This region, with an altitude over 2000 meters, is placed in the High Moroccan Atlas. Thanks to its great biodiversity, it is integrated in the High Eastern Atlas National Park, and is included in the Biosphere Reserve of the southern Moroccan Oasis.

Livestock production combines transhumance practices with the green corridors management (*agdals*) ensuring the flock necessities while conserving and regenerating the vegetation. The use of these simple and efficacy “traditional” techniques is the core axe for the UNFAO involvement and its integration in the GIAHS program. The INRA (Agriculture Research National Institute of Morocco) is responsible for technical support, evaluation and promotion. Aside, the INRA was commanded by UNFAO to characterize the specificities of the region, in

collaboration with the agricultural valorisation regional office of *Tafilalet* (ORMVATAF) (Figure 4.1) and the ADRAR association (local association). UNFAO proposed the following strategies:

- Provide arguments to classify the Imilchil-Amellagou regional production models among the pilot sites already existing in the world.
- Implement measures for a dynamic conservation of the Imilchil-Amellagou system (Economic, cultural, institutional and agriculture actions).
- Characterize other remarkable systems in Morocco, with the aim of developing a National Ingenious Agriculture Heritage System Inventory.
- Seek for a national and international partnership.

The cold oasis system integrates the three site components, namely, the Oasis, the arid corridors opened all year and the humid corridors of controlled opening (*agdals*).

The farmers use polyculture, fallow and rotation techniques to improve the fertility and conservation of soils. At the livestock level, the practice of transhumance in combination with the *agdals* ensures the herd necessities while maintaining and regenerating the vegetal cover.

The use of these adapted techniques is widespread at local, national and international level, with special incidence in the Maghreb region. These techniques are the principal argument for its inclusion in the GIAHS program.

This program also includes actions on:

- Local production valorisation;
- Underground water inventory and valorisation;
- Soil study;
- Non-agricultural income promotion specially destined to women;
- Nature tourism promotion;
- Immaterial heritage inventory.

The program needs a strong support from the Local Community Association (JMAA in its Arabic Acronym) and the livestock associations.

It is a UNFAO, regional authorities and local association partnership (FAO 2012).

Program start-up

This Imilchil-Amellagou program was selected by UNFAO in June 2011. Along this first year, the studies and inventories mentioned above were accomplished. Besides, various participatory attempts were implemented.

The first results give a proactive attitude from the different actors in favour of the project, highlighting the local compromise (Kradi 2012).

Two difficulties appeared:

- Lack of JMAA legal acknowledgement and its customary practices.
- Conflict between the customary rights (*Orf*) over green corridors (*agdals*) uses and management and the Moroccan law.

As a result, this program included as an urgent target that these conflicts should be solved.

Analysis

Despite of the recent start-up of this project, and the difficulty to assess its evolution, it is a remarkable effort in integrating traditional livelihood, participation of local associations, emphasizing particularly women participation, and recognition of space and traditional soil uses. Because of this the acceptance of the project among the main actors in the region can be considered positive. In the year of implementation, two main topics have appeared and are being addressed; namely: the legal recognition of local associations (JMAA) instead of creating new ones; and the difficulties appeared in relation to the traditional *agdal* uses and management (green humid corridors), specially related to the herd size because the *Orf* law does not permit the access to these *agdals* of more than 100 small ruminants heads by rancher.

In November 2011 national elections were hold, causing changes in the local and national representation. Because of this, the process of association forming and some political decisions suffered from delay.

Once the political structures were replaced the project continued normally.

4.4 GLOCHAMORE research strategy

4.4.1 General background

Many of the world's mountain ecosystems are undergoing important global changes which bring about climate and socio-economic changes that may affect the ability of mountain regions to provide critical goods and services to both mountain inhabitants and lowland communities. The Global Change and Mountain Regions initiative (GLOCHAMORE) attempts to address these environmental challenges by making it easier to detect signals of environmental change in mountain environments (Regato 2008). Mountain Biosphere Reserves represent ideal global change laboratories for several reasons:

- Mountain biosphere reserves are widely distributed in 40 countries, making it possible to conduct comparative studies and analyses of regional differentiation of environmental change processes;
- Meteorological, hydrological, cryospheric (relating to snow and ice) and ecological conditions change rapidly over relatively short distances in mountain regions, because of steep altitudinal gradients. Thus biodiversity tends to be high, and characteristic sequences of ecosystems and cryospheric systems are found;
- The boundaries between these systems may shift, due to environmental change. This provides sensitive indicators of forcing mechanisms;
- The higher parts of many mountain biosphere reserves are not heavily affected by direct human activities, providing locations where the environmental impacts of climate change alone can be studied.

These core protected mountain areas are usually surrounded by buffer zones and transition areas that are more influenced by human activities. Changes also occur in socio-economic conditions, land-use and land-management, resource exploitation and the appeal of mountain regions for tourism. UNESCO has joined 13 international organizations and educational institutes in an international effort to address the impact of environmental and climate change on ecosystems and people in mountain regions. In this way, mountain biosphere reserves are used as an 'early-warning' system.

The objectives of the project are to:

- Detect signals of global change in mountain biosphere reserves as a template for mountains in general; the focus is on assessing change in the biophysical environment; understanding ecological and hydrological processes, with and without local human interference, along altitudinal and other gradients (e.g. land use); and developing a network of observation sites to serve as an 'early-warning' system for detecting global change impacts;
- Define the consequences of global change for core mountain regions and for lowland systems depending on mountain resources, in order to better understand the consequences for people and ecosystems;
- Facilitate sustainable land, water, and resource management with and for people in mountain biosphere reserves, the aim being to define responses at local and regional scales; this includes assisting policymakers by indicating the extent of degradation of key mountain resources, and by evaluating the impact of alternative resource management strategies.

