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**THE MAJOR CHALLENGES FACING NORTH AFRICAN OASES
IN THE CONTEXT OF GLOBALIZATION**

A COMPARATIVE STUDY



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Agriculture, agricultural development, agricultural policy, agricultural productivity, agrobiodiversity, Al Fayoum, Al Jufrah , Algeria, Algerian Sahara, Chenini, cooperation, continuities, cultivar , cultural heritage, date palm, date production, desertification, Draa Valley, Deglet Nour, Egypt, ecosystem, farmers, Figuig, food product; food security, Ghadames, Ghardaïa, globalization, groundwater, intervention, Kebili, Kharga, land degradation, Libya, Mauritania, Morocco, migration, Nile Valley, oasis, oasian agriculture, oasian model, oasian society, Ouarghla, Ourzazat, rehabilitation, resource management, Saharan agriculture, self-sufficiency, Siwa, social change, spatial change, sustainability, Tafilalet, Tata, territory, Timimoun, Touat, Tozeur, traditional society, Tunisia, water economics, water management, water quality, water resources, water use, Zagora.

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LIST OF ABBREVIATIONS

AALO : Access to Agricultural Land Ownership
AGPO: Associations de Gestion Participative des Oasis
ANDZOA: Agence des Zones Oasiennes et l'Arganier
APFA: Accession to Agricultural Property Ownership
APIA : Agence de Promotion des Investissements Agricoles
ASOC: Chenini Oasis Conservation Association
CAPMAS: Central Agency for Public Mobilization and Statistics
CBD: Convention on Biological Diversity
CC : Climate Change
CDER: Center for the Development of Renewable Energies
CIF/FIC: Community Investment Fund
COP: Conference Of Parties
COSOP EEAA: Egyptian Environmental Affairs Agency
DPPTCFR/ DPPCTRF: Directorate of Plant Protection and Technical Control and Of Fraud Repression
EIECP: Egyptian Italian Environmental Cooperation Program
FADES: Fonds arabe de développement économique et social
FAO : Food and Agriculture Organization
FENAPROD : National Federation of Dates Producers
FIMADATTES: Moroccan Interprofessional Federation of Dates
GAIF: General Authority for Investment and Free Zones
GDP : Gross Domestic Product
GEF: Global Environment Facility
GIAHS: Globally Important Agricultural Heritage Site
GIZ : Deutsche Gesellschaft für Internationale Zusammenarbeit
HCEFLCD: Haut Commissariat aux Eaux et Forêts et à la Lutte Contre la Désertification
IAO: Instituto Agronomico per l'Oltremare
ICARDA : International Center for Agricultural Research in the Dry Areas
IDW : International Dynamics Workshop
IFAD: International Fund for Agricultural Development
IRD : Institut de Recherche pour le Développement
IRMC : Institut de Recherche sur le Maghreb Contemporain
IMAROM: Interaction between Migration, Land & Water Management and Resource Exploitation in the Oases of the Maghreb
MAPM : Ministère de l'Agriculture et de la Pêche Maritime, Morocco
MENA : Middle East North Africa
MDG : Millenium Development Goals
MICO : Mutuelles d'Investissement et de Crédit Oasian, Mauritania.
MTR : Mid-Term Review
NAPCD: National Action Program on Combating Desertification
NEAP: National Environmental Action Plan
NIAR/INRA: National Institute of Agronomic Research, Morocco
NIP : New Irrigated Perimeters
NPAE/PANE: National Plan of Action for the Environment
NSPESD/ SNPEDD: National Strategy for the Protection of the Environment and Sustainable Development
ORMVAO: Office Régional de Mise en Valeur Agricole de Ouarzazate, Morocco.
ORMVAT: Office Régional de Mise en Valeur Agricole du Tafilalet, Morocco.
OSDP/PPDO : Oasis Sustainable Development Program
OTE : Oasian Territories and their Environment
OTEDD: Tunisian Observatory on the Environment and Sustainable Development
PACC-ZO: Programme Africain d'Adaptation au Changement Climatique
PAMU: Protected Area Management Unit
PDA/DPA: Provincial Directorates of Agriculture
PGI: Protected Geographical Indicator
PPA: Project Performance Assessment
PPP: Public Private Partnership

SOI: Sustainable Oasis Initiative
TEAM: Transition, Environnement, Agriculture et Milieux.
UAE: United Arab Emirates
UK: United Kingdom
UNESCO: United Nations Education, Science and Culture Organization
UNIDO: United Nations Industrial Development Organization
UNCONTRADE : United Nations Commodity Trade Statistic Database
UNDP : United Nations Development Program
UNOPS: United Nations Office for Project Services
WASIS: Smart Water Management to Protect the Oasis areas of Morocco based on Integrated Modelling Systems
WTO: World Trade Organization

EXECUTIVE SUMMARY

Oases have a long history, stretching over some 6,000 years. Oases have patiently developed and evolved over millennia into a very complex ecological, social, and economic agro-system. Most of the unique oasis agro-ecosystems are found in MENA countries, support the livelihood of about 10 million inhabitants, where the most important crop is date palm. Among thousands of oases: Siwa in Egypt; Ghadames and Kufra in Libya; Ouargla and Timimoun in Algeria; Tozeur in Tunisia; Terjit in Mauritania; and Tafilalt and Ouarzazat in Morocco.

The aim of this study is three fold: 1. To uncover the challenges facing the economy of oases in the case of North African countries: Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia; 2. To explain in a comparative perspective how these countries have used their knowledge and expertise to implement their practices in order to monitor the different levels of change; and 3. To provide a series of policy recommendations for a better integration of the oases in the globalizing process. Therefore, this study is ambitioning to provide answers to these broad questions and to analyze the local impacts of the inclusion /exclusion of the oases in/out of the globalizing process. In a situation of evolution and transition, the oases are neither rural nor urban, neither dead nor formally renovated. We constantly find the importance of the three elements water / man / plant, interacting with a production objective. For centuries, oases have remained in balance with themselves and their environment. We are now witnessing new dynamics. Economically, in the current process of globalization, the oases are experiencing significant changes, including water erosion and drought, uncontrolled urbanization, environmental issues, loss of biodiversity, climate change effect, migration, the negative effects of tourism, etc. The MENA region is facing the same challenges as other emerging nations: how to grow and prosper without losing their unique cultural identity. Specifically, there is a constant tension between modernizing and Westernizing in the region. Across the region, governments are proactively applying strategic management practices at the national level. This study is divided into 4 parts.

Part I deals with the economic evolution of oases: their transformation, their links with the modern sectors of the economy, the consequent threats they are facing due to the globalizing processes, and their sustainability today. The literature shows that an oasis is not just a singular space linked to water. Scholars retain the singularities of oases in an arid environment, where water is a key to its spatial and social organization. Oases appear as disparate as territories situated rather on the margins of broader societies, and also as the foundation of myths and recomposed political and economic powers.

Part II is dedicated to the environmental change in the oases: the extreme weather conditions due to climate change and the management of biological diversity and water scarcity. A fairly common destiny seems to have pushed many oases to the extreme. They are marginalized by the stakes of the reorganization of world trade, the displacement of resources (water, labor, biodiversity) and the abandonment of specific lands. There remains only little resistance.

Part III concerns the monitoring of social change: youth condition, movements of migration, and the breakings and discontinuities that follow. Oasian peoples no longer function without vast pendular migrations. They are uprooted, deeply detached from the oases, whose development as irrigated space is not independent of pastoral practices any more. Consequences are the contradictory dynamics between different actors in the oasis, who resort to different models ranging from agribusiness to tertiarization (territorial marketing), to secular pluriactivity and/or oasis militancy. Thus, the heritage evolves, disappears or is redefined otherwise.