Global change, whether generated from climate, land use change, biological invasion, global economic forces, or other sources, will reverberate through networks of relationships that are part of the land and economic systems of mountain regions. This research strategy (GLOCHAMORE) highlights the key areas for research needed now to guide the sustainable management of mountain regions, particularly in Mountain Biosphere Reserves (MBRs), which are to be "sites of excellence to explore and demonstrate approaches to conservation and sustainable development at a regional scale" (UNESCO 2005). The GLOCHAMORE research strategy has been developed and refined by Global Change scientists and MBR representatives sponsored by the European Commission, UNESCO Man and the Biosphere and the International Hydrological Program. The strategy reflects the interests of both scientists and practitioners; whose views should take into consideration the concerns and priorities of local stakeholders.

One Maghreb mountain area is part of the research network.

4.4.2 The Biosphere Reserve of the Oasis du Sud Marocain (Morocco)

This biosphere reserve situated in the east of Morocco encompasses altitudes from 680 to 4,071 meters above sea level. It represents mountainous regions of the High Atlas in the north and the Anti-Atlas in the west, alluvial plains and depressions as well as stony deserts (*Hamadas*, figure 4.9). This large biosphere reserve (> 7 million hectares) plays a critical role in buffering the advance of the Sahara desert. It represents a wide range of bioclimatic areas, from the humid Mediterranean area to the hyper-arid Sahara. There is a rich biodiversity in the area, which is protected from desertification and the invasion of sand by a very effective system of oases with a rich agro-diversity including date-palms (UNESCO 2000). These agro-ecosystems are the backbone of the economy for the inhabitants of the oases (1,299,000 in 2000) which have settled here for a thousand years. The biosphere reserve also hosts the World Heritage Site '*Ksar of Ait-Ben-Haddou*' (Figure 4.1), designated for its architectural and historic value.



Figure 4.9: Hamada crossed by agdal (Lonecamp 2013)

This project covers different types of ecosystems such as aquatic habitats; pre-Saharan rivers and lakes, palm oases, mountain lakes, artificial lakes, high-altitude forests, desert steppes, rocky habitats (cliffs and screes), sand dune habitats, oases (up to an altitude of 1,600 meters above sea level) with agro ecosystems (including cereals, potatoes, olives, dates), grazing areas and urban areas.

The main targets of this project are

- Monitoring of climatic parameters;
- Selection of clones of dates for their tolerance to a fungal disease;
- Research on the dates palm tree;
- Demography, ethnic groups, history;
- Evaluation of cultural and architectural heritage;
- Evaluation of local knowledge in economy and water management.

The variables studied encompass three different blocks, to know:

- Abiotic: climate;
- Biodiversity: Fungi, genetic resources, pests/diseases, plants;
- Socio-economic: Cultural aspects, demography, economic studies, social/socio-economic aspects, traditional practices/ethnology/traditional knowledge.

Analysis

The GLOCHAMORE project, despite not being part of UNFAO programs, works as a very useful tool to incorporate information about the specific dryland mountain ecosystems into UNFAO projects. It includes a wide range of research topics, from anthropology and biology to architecture or economic.

The Mountain Biosphere Reserve by UNESCO emphasizes the local stakeholders' attitude towards the ecosystem conservation. This condition ensures a basic degree of acceptance by local actors to undertake measures, according to the necessities and opportunities detected throughout this research strategy.

4.5 Other UNFAO initiatives not performed in the Atlas

Among the wide range of programs performed by UNFAO, there are some of them that could fit perfectly in the Maghreb region. The reasons to choose the following programs are:

- They take into consideration the importance of conservation and improvement of sustainable traditional models and the active participation of local actors as key point for any successful result;
- They include also the climate change effects mitigation and adaptation as a transversal sight of any performance.

4.5.1 Livelihood Adaptation to Climate Change

Whatever happens to future greenhouse gas emissions, we are now locked into inevitable changes of the climate. Adaptation to climate change is therefore no longer a secondary and long-term response option only to be used as a last resort. It is now prevalent and imperative, and for those communities already vulnerable to the impacts of present day climate hazards, an urgent imperative.

Successful adaptation must be accomplished through actions that target and reduce the vulnerabilities poor people now face, as they are likely to become more prevalent as the climate changes. This approach calls for a convergence of four distinct communities who have long been tackling the issue of vulnerability reduction through their respective activities—disaster risk reduction, climate and climate change, environmental management, and poverty reduction. Bringing these communities together and offering a common platform— and a shared vocabulary—from which to develop an integrated approach to climate change adaptation can provide an opportunity to revisit some of the intractable problems of environment and development (UNFAO 2005).

The starting point for this convergence is a common understanding of the concepts of adaptation, vulnerability, resilience, security, poverty and livelihoods, as well as an understanding of the gaps in current adaptation approaches. Taken together, they indicate a need for adaptation measures based on the livelihood activities of poor and vulnerable communities. This places the goal of poverty reduction at the centre of adaptation, as the capabilities and assets that comprise people's livelihoods often shape poverty as well as the ability to reduce poverty.

This “bottom-up” approach therefore requires an understanding of how livelihoods are conducted and sustained, that is, how resources are mobilized to earn an income and meet basic needs. Central to both the definition of livelihoods and household resilience are livelihood assets, for example the means of production available to a given individual or group that can be used to generate material resources sufficient enough to reduce poverty. The greater and more varied the asset base, the more sustainable and secure the livelihood.

There are generally five forms of livelihood assets: natural capital, social-political capital, human capital, physical capital and financial capital. Taken together, these assets largely determine how people will respond to the impacts of climate change, and should therefore form the basis of adaptation strategies.

Analysis

Nowadays there are no LACC projects implemented in the Maghreb region. However, the livelihood scope dealt with in this initiative fits well with the mountain Atlas' ecosystem requirements due to the key role played by mountain livelihoods in the Maghreb region. Therefore the inclusion of this initiative would provide synergies for an integrative sight on the dryland mountain's ecosystems.