Part IV focuses on dates palm economy: production, marketing and trade, from the experiences of the most important producers in the region. Most of the world's date production is concentrated in these countries, and some of them are leading exporters (Egypt, Tunisia, Algeria). This section of the study aims at addressing the major problems facing this sector and the measures that have to be undertaken to improve production, marketing and trade.

PART I— THE ECONOMIC EVOLUTION OF OASES

The space context is very important. The following aspects are addressed: a global reading of the oasis, understood as a socio-economic and institutional entity, several major aspects of an oasis development strategy, the analysis of the economic vocation of the oasis and the elements of collective action.

1. Links with the national economies: rural/urban and traditional/ modern sectors relationships

Traditionally, oases have played an important role as commercial and administrative centers for nomadic populations, but increasingly this role is changing, as large-scale agricultural projects are

seeking to maximize the agricultural potential of these environments. Formerly in North Africa, the Saharan oases were defined according to the traditional hydraulic system that guaranteed access to drinking water. The traditional governance and customary law of the Saharan areas have been relayed by the national political and legal system. At the same time, the oasis economy was integrated into the national economy, losing its traditional value and function.

Algeria: the issue of food security in the oases: The Algerian case raises a problematic issue: that of food security. For half a century, the Algerian Sahara has faced deep socio-spatial transformations. This has led to new ways of production as part of the national economy. The Saharan regions are most vulnerable to food security. They are dependent, compared to other regions.

Algeria: the oasis of Timimoun: measuring changes in the oasis environment: Timimoun, the Saharan oasis, the "capital" of the Gourara and town, has experienced remarkable population growth since 1954, and a large spatial spread linked to the development of its equipment, the strengthening of its administrative status and its touristic role. This makes Timimoun a relevant example of measuring changes in the oasis environment. Economic diversification and new attractiveness have also played a role in modifying the social and spatial organization of the oasis. The fragility of oasis ecosystems requires an urgent return to the rational use of water.

Algeria: the case of Touat: towards a combination of tradition and modernity?: Traditional cereal cultivation has long occupied an essential place in the oasis gardens of Touat. The complexity of the organization of the foggaras has social consequences that deserve mention. The Algerian Sahara due to the importance of its water and hydrocarbon resources is an important part of the national economy. The State, while implementing a set of economic and political-legal reforms, has encouraged a pragmatic combination of tradition and modernity.

Egypt: Siwa: an example of integration of an oasis through sustainable tourism: Sustainability seems to be a growing trend in Siwa, due to some private businesses in town with sustainability on their agendas, interventions and projects launched by NGOs, as well as the perceptions of Siwa which visitors share with locals.

Libya: agricultural systems in the Libyan Fazzān: The agricultural systems employed in the Libyan Fazzān can be classified into two types: the traditional garden systems and the modern large-scale agricultural system. Economic sanctions have been imposed on Libya for most of the study period, limiting access to spare parts and expert technology. A pattern of declining productivity since 1997 is evident in three oases, but one oasis shows lower inter-annual variability.

Mauritania: the oases amidst systemic changes after independence: Mauritania's rural society has long been characterized by a sharp opposition between nomadic herders and sedentary farmers, which correspond to an ethnic distinction. However, changes are taking place in the rural sector, which foreshadow social and cultural developments. There is currently a sectorialization of these activities. As a result of the rural exodus, the number of people in the rural sector has not really increased. The stability of rural production, in spite of the degradation of resources, masks in fact the consequent structural changes. Capital investment has grown considerably; there is a trend of private investment in the irrigated sector.

Morocco: trends of oasian transformation in a changing political and economic context; In Morocco, there are 11 provinces producing dates located in the South and Southeast of the country, representing two-thirds of the national territory. Paradoxically, one often simultaneously perceives an increasing overexploitation of the natural resources. Climatological determinism is still very dominant among government officials and other policy makers, who are declaring 'war' on desertification. The term 'aridity' has been used to explain and depolitize almost any agricultural problem.

Morocco: the case of Figuig: fighting isolation: Figuig is an oasis in extreme eastern Morocco. It is geographically isolated and kept out of national development programs. Figuig has developed many interactions with the outside world. In order to break its isolation, and thanks to Figuig diaspora, the municipality has entered into diverse cooperation agreements with various international partners. Integration of the oasis into global networks has been a true strategy in various fields (local governance, sanitation, architectural restoration, etc.), to help it carry out its development policy.

Morocco: the case of the Middle Draa Valley: The oasis areas have suffered strong genetic erosion due to the introduction of new varieties and the expansion of unsustainable cultures, especially like watermelon that seems absurd. Farmers switch to more profitable crops but this practice is harmful in the long run because it exacerbates the demand for water. Agriculture in the Draa region is mostly for subsistence and local consumption; marketable products play a minor role. One exception is the production of dates, which generates additional income. Traditional agriculture has become almost

incompatible with modernization lifestyle. This increases the vulnerability of the region and adaptation is related to water management.

Tunisia: a highly differentiated transformation of oases: The decline of traditional forms of agriculture may operate simultaneously with the rise of relatively 'modern' forms of agriculture, and both processes tend to reinforce each other. In Tunisia, studies concluded to the worst problems of agricultural decline and land degradation. In general, oasis agriculture has proven to be persistent. It is clear that oasis agriculture in the Maghreb is not disappearing but undergoing a gradual, though highly differentiated, transformation.

2. Inclusion/exclusion and opportunities/ threats in the globalizing process

Morocco: the complexity of challenges facing the Moroccan oasian system: After considering for obvious commercial reasons that there were universal technological remedies for the problems of the world without any regional distinction, we are now rediscovering that the spatial specificities and the diversity of cultures are to be taken into consideration in the decision-making process.

Tunisia: oasian socio-economic challenges: In Tunisia, the sustainability of oases is confronted with socio-economic challenges of various kinds.

Tunisia: the case of Nefta and the decline of tradition: The city of Nefta was characterized by an architectural and agricultural know-how inherited for generations. This new architecture reflects a better balance between the city and its environment. The current city having adopted or experienced the new world models and standards is beginning to lose the social and architectural features that have been a landmark of its history.

3. The issue of oases sustainability

Sustainability means meeting certain needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, people also need social and economic resources. Sustainability is not just environmentalism.

Algeria: the passage to modern agriculture and the decline of small oasian production: In the post-independence era, Algeria has completely changed its vocation. Algeria underwent two major phases of agrarian reform. The first phase corresponds to that of Algerian socialism relayed by a second phase of capitalist economy. This new dynamism of the oasis agriculture has certainly generated great changes to which the peasants have adhered.

Egypt: oases development through ecotourism: Sustainability has become an important concept for tourism development all over the world. As an example, Egypt has witnessed a severe reduction in the flow of tourists after the revolutionary wave of the Arab Spring. Nowadays, the country is taking several steps to diversify its tourism product. Egypt is developing new products in order to enrich the tourism industry, such as ecotourism in desert areas.

Egypt: AlFayoum oasis: a potential ecotourism destination: One of these places to develop ecotourism is AlFayoum, a beautiful oasis that is endowed with rich natural and cultural heritage. It is located in the heart of Egypt, between the Nile Delta and Upper Egypt. From prehistory up until modern times, AlFayoum has attracted the attention of dynasties, rulers and invaders, historians and explorers, researchers and archaeologists.

Egypt: achieving sustainability through the Siwa Oasis Project: The SOProject is part of the wider Egyptian-Italian Environmental Program, being carried out within the framework of donor initiatives assisting the country in the implementation of the NEAP. But, since the Egyptian revolution in 2011, the number of tourists from foreign countries has declined.

Mauritania: the implementation of the OSDP: Mauritania has conceived and implemented an OSDP to provide the foundations for oasis economies, the empowerment of oasis communities and the improvement of their production conditions. The OSDP served as a point of reference for the Government, IFAD and other donors regarding interventions in oasis areas. Social capital has also made undeniable progress. The OSDP contributed to the empowerment of populations through participatory planning and promotion of local project management.

Morocco: enhancing environmental policy: The Environmental Performance Review (EPR) of Morocco began in 2012. It analyses the progress made by the country from 2003 on the level of

environmental protection, and proposes recommendations on how to improve its environmental management and address environmental challenges. This policy framework for environmental protection and sustainable development addressed primarily water management issues.

Tunisia: towards adaptation of oases system: The CCC/GIZ project highlighted both the strategic importance of oasis ecosystems, economically, socially and ecologically, and the threats to the sustainability of this agro-ecological heritage which are likely to become more severe. The adaptation of oasis systems is necessary in the future; the oasis populations have acquired a valuable knowledge in the management of water scarcity and the natural variability of the climate in arid environment.

PART II—ENVIRONMENTAL CHANGE IN THE OASES

Oases in the Sahara Desert are currently undergoing considerable environmental change. In the central Sahara, these agricultural systems are dependent totally on groundwater resources. Excessive exploitation of these resources can lead to rapid decline in ground water level, result in significant land degradation and impose severe limits to development, making productivity of oases decline. However, analysis reveals that human activities are the driving forces behind ecological deterioration.

1. Facing extreme weather conditions in the context of climate change

As a result of the degrading ecosystem, the oases no longer provide sufficient means of subsistence. Thus, the oasis populations are forced to resort to seasonal migration and are increasingly dependent on the income earned from migrating. The overall objective of oasis sustainability project is to improve the adaptability of populations in oasis areas to face climate change. In a handful of oases, locals are reviving old technologies, such as the khetarras, or farming climate-resilient medicinal and aromatic plants to replace crops that are no longer faring well under drought conditions.

Morocco: a project to adapt to climatic change for resilient oasis: PACC/OASIS: The PACC/Oasis Program (2009-2012) has involved international partners: UNDP, Japan, and national partners. It is intended for strategic actions in the provinces of Errachidia, Guelmim, Ourzazat, Tata, Tinghir and Zagora. Its primary objectives are the management of the risks posed by climate change.

Morocco: a program to combat the threats over the Tafilalet region; The world's largest oasis, in the Tafilalet region of south-eastern of Morocco, is also threatened by climate change, is also raising awareness among oasis communities about the importance of plantations that help sustain the region's fauna and flora and resist desertification. To reduce its vulnerability, the government has been advised to better manage water resources through innovating irrigation techniques and reducing waste, implementing long- and short-term strategies and to invest in renewable energies.

Morocco: tourism as a response to changing economic and social conditions in the Tata region: The Tata region is one of the hottest regions of Morocco. Tourism was identified as the leading economic opportunity despite relatively little infrastructure and the complete lack of recognition in the domestic and international tourism marketplace. There was an understanding that the impressive mix of cultural, heritage and natural resources was sufficiently attractive to support a viable tourism sector.

Tunisia: the active role of the State: Since five decades, new agricultural extensions can be found in almost all the Tunisian oases and in the oases of the lower Todgha where sufficient uncultivated arable land outside the traditional oases is available. Besides new extensions adjacent to the old oases, completely new agricultural zones have been developed. The Tunisian State has actively promoted the creation of new agricultural areas outside the traditional oases. This often coincides with the mechanization and partial modernization of agricultural techniques, and a growing orientation towards a limited number of 'cash crops' such as dates or almonds, which are sometimes for export.

2. Managing biological diversity and water scarcity in desert environment

Algeria: the Foggara oasis and the rational water management: In Algeria, the region of the Touat was organized according to the production of water and irrigated agriculture. This organization and its importance are reflected in social, cultural and economic facts. Algerians in this region attribute to the foggaras a sacred character comparable to that of the Koranic schools and mosques.

Egypt: Kharga, a desert crossroad over the millennia: Kharga represents a special case. Being large and near to the Nile, Kharga shows the best the everlasting effect of this connection. The isolation of oases in the Nubian Desert allowed two important features of biodiversity: (1) retention of some

species that disappeared and are in their areas of origin, and (2) appearance of new species that evolved within the oasis.

Egypt: water management and agricultural biodiversity in Siwa: Siwa oasis is ecogeographically and culturally isolated from other agrarian communities. The perennial crop inventory of Siwan Berbers has remained relatively stable through time and few traditionally cultivated annual species or landraces have been lost. However, additional crop species from other parts of Egypt have been adopted since a paved road was completed to Siwa in 1986.

Morocco: animal husbandry and water management: 1. The importance of animal husbandry seems to be increasing for sedentary oasis populations. Some studies suggest a relationship between this phenomenon and migration. The development of urban centers near oasis areas seems to create growing markets for meat and dairy products. 2. Irrigation water management is crucial for agricultural production and livelihood security in Morocco as in many other parts of the world. Implementing an effective water management system is a complex task for policy makers.

Morocco: the issue of water management in the Draa Valley: In the future, water supply is likely to be reduced, and this will increase water scarcity in the region and tighten water supply for irrigation. Farmers do not only adjust to the area cultivated, but also change their cropping patterns under water scarcity. Crop yields decrease if water requirements are not satisfied.

Tunisia: the negative effects of overexploitation of water: The oases have been experiencing a loss of biodiversity for several decades, and this trend is constantly accelerating. The market economy has favored the exaggerated extension of the Deglet Nour dates at the expense of other varieties. Oases of southern Tunisia will be the most affected in Tunisia by climate change, due to an increase in temperature and a decrease in precipitation.

PART III—MONITORING SOCIAL AND CULTURAL CHANGE IN THE OASES

The late 19th and 20th centuries brought many fundamental changes to oasis societies in the Maghreb. These regions were gradually integrated into a modern, central State as well as in the national and international market economy. The demise of nomadism led to the subsequent sedentarization of most nomads in or at the fringes of oases. These processes, which have continued in the post-colonial era, created important income earning opportunities outside agriculture for oasis peasants, sharecroppers and slaves, especially through migration towards large towns and foreign countries.

1. Social transformations, migration movements and diversification of economic activities

International migration has increased the income of many oasis households, decreasing their dependence on agriculture and enabling a greater diversity of economic activities. Such changes have led to important transformations in the agricultural realm, claiming that migration has contributed positively to agricultural development. Oasis agriculture in the Maghreb is undergoing a spatially differentiated transformation. Migration has generally contributed to agricultural transformation in a positive way as international migrant households show a high willingness to invest in agriculture.

Algeria: emancipation, urbanization and standardization: The Algerian State has carried out a series of actions to develop these areas in the agricultural sector as well as in services, transport and housing. As a result, the oases were modernized, transformed and ultimately standardized. Although the process of opening up the Sahara was initiated during colonization, it was only after independence that it was almost completed.

Egypt: urban development and revival of the cultural heritage in Siwa: There are very few formal guidelines or architectural codes for the development of Siwa. The aesthetic qualities of the traditional Siwan architectural style is one of the most important legacies and attractions of the oasis but it is being abandoned in favor of “modern” building styles which are expanding and jeopardizing Siwa’s unique architectural identity. The oasis is lacking a coherent master urbanization plan.

Libya: profound structural transformations: The oasian communities differ greatly from each other in their exterior formats. Mourzouk is a scattered oasis, with widely spread cultivated areas, whereas Ghat has an intermediate position with wide spread gardening areas.