4.5.2 Voluntary Guidelines to Improve Governance of Tenure of land, Fisheries and Forests

UNFAO published the Voluntary Guidelines to Improve Governance of Tenure of land, Fisheries and Forests recently (May 2012). The aim of this guide is to seek for equilibrium among all actors, with an emphasis on vulnerable and marginalized people, with the goals of food security and progressive realization of the right to adequate food, poverty eradication, sustainable livelihoods, social stability, housing security, rural development, environmental protection and sustainable social and economic development. All programmes, policies and technical assistance to improve governance of tenure through the implementation of these Guidelines should be consistent with States' existing obligations under international law, including the Universal Declaration of Human Rights and other international human rights instruments (UNFAO 2012).

Analysis

This initiative appears a decisive opportunity to solve the critical problems related to land tenure management in the Atlas region. It is still too soon to predict the results; as budget initiatives as well as projects are not yet clearly allocated. However the clarity of its targets could be an essential tool to tackle the contradictions between state structures and traditional uses and management within the land property framework.

5. Conclusions, discussion and recommendations

In this final chapter the research questions as presented in the introduction will be answered and overall conclusions will be drawn. The second section contains a short general discussion.

Next to the conclusion and discussion also recommendations will be formulated for both further research and further actions in the Maghreb Mountainous Ecosystems in the final section.

5.1 Conclusions

This chapter consists of two sections. In the first section an answer to the research questions will be given based on the results of the literature research and interviews. The second section provides an overall conclusion.

5.1.1 Answers to the research questions

The research questions all deal with a specific part of the research in order to acquire the necessary knowledge to meet the research objective.

The first research question was related to Global Change effects in the Atlas Mountains and was formulated as:

1: “How does global change affects these ecosystems?”

From literature research it became clear that:

- Sedenterazitation becomes more important. This process is particularly mature in the Algerian and Tunisian Atlas.
- Productivity increasing policies promoted by the states applied to cope with the basic food products dependency on external markets, have led to a withdrawal of land dedicated to traditional production systems.
- The effects of climate change are a threat for especially Atlas Dryland Mountains.

These three factors are causing pressure on the environment and threaten the sustainability of traditional land use. Consequently, there is a serious environmental deterioration, loss of biodiversity and an impoverishment of the population.

In the traditional production system, the herds were conducted over long distances allocating them to places where fodder was available including close green corridors (*agdals*). With the arrival of sedentarization, these distant resources were no longer used and the animal feed necessities had to be satisfied in the surroundings of the settlements. This change, together with the increase in the size of the herd, has brought an overuse of mountainous resources (water, vegetal cover, forest, *agdals*, etc.). Aside from this, rangelands play an important role as carbon sequestration sinks, thus the loss of vegetal cover implies a disadvantage with regard to the mitigation of climate change effects.

Moreover, the introduction of new crops nestled in communal land defies the traditional land tenure rights. These rights are based on a customary basis, being the keystone for a sustainable management of the Atlas mountain ecosystems along centuries.

The second research question analyses the mountain policies in the region, and was formulated as:

2: “Which are the policy instruments used by the Maghreb countries to deal with the situation?”

In chapter 3 the key aspects of mountain policy tools in the Maghreb are described and analysed.

Since the 1990s there is a strong push to a “modernization” process in all Maghreb sectors. This is especially true for agriculture. Policies target the basic food products export/import balance; and has led to the application of a growth strategy in Algeria, Morocco and Tunisia.

This strategy named Green Plan in Morocco, PNDAR in Algeria and Blue Plan in Tunisia, was applied in all these countries’ territory without a proper territorialization. Therefore, mountains and other distinguished areas (such as oasis, deserts and plateaus) were addressed in the same way, without taking into account the particularities of each ecosystem.

Furthermore the economic and technical resources applied by these policies were hardly endowed in these areas.

In addition, the three states have paid scarce attention to infrastructure (e.g. roads, water, and electricity) and community services (e.g. health, education). This lack of infrastructure and services exacerbates the living conditions for an increasing sedentary mountain population.

Technical and administrative decentralized structures (i.e. local governmental agencies and offices) are very weak.

It seems that in recent years the states have become aware of the mountain importance, and the necessity of addressing its development with specific strategies.

Tunisia started some integrated development programs in mountain zones.

Recently Morocco included the so-called pillar II within its Green Moroccan Plan to undertake specific programs/actions for disadvantaged areas, with special mention for mountain areas.

Algeria is reviewing its rural strategy. But, so far, does not highlight the mountain specificity in the programs' implementation. The analysis of the policies shows that Tunisia is leading in the characterization of ecosystems; moreover it has identified some key aspects for a comprehensive strategy to deal with the mountain areas' restrictions. Worth noting is the importance given to the political structures adequacy, the decision making and project implementation taking into account the traditional management models.

It should be noted that there are problems implementing and enforcing mountain strategies in the Maghreb, especially in Morocco and Algeria, because of the weak state presence in many distant and isolated regions. This is strengthened by the fact that these mountain areas were historically anti-colonialist and nationalist resistance cores. Thus, there is a rooted distrust towards the central government. Moreover, nowadays the Maghreb region is suffering from an instable political situation, with different features in each country.

Despite the three countries, together with Libya, belong to the Arabic Maghreb Union, conflicts among the states are very sharp (Western Sahara between Morocco and Algeria; gas channels between Algeria and Tunisia; Islamic fundamentalism, etc.).

Although climate change mitigation and adaptation are taken into consideration throughout mountain policies, often these issues are addressed just in paper.

The third and last research question deals with the UNFAO programs applied in the region, the question was stated as:

3: "Which are the policies of International organization such as UNFAO in the region?"

UNFAO is present in the Maghreb mountain ecosystems through various programs. These programs are applied in projects on livelihood improvements, climate change adaptation, mountain ecosystems, etc.

Despite these projects are recent (pilot in the majority of cases) and have limited size, some specific opportunities and contradictions have already been detected. Highlighting the necessity of sylvopastoralism reinforcement and a traditional land management.

There is a remarkable effort to integrate the traditional ways of living, the participation of local associations, emphasizing particularly women participation, and the recognition of space and traditional soil uses. UNFAO involved Maghreb research institutes in research and characterization of dryland mountain ecosystems.

5.1.2 Overall conclusion

The research objective was formulated as:

Explore which the main factors are affecting dryland mountain ecosystems in the particular case of mountainous Maghreb countries and analysing the policy instruments applied in the region by governments and some UNFAO projects”.

The Maghreb Atlas massif constitutes an ecological, historical and human unity with a clear identity whose long-term development must be addressed as a whole.

The sylvopastoralism system is the main income and commodity (e.g. food, fuel, etc.) source for the Dryland Mountain's population in the Maghreb and characterizes the Atlas livelihoods.

Extensive livestock production on communal land (sylvopastoralism) is the most appropriate use of Atlas Dryland Mountains. The mobility and flexibility of pastoral systems enable them to make the best use of the environment.

However, pastoral communities remain among the most politically and economic marginalized groups. Transhumant cultures find themselves facing insecurity in multiple dimensions, including land, political, legal, food, environmental and physical insecurity. Pastoral marginalization comes from global processes involving structural adjustment, policy modernization and economic liberalization. These global processes boosted the sedentarization of nomadic and semi-nomadic populations together with their herds, generating conflicts between land uses and sustainability.

Common property resources (traditionally managed by customary law) are commonplace in the Atlas Mountains, and unclear private user rights for individual farms encourage short-term resource exploitation rather than long-term conservation. Moreover, changes in land tenure alter the behaviour of individuals and local communities, leading to land degradation (e.g. overgrazing following the settlement of nomads). Key constraints stemming from lack of

tenure, promotion of privatization, and minimal health and education services and insecurity must be addressed to ensure that the synergistic relationship between livestock-based livelihoods and the environment can be successful and sustainable.

The sedentarization process appears to be irreversible; this requires development policies to seek for solutions that adapt the traditional agro-pastoralist production models. There are some political efforts (see chapter 3) to protect and readapt these traditional systems to the global processes.

With regard to climate change, an appropriate grassland management practice contributes to adaptation and mitigation of climate change effects, as well as increasing productivity and food security and reducing environmental degradation. In addition livestock plays an important role in carbon sequestration through improved pasture and rangeland management, contributing to mitigating the climate change effects. Healthy grasslands, livestock and associated livelihoods constitute a win-win option for addressing climate change in fragile dryland areas where pastoralism remains the most rational strategy for maintaining the wellbeing of communities.

5.2 Discussion

In this section the limitations of this research are discussed.

This study was done during a three months internship at the UNFAO headquarters at Rome, Italy. Although the UNFAO was very willing to support this research, not all information searched could be found. The main reason for this is that a lot of specific and even general data, for the Maghreb region is not available, and when it does, it is in mainly in Arab, or less often in French. In the specific case of mountains there is no disaggregated data available.

These limitations were partially compensated by the advice and information given by UNFAO experts and technicians.

Also changing policies and the political instability in the Maghreb made it difficult to analyse the trends in the economic development in mountains.

The author was unable to visit the Maghreb projects, a visit could have led to a more accurate study. Nevertheless, the collaboration and disposition of UNFAO experts, with special mention of the Mountain Partnership Secretariat staff, was a valuable input for this research in order to get information and opinions about general aspects on the mountain ecosystems actual situation.

5.3 Recommendations

This research is done to get more insight in the Atlas Mountain Ecosystems. The results of this research can be used as a starting point for further research. Besides as a start for further research, the results could also be used to improve the Mountain strategies in the Maghreb region. Recommendations for this goal are formulated in the second section.

5.3.1 Recommendations for further research

Further research is recommended to update information on programs and policies i, composing evaluation and monitoring reports on projects implemented, with special mention of Imilchil-Amellagou Pilot Project. Furthermore, a visit to the area is advised, particularly to Imilchil-Amellagou pilot project because its interesting projection, using the contacts provided by UNFAO during the internship. Also a review of the study's conclusions by UNFAO experts and Maghreb Agriculture Institutes could help to refine the research objectives for a new research.

5.3.2 Recommendations for further actions in the Maghreb Mountains

For a sustainable management of Maghreb Atlas Massif

The common targets for a global action in the dryland mountain ecosystems must address:

- Conserve and reinforce the sylvopastoral system and the traditional land management models.
- Promote adaptive techniques to the system's changes experienced in the last 50 years (e.g. sedentarization, climate change). These changes have impacted particularly agriculture (increase of livestock density, communal land conversion into intensively used and private agricultural land leading to overgrazing and land degradation).
- Target poor and very poor population (>25% in the majority of areas) in economic diversification policies (i.e. craft, tourism, small industry).
- Set up promotion programs for women empowerment.
- Improve local infrastructures and services (drinking water, electricity, roads, education and health).

- Integration and participation are the key aspects for any successful rural development policy implemented in mountain areas. Dryland mountain specificities recognition plays also a decisive role in the design of development actions.
- The decisive factor for a sustainable development is to ensure an effective management of scarce and degradation-threatened resources.

For a global action program in the Maghreb Atlas Massif

Situation synthesis

In this historically and economic differentiated space, Maghreb Mountain communities have maintained exchanges and relationships that have modelled their common history and culture, and in that way build adaptive models to the conditions of these dryland mountains.