Mauritania: the impact of social and cultural developments: The majority of the population, once nomadic, is now settled in towns, in large boroughs, and in villages. The landscapes of the valley of Mauritania are also upset. Irrigation is most developed. New organizational structures emerge slowly in this rural world. There is a need for more investment to maintain production (drainage, fertilizer, etc.). The question of access to land of the harâtîn is not definitively settled; the after-effects of the events of 1989 are far from being erased. Private investment in the rural sector remains marked by speculative interests.

Morocco: the differentiated impact of migration on oasis systems: In the past century, rural areas in the Maghreb have witnessed a mass migration of their people to urban centers within their own countries as well as to Europe and the Arab oil countries. Migration was generally strongest in the regions that were relatively disadvantaged in terms of ecological conditions. The dominant scenario in the Maghreb in particular is rather pessimistic. International migration is perceived as the main avenue of upwards socio-economic. Migration has enabled households to invest in housing, agriculture, private enterprises and the education of male and female children.

Tunisia: migration and agricultural transformations: Higher aspirations, better education, a whole process of 'opening up' seem to have led to an increased emphasis on migration. Migration also seems to have accelerated the erosion of ancient socio-ethnic and religious hierarchies as well as the role of old community institutions regulating village life.

2. Cultural change: dealing with breakings and discontinuities

There is new spatial logic, where the distinction between old and new oases perimeters gave way to a duality between attractive territories and marginalized spaces. If some oases oriented towards agriculture export are considered "real world- regions", those that are in isolated areas seem to subsist with difficulty.

Algeria: dynamic transformations in the oasis of Ouargla: The phenomenon of urbanization within the palm plantation has stimulated agricultural activity and could be a new opportunity for the redeployment of agriculture and the safeguarding of the oasis of Ouargla.

Morocco: promotion of cultural heritage and inclusion of women: Morocco has always tried to value its cultural heritage and creative industries within government policies and strategies relating to human development, poverty reduction, gender equity, as well as development and sustainability. Intra-household relations in Morocco are based on strong patriarchal principles. Only men have been allowed to migrate alone. In this context, remittances are destined for the entire family household as the literal price that the migrant pays for this control.

Tunisia: agribusiness and territorial marketing as responses to contradictory dynamics : The oasis economies of southern Tunisia do not escape these developments. In particular, accelerated urbanization and desertification processes contribute to a profound transformation of the very structure of the oasis territory. Tunisia has developed the oasis agribusiness model, territorial marketing and tertiarization of oases and has developed diversified and multi-family farming.

PART IV—ON PALM DATES ECONOMY

The date palm is the dominant component upon which the sustainable biophysical and socio-economic structures of the oasis ecosystem are based. The exploitation of the date palm is an important source of financial income for the inhabitants of the oases. Most of the world's date production is concentrated in a few countries in the same region. Date production of Egypt alone represents about 20% of the total world production, while Tunisia, Algeria and Saudi Arabia are among the five leading date-exporting countries. North Africa is the second most important growing area for date palms in the world with approximately 30% of the world's total number of date palms; its production is about 1,500,000 tons of dates. Modern technological developments have made it possible to look at the palm as a raw material source for industrial purposes. Practically all parts of the date palm, except perhaps the roots, are used for different purposes.

Algeria: dates as a keystone to the oasis ecosystem: Date palm culture remains the basis of the desert ecosystem which occupies almost 80% of the whole surface of Algeria. Algeria ranks fifth among producing countries with 0.52 M tons in 2005 from some 10.4 million trees and it is the world second

largest producer of the Deglet Nour variety. Tunisia and Algeria have focused on the high value confectionary market in Europe. Date palm sector in Algeria is suffering from problems such as potentialities, technical and environmental constraints and socio-economic preoccupations. Poor marketing on a national and international scale is also a problem because of a lack of adequate organizations. Moreover, the absence of rapid means for transporting dates from farms to markets contributes to the deterioration of dates. This problem seems to be either solved or reduced as the Algerian government has set up a "green corridor" for exporting dates in September 2006. However, participation of the date sector in Algerian exports remains weak. More efforts should be made to establish a better international market position. The main socio-economic constraints hindering the development of the sector are phenomena like: date palm grove abandonment, lack of know-how, low mechanization, water shortages, mismanagement, etc.

Egypt: a big producer with ambitious plans: Egypt has been the world's largest producer of dates since 1974, thanks to a good access to water by palms growing along the Nile valley. Cultivation of new date palms is continuous, in particular in the new reclaimed land in the desert and in saline-affected areas. The date palm sector in Egypt does not have a national marketing authority in charge of designing a clear strategic policy for exporting dates, in addition to the lack of care in categorizing dates for export or grading them in terms of quality and pricing. Furthermore, Egyptian dates face a strong competition in the markets from those of Saudi Arabia, Iran, Tunisia and UAE.

Libya: international projects to promote the date sector: The data used here date back to the period before the war in Libya. A few years ago, members of the Palmiria Group participated in an important project in Libya focusing on sustainable local date palm cultivation. This project aimed at guaranteeing the production of high quality dates by adopting better production practices, grading standards for fruit for international markets, valorization of traditional oases management and the protection of agro-biodiversity through low environmental impact agricultural practices.

Mauritania: implementation of an ambitious program: Mauritania has one of the poorest agricultural bases in West Africa. Most important to the rural economy has been the livestock subsector. Farming was restricted to the narrow band along the Senegal River. Annual river flooding sustained crop production. Government planners neglected both herding and farming until the 1980s, concentrating instead on development in the modern sector. Mauritania has developed several programs to safeguard the national phoenicultural heritage. The two main projects concern the sustainable development of oases and the protection of the date palm.

Morocco: date sector benefiting from Morocco Green Plan: The date palm is the pivot of the oasis ecosystem of the Moroccan Saharan and pre-Saharan regions and the providential tree for more than 2 million inhabitants. Date palm is grown mainly in eleven provinces situated in the southern and northeastern parts of the country. The date palm still suffers from several problems such as lack of appropriate cultural techniques, protection and post harvest industry. In fact, the use of traditional and empirical techniques remains a serious constraint to improving quantitatively and qualitatively the date production. To optimize the Moroccan date, an ambitious program of standardization was initiated to facilitate its access to various markets. By 2020, Morocco aims at recapturing its dates market where it has to import 30 000 tons every year from Algeria and Saudi Arabia.

Tunisia: the experience of a world leading producer: Tunisia is the world leading producer of Deglet Nour. Although Tunisia represents only about 2% of the world's production, it is the leader in terms of value of exports with 30% of the world's export total and it provides Europe with more than half of its Deglet Nour dates. The date palm sector in Tunisia comes in third place in its domestic farm product exports, after olive oil and seafood products. The date producers ambition to improve the quality and marketing methods to face the competition of other countries like Algeria and Morocco.

CONCLUSIONS

Beyond the diversity of the cases studied, there is a unity of the fate of oases in the MENA region, stemming from the fragility of their present status. The study uses a comparative perspective, when addressing the six countries studied. However, some countries (Algeria, Egypt, Morocco, Tunisia) have been more focused on than others (Libya, Mauritania), and there is a great disparity on the level of the quality of the data available and the scientific production. It seems necessary to widen the debate on oases, because different categories of new actors are appearing and have a major influence on the

current dynamics of these spaces. There is also an urgent need for the intervention of the developmental State.

RECOMMENDATIONS

These conclusions allow a certain number of strategic recommendations to achieve a renewed vision of the oases and to overcome the dramatic consequences of globalization.

A renewed vision of oases development: This new perspective should stem from a combination of several concerns: 1. The conservation and improvement of oases ecosystem; 2. Preservation of biodiversity; 3. Reducing pollution and nuisances; 4. The preservation of agricultural land and the sustainable management of urban space; 5. Intensification and valorization of oasian agricultural production; 6. The development of drainage water; 7. A better marketing strategy for dates; 8. Better land restructuring; 9. The development of renewable energies; 10. A better integration of oasis zones with their environment; and 11. A better local environmental governance and decentralized management of natural resources.

Involvement of actors and enlargement of their missions:

	Actors	Missions
1	State/Public authorities	Conductors of development interventions
2	Scientific/Academic research	To identify problems threatening the oasis ecosystem and to find solutions
3	Local authorities	Coordination of all stakeholders and participation through financial contributions
4	Media and communication strategy	Raising awareness of oases preservation at all levels, to support initiatives, information and good governance
5	Private responsible citizens	Responsible economic agents have a decisive role in the preservation of the oasian ecosystem
6	Farmers	Adopting water-saving practices, improving the value of natural resources, preserving land and biodiversity
7	Workers/women/youth	Different roles to play in everyday life of the oases
8	Private operators	Participating in activities relating to oasis agriculture, industry, dates, sustainable tourism in the oasis system
9	GDA's	Ensuring transparent administrative/financial management, limiting illegal operations, helping farmers and initiating projects
10	NGOs	A vital link between oases and other actors, necessary to alert, popularize, sensitize and mediate issues

Enhancing services, coordination and academic research: Strategic Recommendations

1. Global guidelines: This strategy is mainly characterized by four determinants:

(I)The concept of construction of the territory, overlapping local development and governance.	(II)A strong representativeness, involving local populations and grass-roots organizations in local development projects.
(III)The concept of sustainable development, centered on conciliation between development and environmental imperatives.	(IV)A holistic vision, combining relations with other spaces and communities and rethinking the management of oases.

2. Strategic axis of intervention (SAI)

SAI1: Improvement of oasis governance and involvement of all stakeholders in the implementation of the strategy; SAI2: Protection, integrated management and economy of use of water resources; SAI3: Rehabilitation and conservation of the plant and animal biodiversity of the oasis ecosystem; SAI4: Protection of the environment of the agricultural and urban areas of the oases and improvement of the living environment of the oasis populations; SAI5: Management, preservation of agricultural land, combating desertification and sustainable management of the oasis urban space; SAI6: Rehabilitating productivity and maintaining a viable and ecological operating system; SAI7: Creation and consolidation of income-generating activities and promotion of social solidarity economy; SAI8: Rehabilitation and consolidation of the heritage, landscape, socio-cultural and tourist values of the oases; SAI9: Risk management and adaptation of oases to climate change.

INTRODUCTION



The aim of this study is three fold:

- To uncover the challenges facing the economy of oases in the case of North African countries: Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia;
- To explain in a comparative perspective how these countries have used their knowledge and expertise to implement their practices in order to monitor the different levels of change: economic, environmental, social and cultural; and
- To provide a series of policy recommendations for a better integration of the oases in the globalizing process, along with their protection from degradation.

1. THE OASIS AGRO-ECOSYSTEM: FROM EARLY HISTORY TO THE INTEGRATION INTO MODERN MARKET ECONOMY

The word “oasis” seems to have two different etymologies: for some scholars, it is a Greek word for watered green fertile land in the desert where the “oasis effect” is manifested as cooling caused by vegetation. For others, it is a Coptic term for places far from the Nile Valley. Oases have a long history, stretching some 6,000 years. The areas of Egypt Mesopotamia (Iraq) are the birthplace of the date palm. Under the harsh desert environment, especially in the MENA region, farmers use their adaptive ingenuity which was accumulated over millennia to create sustainable palm-based agricultural systems. These systems are usually managed through local resource management institutions that enable farmers to make judicious decisions for sustainable resource use and to maintain a stable and productive oasis agro-ecosystem patiently developed and evolved over millennia into a very complex ecological, social, and economic infrastructure. It is the final optimization of the interaction between cultural references, engineering constraints, economic

limitations, and climatic diversity of an environment equally hostile to human, animal and plant life.

Most of the unique oasis agro-ecosystems are found in MENA countries. They support the livelihood of about 10 million inhabitants, where the most important crop is date palm. Among thousands of oases: Siwa in Egypt; Ghadames and Kufra in Libya; Ouargla, Taut, and Timimoun in Algeria; Tozeur and Tamerza in Tunisia; Terjit in Mauritania; and Tafilalt and Ourzazat in Morocco.

The oasis agro-ecosystem is a standard model for a spatially heterogeneous, three-story inter-cropping system of date palms, fruit trees and annual crops. The composition and configuration of the three-story system creates different profiles of horizontal wind speed, relative air temperature and relative air humidity. Life in the oases is managed through refined social practices and institutions. The indigenous knowledge associated with this diversity and its management is crucial to ensure a sustainable life in the oases. Oases, often compared to "desert islands" were early integrated in market economy. Economically, they were commercial nodes (the Silk Road of the Sahara in the Middle East), places of transit (migration, nomadism), intersections of infrastructure and structural networks inserted in a hierarchical organization. In the current process of globalization, the oases are experiencing significant changes, including the expansion of irrigated areas with agro-industry for export, migration and its impacts, geopolitical upheavals of the Arab Spring, the urban growth and land pressure, and environmental issues.

Many questions arise. At the level of oasis, there is new spatial logic that gave way to a duality between attractive territories and marginalized spaces. If some oases oriented towards agriculture export are considered "real world- regions", those that are in isolated areas seem to subsist with difficulty. These various mutations finally raise the issue of water resources, crucial in desert environments, of pressure exerted on crop yields, on the margins of urban and industrial areas. All these factors put a threat on the sustainability of some oasis, as they experience an increasing pressure on water quality and availability in a context of climate change and/or variations. Ancient oases were based on hierarchical and cohesive societies, with high-technical skills and efficient hydraulics control. The current situation is quite different. The changes may occur in the form of ruptures and discontinuities, in contrast with other systems that are still functioning in fairly unchanging ways.

This study aims to provide answers to these broad questions and to analyze the local impacts of the inclusion /exclusion of the oases in/out of the globalizing process. (MARSHALL, Anaïs, LAVIE, Emilie, CHALEARD, Jean-Louis, FORT, Monique and LOMBARD, Jérôme, 2013). Indeed, there is a difference between the modern day use of the term oasis and the evolution of the rural irrigated landscape to be found in the region. The confusion around the term oasis comes from the fact that such agrarian landscapes are so multiform in their appearance but also in their intended purposes. In a situation of evolution and transition, and in view of the new functions that seem to come to them, the oases, neither rural nor urban, neither dead nor formally renovated, become a fuzzy concept! It is no longer clear how to define the oases today, nor how to classify them in the light of the diversity of situations and the evolutionary paths through which they have passed.

Therefore, an updated and more dynamic definition of the "oasis" concept should be sought, and the proposal of new typologies seem to be a relevant task. The past,

present and future of the term "oasis" will not be the same. When the term oasis is evoked, it is in the sense, on the one hand, of a rather historical phenomenon lent to local rural societies (so-called hydraulic societies), and on the other side of "marvel", the notion of the diversity of natures-societies at the scale of the earth (DEMANGEOT, J., BERNUS, 2001, LEBEAU, 2004). Whether in ancient or newer works, one finds the will to define, to classify, to characterize what an oasis is really. We constantly find the importance of the three elements water / man / plant, which are interacting with a production objective. For centuries, oases have remained in balance with themselves and their environment. We are now witnessing new dynamics. Two types of evolution are attracting attention:

- All oases have profound landscape dynamics and are distinguishable from each other;
- The recent irrigated perimeters generating new panoramas have become multiple and complex.