Strong changes in these communities have occurred in recent years. Sedentarization and state borders have balkanized the Atlas, thus, the frequent exchanges coming from transhumance and trade have decreased.

The state administration actions with regards to mountain development programs can be characterized by:

- Scarce and low budget.
- Many improvement agricultural programs have been considered inadequate by the own promoters, and often, imbalance catalyzers for sylvopastoralism and local communities.
- In recent years Maghreb states have become aware of the importance of recognizing mountain specificities. In this way Tunisia and Morocco have included innovative strategies, incorporating the active participation of local populations.
- The actual relationship among states is conflictive, a fact that prevents any joint action of the three Maghreb states.
- UNFAO and various NGOs implement projects in the Atlas, with different scopes but with common strategies (common action of local community participation, local culture and uses preservation, climate change mitigation and adaptation, development of experiences transferability). Also UNESCO, within its MAB program (Man And Biodiversity) has declared various Maghreb areas as Biosphere Reserves.

These initiatives are recent and do not form a network that permit the transferability and the synergy among them.

UNFAO appears to be the suitable platform to lead a global action program in the Atlas because:

- UNFAO incorporates technical and economic resources to serve as platform for implementation.
- UNFAO is already present throughout various programs in the region.
- UNFAO has the recognition of states, regions and communities, a fact that facilitates its acceptance as promoter agent.
- UNFAO can help to mobilize state resources for agricultural an research, as well as the transmission of its output to farmholders.
- UNFAO can also promote the active participation of other international organizations for local development (UNESCO, European Union, World Bank, etc.).

Dryland mountains represent the 41% of world mountains, their importance at global level makes it recommendable to create of a World Dryland Mountains program:

- Led by UNFAO and framed in the Mountain Partnership Secretariat.
- Establishing an Agency/office for dryland mountain specificities whose main functions would be:
 - ✓ Promote and coordinate pilot local projects supported by the technical and economic UNFAO structures.
 - ✓ Transfer experiences and resources, searching for synergies.
 - ✓ Promote the co-participation of other institutions in the Maghreb mountain development, both Maghreb and at world level.

Payments for Ecosystem Services

Also carbon sequestration programs have the potential to provide economic benefits to households in degraded dryland ecosystems, both through payments for carbon sequestration (or other payments for ecosystem services) and through co-benefits for production and climate change adaptation payments (UNFAO programs, conventions). Payments for carbon sequestration in rangelands are currently limited to voluntary carbon markets; negotiations on future global climate change agreements as well as emerging domestic legislation in several developed countries may soon increase the demand for emission reductions from rangeland management activities in developing countries.

Bibliography

(IPCC 2007a). Climate Change 2007: The Physical Science Basis. . Contribution of Working Group I to the Fourth Assessment Report of the IPCC., UNFCCC: 177.

ADA (2009). Plan vert. Agence pour le developpement agricole.

Balaghir, J. (2009). Le progress technologique: une option incontournable pour l'adapter à l'agriculture marocaine au changement climatique.

CBD (2013). from <http://www.cbd.int/>.

Comision, E. (2003). "Guidelines for the Evaluation of Rural Development Projects supported by SAPARD."

Constance Neely, S. B. a. A. W. (2008). Managing dryland pastoral systems: implications for mitigation and adaptation to climate change, UNFAO.

El Hamraoui, A. (1983). Le phénomène migratoire et son impact sur la société et l'espace dans le Rif (Nord du Maroc).

FAO (2012). Globally Important Agricultural Heritage System (GIAHS).

FAOSTAT (2009). FAO Statistical Yearbook 2009, UNFAO.

Flowersway (2013). from <http://www.flowersway.com/article/systeme-d-irrigation-les-khettaras-1443>.

Folliott, P. F., K. N. Brooks, and M. M. Fogel. (2002). "Managing watersheds for sustaining agriculture and natural resource benefits into the future." Quarterly Journal of International Agriculture **41**(1/2): 23-40.

Forni, N. (2003). Land tenure policies in the Near East. Land Reform, FAO. **2003/1**.

Hardin, G. (1968). "The Tragedy of the Commons." Science.

IUCN (2009). Ecosystem-based Adaptation: A natural response to climate change.

Kapos, V., J. Rhind, M. Edwards, M.F. Price and C. Ravilious (2000). "Developing a map of the world's mountain forest." Forests in Sustainable Mountain Development: A State-of-Knowledge Report for 2000.

Kradi, C. (2012). L'agriculture solidaire dans les éco-systèmes fragiles au Maroc, INRA Moroccan.

Laoubi and Yamao (2012). "The challenge of agriculture in Algeria: are policies effective?"

l'Agriculture, M. t. d. (2001). Raport national sur la montagne tunisie.

Lonecamp (2013). from <http://www.lonecamp.com/hamada/>.

Maurer, G. (1992). "Agriculture in the Rif and Tell Mountains of North Africa." Mountain Research and Development **12**(4): 337-347.

Mestapha, D. (2013). from <http://daoudi720.skyrock.com/393766699-COSTUMBRES-Y-ENTORNO.html>.

Ministry, A. (2008). The Ministerial Conference on "Water for Agriculture and Energy in Africa: the Challenges of Climate Change". I. r. b. c. Algeria.

Mohamed Ha MMam, M. B. S. (2002). "Formation des revenus et stratégies paysannes dans les zones de montagne: le cas de Lansarine au Nord de la Tunisie." NEW MEDIT **3**: 7.

Naggar, M. (2000). "Éléments de base d'une stratégie de sylvopastoralisme en Afrique du Nord." Options Méditerranéennes n°**39**.

naturalistas (2013). from <http://viajesnaturalistas.blogspot.com.es/2011/10/cabo-de-gata-1-barrancos-y-costas.html>.