The term oasis is often attached essentially to the oases that already existed at the time of colonization, the new forms of farming then receive the terms of modern oases and then New Irrigated Perimeters (NIP). These new forms of farms do not replace old ones, but they are either juxtaposed to old ones or create new kinds of spaces. Based on the date of appearance of irrigated areas, the public perimeters have thus been separated into three distinct groups:

- Traditional oases, the creation of which dates back to before 1900, and whose water originated mainly from sources;
- The modern oases, created after 1900, thanks to the installation of deep wells by the State, managed collectively; and
- After 1970, new irrigated areas, public or private, are set up around surface wells, individual or collective wells or unconventional waters.

There are three main criteria for distinction: the first in terms of landscape, (number of stages of crops), the second is an ecological one (origin and nature of soils ...), and the third is of a social order (culture system, Land tenure, agricultural practices, etc.). (ABDEDAIEM, Slaheddine, VEYRAC-BEN AHMED, Bénédicte, 2015). Today, the oases are distributed throughout the arid areas of the world. Scholars distinguish the new oasis in North America and Australia, and the oldest, throughout arid regions linking Africa to Asia. The oasis economy is closely linked with the agricultural sector, which has been a form of adaptation for centuries. This has numerous aspects, like:

- Intensive agriculture within the oasis associated with extensive livestock on large external pastoral spaces of oasis.
- Traditional irrigation of surface water, with water sharing.
- Rational use of space with an expertise of flood spreading and/or dry perimeters, allowing the cultivation of large areas.
- A system of water collection of groundwater and gravity adduction as "Khattaras" or "Foggaras."
- Development of an adapted biodiversity as a genetic reservoir of local species.
- Traditional oasis consists of the superposition of three stratum: Stratum of trees: date palm 15 to 30 m., shrub stratum: fruits such as apples, pomegranates and henna and, herbaceous stratum: market gardening oasis with many varieties.

In fact, the oasis contains an important source of species and varieties of highly endemic fruits—grapes, peaches, apricots, pomegranates, dates, figs—in addition to cereals and legumes (barley, wheat, alfalfa) and animals (poultry, goats and sheep). In the oasis, practically everything can grow, this characteristic makes it a place whose intensification rate is of the highest. The oases include an exceptional wealth of flora and fauna biodiversity. There are more than 300 varieties of palm, some of which are steadily mature, several varieties of olives and grenadiers, several varieties of fig, vine, apricot and other tree species such as apple, pear, peach, plum, mulberry, quince, lemon tree, some local varieties of bananas.

The aim of this research on oases is to draw attention to the richness of the oasis heritage, but also to its ecological fragility and to the necessary implementation of a strategy to safeguard and adapt oasis systems in a context increasingly characterized by the constraining effects of climate change. It also aims to show that solutions exist and that it is necessary to implement more coherent approaches and public policies to better value and preserve all the oasis systems.

2. EARLY INTEGRATION OF OASES INTO MARKET ECONOMY AND MAJOR ENVIRONMENTAL AND SOCIO-ECONOMIC CHALLENGES

Economically, in the current process of globalization, the oases are experiencing significant changes, including depletion of aquifers, salinization and hydromorphy, water erosion and drought, palm pests, uncontrolled urbanization, loss of biodiversity, climate change effect, pollution from domestic waste, the expansion of irrigated areas with agro-industry for export, migration and the urban growth and land pressure, environmental issues, the crisis in institutions, land structures, international competition and the negative effects of tourism. (GARCIER, Romain J. et BRAVARD, Jean-Paul, 2015).

The IDW OTE 2017 Workshop has set various objectives aimed concerning the following aspects: The dynamics of exchanges, complementarities, breaks and conflicts in the Saharan and oasis territories. Socio-economic analysis, migratory flows, local knowledge and know-how, measurement and assessment of the sustainability of these territories, with a focus on the stakes and impacts around the water and soil resources. The oasis civilization, its lifestyle, and its special ecosystems are part of the common heritage of humanity: these threats could make them disappear within one or two generations. In general, the oasean environment is characterized by:

- Low and irregular rainfall in time and space (between 50 and 200 mm/year);
- Very high in summer and relatively low temperatures in winter (-5°C to +55°C);
- A daily thermal amplitude generally quite high (15 to 20°C);
- An intense evaporation: in fact, it reached more than 2500 mm annually;
- Two types of winds that are dry and warm known Chergui. (KARMAOUI, Ahmed)

3. OASES TRANSFORMATIONS AND THE ISSUE OF SUSTAINABILITY

Commentators in the West often view the Middle East as a homogeneous region, lumping together countries as culturally, politically, and economically distinct as Lebanon and Yemen. Today, the MENA region is changing. The region's leaders are

committed to catching up to the rest of the world, while trying to get the best from the tremendous economic vitality of the region. In addition, a growing number of countries in the region have joined the World Trade Organization (WTO), which provides incentives to governments to open up their economies through the liberalization of restricted sectors. For example, Egypt is seeking to reform its business environment and the efforts deployed by Egypt's General Authority for Investment and Free Zones (GAIF) have been appreciated by the World Bank and have attracted increased foreign investments. In fact, the World Bank named Egypt one of the top reformers since 2008.

The MENA region decision makers are fundamentally progressive, facing the same challenges that emerging nations everywhere face: how to grow and prosper without losing their unique cultural identity. Specifically, there is a constant tension between modernizing and Westernizing in the region. Modernization is valued, but only within traditional parameters. Decision makers recognize the importance of setting a clear direction, but the sheer number of economic changes taking place mandates strategies that are open to rapid change. Indeed, across the region, governments are proactively applying strategic management practices at the national level. Increased government accountability is evident in the unveiling, implementation, public communication of strategic plans, and in the public review of these plans. (SADDI, Joe, SABBAGH, Karim, and SHEDIAC, Richard, 2008).

Within these systemic changes, the development of agriculture in the Saharan regions remains based on two complementary axes:

- The first is the preservation of the old palm plantations which constitute an important heritage and which plays a primordial role in the ecological and social balance of the oasis environment. There is a continuing degradation of these ecosystems and a limited scope of government interventions.
- The second axis is based on the extension of agricultural land ownership through the development of new land. The agricultural development policy, presents many shortcomings, among which the inadequate farming models and the inefficiency of the institutions responsible for the implementation of this policy. (BOUAMMAR, Boualem; BEKHTI, Brahim), (CHAOUCH S., 2004).

The causes and factors that are responsible for the degradation of the old oases are more varied than the notable differences in the different agro-ecological regions, although we often observe similarities of situations. In this respect, the oases are differentiated by the constraints that hinder their development and the factors characteristic of their degradation, in this direction, strong hypotheses seem to be most common to the oases of the South to explain the main reasons for this ecological imbalance.

1) The profound changes that the oasis society has undergone in its social, economic and cultural dimension have had a major impact on the role of the palm grove for the oasis man. From the ecological role of softening climate, these changes are giving this palm plantation the only economic role, which it is unable to fulfill due to its lack of profitability.

2) The common causes encountered by these oases in or near major agglomerations are of anthropogenic origin. Man is the most decisive element in this degradation by its direct action on the environment or indirectly by the nature of its activities.

3) Demographic pressure in large cities and anarchic urbanization (some 6 Saharan urban centers have become cities with more than 200 000 inhabitants) in the oasis leading to a decline in vegetation cover.