Oskam, A., G Meester and H.Silvis (2010). EU policy for agriculture, food and rural areas. Wageningen, Wageningen Academic Publishers.

Pajares, P. R. (2011). Highlands and Drylands, Mountains, a source of resilience in arid regions, UNFAO.

Rae (2002). "Algeria Country Profile."

Regato, P. (2008). Adapting to Global Change, Mediterranean Forests.

Souvannavong, J. D. S. (2005). Características del Magreb, Dpto. Geografía Humana. UA.

UN (1992). United Nations Conference on Environment & Development. Rio de Janeiro, Brazil.

UNCCD (2013). "United Nations to Combat Desertification." from <http://www.unccd.int/>.

UNDP. from <http://www.undp-alm.org/projects/spa-cba-morocco-resiliency-through-sustainable-farmingforestry-strategies-azilal-province>.

UNDP (2008). Rapport mondial sur le développement humain 2007/2008. La lutte contre le changement climatique : un impératif de solidarité humaine dans un monde divisé, UNDP.

UNEP (2000). Global Environmental Outlook 2000.

UNESCO (2000). "MAP Biosphere Reserve Directory."

UNESCO (2005). Global Change and Mountain Regions. UNESCO.

UNFAO. from www.fao.org.

UNFAO (2005). "Livelihood Adaptation to Climate Change." from <http://www.fao.org/climatechange/laccproject/en/>.

UNFAO (2012). Climate-Smart Agriculture.

UNFAO (2012). Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security

UNFCCC (2013). from WWW.unfccc.int.

Venema, B. A. M. (2003). "Access to land and Berber Ethnicity in the Middle Atlas, Morocco." Middle Eastern Studies.

Virginia Belsanti, A. A. a. L. L. (2005). Results of a survey on Policies, Institutions and Processes for Sustainable Agriculture and Rural Development in Mediterranean Mountain areas, CIHEAM – IAM Bari

Virginia Belsanti, A. A. a. L. L. (2006). Results of a survey on Policies, Institutions and Processes for Sustainable Agriculture and Rural Development in Mediterranean Mountain areas CIHEAM.

White, R., S. Murray, and M. Rohweder. (2000). Pilot analysis of global ecosystems: Grassland ecosystems, Inst. Washington DC.

Wikipedia (2013). from <http://pt.wikipedia.org/wiki/Ficheiro:Juniperus-thurifera-01.jpg>.

Zakoura, F. (2009). Community Based Adaptation Morocco Project proposal.

Appendix 1

Agenda 21

Agenda 21 (UN 1992) is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment.

Agenda 21, the [Rio Declaration on Environment and Development](#), and the [Statement of principles for the Sustainable Management of Forests](#) were adopted by more than 178 Governments at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, 3 to 14 June 1992.

The [Commission on Sustainable Development](#) (CSD) was created in December 1992 to ensure effective follow-up of UNCED, to monitor and report on implementation of the agreements at the local, national, regional and international levels. It was agreed that a five year review of Earth Summit progress would be made in 1997 by the [United Nations General Assembly meeting in special session](#).

The full implementation of Agenda 21, the Programme for Further Implementation of Agenda 21 and the Commitments to the Rio principles, were strongly reaffirmed at the World Summit on Sustainable Development (WSSD) held in Johannesburg, South Africa from 26 August to 4 September 2002.

Section II

CONSERVATION & MANAGEMENT OF RESOURCES FOR DEVELOPMENT

Chapter 13

Managing Fragile Ecosystems: Sustainable Mountain Development

INTRODUCTION

13.1. Mountains are an important source of water, energy and biological diversity. Furthermore, they are a source of such key resources as minerals, forest products and agricultural products and of recreation. As a major ecosystem representing the complex and interrelated ecology of our planet, mountain environments are essential to the survival of the global ecosystem. Mountain ecosystems are, however, rapidly changing. They are susceptible to accelerated soil erosion, landslides and rapid loss of habitat and genetic diversity. On the human side, there is widespread poverty among mountain inhabitants and loss of indigenous knowledge. As a result, most global mountain areas are experiencing environmental degradation. Hence, the proper management of mountain resources and socio-economic development of the people deserves immediate action.

13.2. About 10 per cent of the world's population depends on mountain resources. A much larger percentage draws on other mountain resources, including and especially water. Mountains are a storehouse of biological diversity and endangered species.

13.3. Two programme areas are included in this chapter to further elaborate the problem of fragile ecosystems with regard to all mountains of the world. These are:

- (a) Generating and strengthening knowledge about the ecology and sustainable development of mountain ecosystems;
- (b) Promoting integrated watershed development and alternative livelihood opportunities.

PROGRAMME AREAS

A. GENERATING AND STRENGTHENING KNOWLEDGE ABOUT THE ECOLOGY AND SUSTAINABLE DEVELOPMENT OF MOUNTAIN ECOSYSTEMS

BASIS FOR ACTION

13.4. Mountains are highly vulnerable to human and natural ecological imbalance. Mountains are the areas most sensitive to all climatic changes in the atmosphere. Specific information on ecology, natural resource potential and socio-economic activities is essential. Mountain and hillside areas hold a rich variety of ecological systems. Because of their vertical dimensions, mountains create gradients of temperature, precipitation and insolation. A given mountain slope may include several climatic systems - such as tropical, subtropical, temperate and alpine - each of which represents a microcosm of a larger habitat diversity. There is, however, a lack of knowledge of mountain ecosystems. The creation of a global mountain database is therefore vital for launching programmes that contribute to the sustainable development of mountain ecosystems.