4) In the oases surrounding small agglomerations, which are generally less ancient, the origin of degradation is mainly due to agricultural exodus, aging labor and other reasons that are much more ecological than socio-economic.

There are difficulties for the implementation of the agricultural development policy in the Saharan regions. The heavy investments required for land management, drilling, electrification and road construction require State intervention. This also reflects the difficult conditions under which farmers are trying to develop land. The most plausible causes explaining the shortcomings observed in government intervention actions and their inefficiency are mainly:

A) Strategies developed by public authorities do not fit the expectations of oases. (BOUAMMAR, B., 2000), (AOUIDANE, A., 2008). There are inconsistencies in the farming models that the public authorities wanted to promote.

B) The authorities have used means that are not adapted to the reality of the oasis environment (support for production, extension, subsidy policy, site selection ...). The compartmentalization of these structures or their lack of coordination has only accentuated the lack of efficiency in the implementation of the various programs.

C) The conception of agricultural and rural development, based on concepts and notions produced for other contexts, is not adapted to the oasis environment and cannot serve as an appropriate tool.

In the past, ancient civilizations, in arid regions and particularly in the Sahara, have innovated a system of exploitation of the environment to meet their daily needs, for the establishment and stability of the populations . This gave rise to places of life "the Oasis" in an environment naturally hostile to a human settlement. Over time, the integrated development and organization of the social and economic activities associated with the rational management of space and resources has made it possible to establish a sustainable economic base around dates and phycultural derivatives. It is therefore a question of developing comparative advantages and competitive advantages, while remaining in a logic of local production, by introducing more efficient technical itineraries which ensure better profitability, by adapting the research systems, by providing a field for the application of innovations, by making agricultural credit more fluid. But this can not be done without a legal framework .

4. PRESENTATION OF THE DIFFERENT SECTIONS OF THE STUDY

This study is divided into 4 parts:

- Part I deals with the economic evolution of oases: their transformation, their links with the modern sectors of the economy, the consequent threats they are facing due to the globalizing processes, and their sustainability today;
- Part II is dedicated to the environment change in the oases: the extreme weather conditions due to climate change and the management of biological diversity and water scarcity;
- Part III concerns the monitoring of social change: the youth condition, the movements of migration, and the ruptures and discontinuities that follow; and

- Part IV focuses on dates palm economy: production, marketing and trade, from the experiences of the most important producers in the region.

The study concludes that beyond the diversity of the cases studied, there is a unity of the fate of oases in the MENA region, stemming from the fragility of their present status. This allows a certain number of strategic recommendations to achieve a renewed vision of the oases and to overcome the dramatic consequences of globalization.

We have tried to use a comparative perspective, when addressing the six countries studied. Nevertheless, this has not been systematically implemented, because much of the empirical work is methodologically flawed, biased, or sometimes outdated. More systematic empirical comparisons and analytical rigor are needed to formally test the different hypotheses on the effects of change in the oases. This subject is attracting more and more researchers. However, some countries (Algeria, Egypt, Morocco, Tunisia) have been more focused on than others (Libya, Mauritania), and there is a great disparity on the level of the quality of the scientific production.

PART I

THE ECONOMIC EVOLUTION OF OASES



1. The importance of space context

The reading of the Saharan space sheds light on the fact that this is where the oldest and most refined agrarian civilizations of the past have been born and mutually fertilized, and where authentic actors (producers, nomadic breeders and others) have a keen sense of their space. Thus, the users of the arid territory live in a sort of symbiosis that makes them united to all activities, this interdependence sometimes also leading to conflicts and disputes. The creation of new perimeters has transformed the oasis and saharan world, modifying the economic exchanges. New quality products are emerging in the two spaces that have the potential to develop these spaces, but also as vectors of constraints and potentially conflicts, especially on the resources that support their production. Specific issues arise: complementarities and rivalries between the oasis and its environment, between actors with different production systems, economic and social exchanges, and land issues on the use and appropriation of oasis and saharan resources, oasis products and their valuations, new opportunities and off-oasis products created, quality issues for high value-added marketing and the constraints encountered.

Therefore, for a better understanding of the functioning of the oasis and saharan production systems, the following aspects should be addressed: A global reading of the oasis, understood as a socio-economic and institutional entity. Several major aspects of an oasis development strategy: the analysis of the economic vocation of the oasis and the elements of collective action such as mutual assistance. This point concerns the analysis of the sets of individual, collective, private and public actors in the oasis. An analysis of the functioning of oasis production systems over time and their environmental, social and economic performance, the methods of production and local processing of oasis products and their promotion.

2. The organization of oases ecosystems

The focus here is on the assessment of the sustainability of oasis systems: environmental sustainability first, both natural constraints and water in particular are strong in arid environments, in connection with social sustainability. The

trajectory of the oases can be placed in the context of its Saharan environment to see the evolution of the economic, social and environmental interdependencies between the two spaces. Institutional processes for implementing sustainability can also be explored on the basis of examples or case studies. Social issues around water and soil and, more generally, natural resources, analysis of the dynamics and phenomena of social exclusion linked to environmental constraints in different social and institutional contexts. Institutional aspects are taking into account sustainability in oasis development plans: this concerns collective action and the modes of participation of the different stakeholders. We will search for experiences that take into consideration the sustainability of the oasis in relation to its Saharan environment. (LAKHDARI, 2014, WID TOE, 2017).

Since surface water is insufficient or insignificant, the use of groundwater irrigation is necessary at a time when drilling techniques did not yet exist until at least 1850. The pioneers of the system had to redouble their ingenuity in choosing an unusual species, the "date palm", which was irrigated with a generally poor quality of water. Indeed, because of its thermal, hydric and saline stress (DUBOST, 1991), the date palm remains among the fruit species cultivated by man, the best adapted to the agroclimatic conditions prevailing in the Sahara. In spite of the practice of phyculture, diversification of crops under the cover of the palm tree has been possible, ranging from fruit trees (grenadier, apricot, fig) to condimental and aromatic plants.

In the oasien environment, the activity is certainly diversified but still centered around the date palm, whose management requires tasks in keeping with the agricultural seasons, which in turn generates permanent and seasonal jobs through various maintenance work: irrigation, planting drainage, pollination, harvesting, packaging and marketing of national and international timber production. As the date is the basis of the Saharan economy, the oases live at the biological rhythm of the date palm. (LAKHDARI and al); (DOUMMANDJI-MITICHE B. et al., 1982), (DOUMMANDJI-MITICHE B. et al., 1995, IDDER M., 2011, CHOUHET Wesiba, 2013, DOUMMANDJI-MITICHE B. et al., 1997, HANNACHI, S., FARHI, 2014).

With its original concept based on an integrated management of space, natural resources, its own production and its derivatives, the oasis generates virtually no waste. Everything is used and / or recycled between the palm grove, livestock and habitat and / or flows outside the oasis through trade: it functions as a self-regulating system, while being very open to the world. Throughout its history, the oasis has capitalized a tangible and intangible heritage in terms of the specific know-how of arid and warm environments in all areas of human life (hydraulic, aridoculture, buildings, environment, crafts, culture, etc.). This makes it an unavoidable landmark in the Sahara, from which one can draw inspiration both in terms of development and scientific research. It all functions as an ecosystem in the biophysical sense of the term, but also as a social, economic and cultural organization.