OBJECTIVES

13.5. The objectives of this programme area are:

- (a) To undertake a survey of the different forms of soils, forest, water use, crop, plant and animal resources of mountain ecosystems, taking into account the work of existing international and regional organizations;
- (b) To maintain and generate database and information systems to facilitate the integrated management and environmental assessment of mountain ecosystems, taking into account the work of existing international and regional organizations;
- (c) To improve and build the existing land/water ecological knowledge base regarding technologies and agricultural and conservation practices in the mountain regions of the world, with the participation of local communities;
- (d) To create and strengthen the communications network and information clearing-house for existing organizations concerned with mountain issues;

(e) To improve coordination of regional efforts to protect fragile mountain ecosystems through the consideration of appropriate mechanisms, including regional legal and other instruments;

(f) To generate information to establish databases and information systems to facilitate an evaluation of environmental risks and natural disasters in mountain ecosystems.

B. PROMOTING INTEGRATED WATERSHED DEVELOPMENT AND ALTERNATIVE LIVELIHOOD OPPORTUNITIES

BASIS FOR ACTION

13.13. Nearly half of the world's population is affected in various ways by mountain ecology and the degradation of watershed areas. About 10 per cent of the Earth's population lives in mountain areas with higher slopes, while about 40 per cent occupies the adjacent medium- and lower-watershed areas. There are serious problems of ecological deterioration in these watershed areas. For example, in the hillside areas of the Andean countries of South America a large portion of the farming population is now faced with a rapid deterioration of land resources. Similarly, the mountain and upland areas of the Himalayas, South-East Asia and East and Central Africa, which make vital contributions to agricultural production, are threatened by cultivation of marginal lands due to expanding population. In many areas this is accompanied by excessive livestock grazing, deforestation and loss of biomass cover.

13.14. Soil erosion can have a devastating impact on the vast numbers of rural people who depend on rainfed agriculture in the mountain and hillside areas. Poverty, unemployment, poor health and bad sanitation are widespread. Promoting integrated watershed development programmes through effective participation of local people is a key to preventing further ecological imbalance. An integrated approach is needed for conserving, upgrading and using the natural resource base of land, water, plant, animal and human resources. In addition, promoting alternative livelihood opportunities, particularly through development of employment schemes that increase the productive base, will have a significant role in improving the standard of living among the large rural population living in mountain ecosystems. Objectives

OBJECTIVES

13.15. The objectives of this programme area are:

- (a) By the year 2000, to develop appropriate land-use planning and management for both arable and non-arable land in mountain-fed watershed areas to prevent soil erosion, increase biomass production and maintain the ecological balance;
- (b) To promote income-generating activities, such as sustainable tourism, fisheries and environmentally sound mining, and to improve infrastructure and social services, in particular to protect the livelihoods of local communities and indigenous people;
- (c) To develop technical and institutional arrangements for affected countries to mitigate the effects of natural disasters through hazard-prevention measures, risk zoning, early-warning systems, evacuation plans and emergency supplies.

Section II

CONSERVATION & MANAGEMENT OF RESOURCES FOR DEVELOPMENT

Chapter 14

Promoting Sustainable Agriculture & Rural Development

INTRODUCTION

14.1. By the year 2025, 83 per cent of the expected global population of 8.5 billion will be living in developing countries. Yet the capacity of available resources and technologies to satisfy the demands of this growing population for food and other agricultural commodities remains uncertain. Agriculture has to meet this challenge, mainly by increasing production on land already in use and by avoiding further encroachment on land that is only marginally suitable for cultivation.

14.2. Major adjustments are needed in agricultural, environmental and macroeconomic policy, at both national and international levels, in developed as well as developing countries, to create the conditions for sustainable agriculture and rural development (SARD). The major objective of SARD is to increase food production in a sustainable way and enhance food security. This will involve education initiatives, utilization of economic incentives and the development of appropriate and new technologies, thus ensuring stable supplies of nutritionally adequate food, access to those supplies by vulnerable groups, and production for markets; employment and income generation to alleviate poverty; and natural resource management and environmental protection.

14.3. The priority must be on maintaining and improving the capacity of the higher potential agricultural lands to support an expanding population. However, conserving and rehabilitating the natural resources on lower potential lands in order to maintain sustainable man/land ratios is also necessary. The main tools of SARD are policy and agricultural reform, participation, income diversification, land conservation and improved management of inputs. The success of SARD will depend largely on the support and participation of rural people, national Governments, the private sector and international cooperation, including technical and scientific cooperation.

14.4. The following programme areas are included in this chapter:

Land and Livestock Management in the Mountains of Maghreb

- a. Agricultural policy review, planning and integrated programming in the light of the multifunctional aspect of agriculture, particularly with regard to food security and sustainable development;
- b. Ensuring people's participation and promoting human resource development for sustainable agriculture;
- c. Improving farm production and farming systems through diversification of farm and non-farm employment and infrastructure development;
- d. Land-resource planning information and education for agriculture;
- e. Land conservation and rehabilitation;
- f. Water for sustainable food production and sustainable rural development;
- g. Conservation and sustainable utilization of plant genetic resources for food and sustainable agriculture;
- h. Conservation and sustainable utilization of animal genetic resources for sustainable agriculture;
- i. Integrated pest management and control in agriculture;
- j. Sustainable plant nutrition to increase food production;
- k. Rural energy transition to enhance productivity;
- l. Evaluation of the effects of ultraviolet radiation on plants and animals caused by the depletion of the stratospheric ozone layer.

Appendix 2

Some Definitions

United Nations Framework Convention on Climate Change:

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) sets an overall framework for intergovernmental efforts to address climate change. It is called a framework convention because it is seen as a starting point of addressing the problem of climate change. The Convention entered into force on 21 March 1994. The ultimate objective of the Convention is “to stabilise greenhouse gas concentrations at a level that will prevent dangerous human interference with the climate system”. With 194 Parties, the UNFCCC has near universal membership. Under the Convention, membership governments commit to:

- gather and share information on greenhouse gas emissions, national policies and best practices;
- launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and
- cooperate in preparing for adaptation to the impacts of climate change.
- Since the UNFCCC entered into force, the parties have been meeting in Conferences of the Parties (COP) to assess progress in dealing with climate change. The COP is seen as the "supreme body" of the Convention (UNFCCC 2013).

Convention on Biological Diversification

The Earth's biological resources are vital to humanity's economic and social development. As a result, there is a growing recognition that biological diversity is a global asset of tremendous value to present and future generations. At the same time, the threat to species and ecosystems has never been as great as it is today. Species extinction caused by human activities continues at an alarming rate.

In response, the United Nations Environment Programme (UNEP) convened the Ad Hoc Working Group of Experts on Biological Diversity in November 1988 to explore the need for an international convention on biological diversity. Soon after, in May 1989, it established the Ad Hoc Working Group of Technical and Legal Experts to prepare an international legal instrument

for the conservation and sustainable use of biological diversity. The experts were to take into account "the need to share costs and benefits between developed and developing countries" as well as "ways and means to support innovation by local people".

By February 1991, the Ad Hoc Working Group had become known as the Intergovernmental Negotiating Committee. Its work culminated on 22 May 1992 with the Nairobi Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity.

The Convention was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). It remained open for signature until 4 June 1993, by which time it had received 168 signatures. The Convention entered into force on 29 December 1993, which was 90 days after the 30th ratification. The first session of the Conference of the Parties was scheduled for 28 November – 9 December 1994 in the Bahamas.

The Convention on Biological Diversity was inspired by the world community's growing commitment to sustainable development. It represents a dramatic step forward in the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources (CBD 2013).

[United Nations Convention to Combat Desertification](#)

Desertification, along with climate change and the loss of biodiversity, were identified as the greatest challenges to sustainable development during the 1992 Rio Earth Summit. Established in 1994, UNCCD is the sole legally binding international agreement linking environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found. In the 10-Year Strategy of the UNCCD (2008-2018) that was adopted in 2007, Parties to the Convention further specified their goals:

"to forge a global partnership to reverse and prevent desertification/land degradation and to mitigate the effects of drought in affected areas in order to support poverty reduction and environmental sustainability".

The Convention's 195 parties work together to improve the living conditions for people in drylands, to maintain and restore land and soil productivity, and to mitigate the effects of drought. The UNCCD is particularly committed to a bottom-up approach, encouraging the participation of local people in combating desertification and land degradation.

The UNCCD secretariat facilitates cooperation between developed and developing countries, particularly around knowledge and technology transfer for sustainable land management. As the dynamics of land, climate and biodiversity are intimately connected, the UNCCD collaborates closely with the other two Rio Conventions; the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC), to meet these complex challenges with an integrated approach and the best possible use of natural resources (UNCCD 2013).

Mountain:

In this section some definitions are given in order to give a general overview on some key concepts taken into account in this study. These concepts are especially important to define the characteristics of the Maghreb Atlas Mountains.

Kapos (Kapos 2000) uses criteria based on altitude and slope in combination to represent the world's mountain environments. The global mountain area thus defined is almost 40 million square kilometres, or 27% of Earth's surface. Aside he divides mountains in 7 different classes, based on altitude and slope criteria:

- Class 1, elevation 4,500 meters or higher;
- Class 2, elevation 3,500–4,500 meters;
- Class 3, elevation 2,500–3,500 meters;
- Class 4, elevation 1,500–2,500 meters;
- Class 5, elevation 1,000–1,500 meters and slope;
- Class 6, elevation 300–1,000 meters and local elevation range;
- Class 7, isolated inner basins and plateaus less than 25 square kilometers in extent that are surrounded by mountains but do not themselves meet criteria 1–6 (this seventh class was introduced in the 2002 revision of the original 2000 system).

In the case of the Atlas range and sub ranges, mountains can be classified from class 2 to class 7. Toubkal peak is the highest mountain with 4167 m, so class 1 is not present in the Atlas range and its sub ranges. Most areas correspond to class 3 and 4; of class 5 and 6 are important when the ranges are close to the coast.

In this context the mountain geographer, Carl Troll, made the remark that much of the high land near the equator could be described as “high mountains without a high mountain landscape”. From the foregoing, it is apparent that the world's mountains do not lend

themselves to any unifying definition or classification. For the present study, however, we use Kapos definition.

As indicated above, the Maghreb Mountains have some common physical, economic and social features that make it logical to treat them as a whole. One of the main characteristics is that they are Dryland Mountains. The Convention on Biological Diversification (CBD) and the

Dryland Mountains

United Nations Convention to Combat Desertification (UNCCD) states that Dryland Mountains cover the 8.5% of the earth surface, comprising the major part of the Maghreb Mountains and plateaus.

UNCCD describes dryland as all the arid, semi-arid and dry sub-humid areas, other than polar and sub-polar regions, in which the ratio of annual precipitation to potential evapotranspiration, known as aridity index (AI) falls within a range from 0.05 to 0.65; this encompasses 34.9% of the Earth's land surface.

The CBD definition differs from the UNCCD definition in two ways:

- It also includes hyper-arid zones (UNEP/CBD/SBSTTA/5/9) (Aridity Index (AI) < 0.05), which represent approximately 6.6% of the Earth's land surface. All areas with an AI less than 0.65 are therefore included; this encompasses 41.5 % of the Earth's land surface.
- Major vegetation types are used to define dryland areas in addition to those defined by the climatic criterion (AI) (UNEP/CBD/SBSTTA/5/9). Hence, the CBD not only applies to the biological diversity of drylands, but also includes Mediterranean, grassland and savannah ecosystems (Decision V/23). These ecosystem types are present in some areas with AI \leq 0.65, including humid and cold areas (Pajares 2011).
- This definition of dryland encompasses the whole Maghreb Mountains.(UN 1992)