1. LINKS WITH THE NATIONAL ECONOMIES: RURAL/URBAN AND TRADITIONAL/ MODERN SECTORS RELATIONSHIPS

Traditionally, oases have played an important role as commercial and administrative centres for nomadic populations, but increasingly this role is changing, as large-scale agricultural projects are seeking to maximize the agricultural potential of these environments (WILKINSON, 1978). Concerns remain, not only about the threat to

regional socio-economic functioning of oases, but also about the potential loss of germplasm (AL-IDRISSI et al., 1996) and other important ecological functions which these remote outposts of vegetation provide, particularly with regard to bird migrations (LAVEE et al., 1991; LIECHTI et al., 2003; SAFRIEL and LAVEE, 1991). Furthermore, Saharan oases have enabled trans-Saharan trade and travel throughout the intensifying aridity of the last 5,000 years (LIVERANI, 2000). Their loss would make the logistics of travel in the region much more problematic. Monitoring these oases presents a series of difficulties. Their remoteness within very large desert areas makes field-based monitoring unviable. Where they exist, data tend to be unreliable, and are often withheld because of their strategic sensitivity.

Formerly in North Africa, the Saharan oases were defined according to the traditional hydraulic system that guaranteed access to drinking water. Things have changed in many cases which have since undergone an important socio-spatial change marked by the existence of drilling and catchments. This change in the acquisition and distribution of water contributes to the remodeling of landscapes and the reconstruction of rural communities. Faced with this choice, the oasis ecosystem and the traditional intramural habitat are now giving way to concentrated urbanization and changes in the traditional agrarian structure. Thus, the traditional governance and customary law of the Saharan areas have been relayed by the national political and legal system. At the same time, the oasis economy was integrated into the national economy, losing its traditional value and function. In half a century, Saharan space and society have experienced as many mutations as during the previous ten centuries (CÔTE, 1988), (RICARD, 2005). Therefore, there are heavy agricultural holdings in the framework of the different programs of Saharan agriculture in Algeria, Tunisia and Libya.

Despite the attempts to modernize Saharan agriculture, many peasant communities cling firmly to their ancestral systems. In Touat for example, much of the agricultural practices are still based on legacy processes. Here, one hardly composes with modernity and nobody wants to question the ancestral systems, even if the experiments of capitalist agriculture have yielded more or less positive results. It deserves an objective analysis that will facilitate either the choice between modern and traditional tools or their more or less reasonable combination. (KERROUMI, Brahim).

In general, the agricultural transformation taking place in the Maghreb's oases is made up of several underlying trends: (1) persistence as well as (2) the decline of traditional oases; (3) 'vertical' intensification, modernisation and increasing motor pumping in traditional oases; (4) 'horizontal' intensification through new agricultural extensions in the desert, solely based on motor pumping; and (5) changes in animal husbandry, (6) general changes in cropping patterns.

1.1. ALGERIA: THE ISSUE OF FOOD SECURITY IN THE OASES

We can start reviewing the Algerian case by raising a problematic issue as an example: that of food security. For half a century, the Algerian Sahara has faced deep socio-spatial transformations. Changes affecting the original ecosystem had led to new ways of production as part of the national economy. It is important to describe the landscape of the oasis foggaras and to reveal by closely observing its traditional irrigation and small agricultural production system. In a second step, we will address new forms of Saharan agriculture that have been introduced as means of

modernization to contribute to the food security of the country. To this end, land reforms have been specially introduced to encourage Saharans to adapt themselves to newly developed methods and to move towards new production techniques and irrigation systems. It would be interesting to find out (1) to what extent the State managed to redesign space and society, and (2) to what degree these changes have affected the small scale food production and community-based modes of irrigation.

The foggara oases exist mainly in the western part of the Algerian Sahara, more precisely in the region of Touat limited to the east by the Great Western Erg and the rocky plateau of Tademait. The empty spaces of the Hammada of Tindouf and the Erg Chech delimit its western part. Between the two morphological ensembles, a long strip of palm groves is inserted. It borders several dozen oases over a distance of at least 600 km. This vast biophysical complex constitutes the Touat region or "the road of the palm trees". Touat is located in the wilaya of Adrar, 1600 km south-west of Algiers. With an area of 427,968 km², it represents 18% of the national territory. (CHEREF, Abdelkader, 2015, GUEDDOUH, Nadir, 2017).

A study undertaken to assess the situation of food security in the region of Ghardaia (southern Algeria), including coverage needs food products, has revealed that this region is characterized by an increased dependence on supplies, reflecting the vulnerability of the Sahara in southern Algeria. Several constraints may explain this situation: the low agricultural productivity, the failure of development programs, the harsh natural conditions, the water deficit and limited land resources (BESSAOU & MONTAIGNE, 2009). In fact, some regions are more disadvantaged than others in terms of productive resources. In this respect, the south, sometimes called the guarantor of national food security, as it covers vast tracts of land and it is full of ground water, is actually more vulnerable. Indeed, the Saharan climate is hostile land is mostly infertile, and often non-renewable water resources are costly to mobilize and sometimes even unfit for agricultural use (BOUAMMAR, 2010, MARD, 2013). Finally, groundwater is present in all the ancient oasis of Ghardaia and remains the main source of irrigation water, despite their limited capacity. Means of self-sufficiency obtained for the wilaya of Ghardaia, indicate overall low coverage needs through local production. There are deficits in agricultural crop and livestock production affecting all commodity groups except the production of dates, which is rather redundant.

Concerning the production of vegetables and fresh fruit, market gardening and orchards are intercropped with palm tree in the traditional farming systems (Bouammar, 2010). In intensive culture, they are also produced on independent plots. Culture provides fresh vegetables on average 88 % of the food needs of the local population. This is very important in terms of self-sufficiency rate. However, in terms of volume, market gardening offers greater production, estimated at about 65 000 tones against 52 000 t for dates in 2012 (MARD, 2013). A large number of farmers in the region do not know how to properly maintain their trees for lack of decisive productivity expertise, namely the size, health protection and fertilization of trees. The government has invested heavily in the expansion of fruit growing, but not enough in the extension of farmer learning the techniques of the basic production.

The study of the coverage of food needs of the population of Ghardaia, compared to local production, shows dependence and a need to resort to imports. Thus, with the exception of the production of dates, self-sufficiency ratios are lower than the

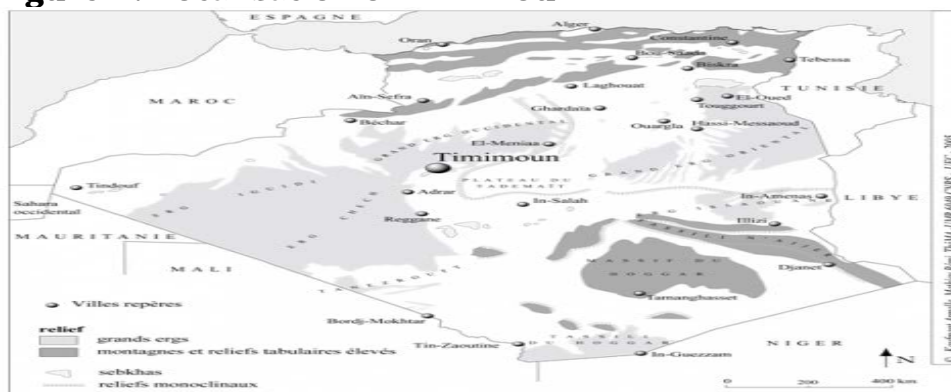
national average, especially for cereals, which represent the basis of the diet. This means that in Algeria, the Saharan regions are most vulnerable to food security. They are characterized by dependence compared to other regions. This state of increased dependence poses a serious problem of food insecurity, that can only be solved by an increase in local production. (OTMANE, Tayeb and KOUZMINE, Yaël, 2014).

1.2. ALGERIA: THE OASIS OF TIMIMOUN: MEASURING CHANGES IN THE OASIS ENVIRONMENT.

Timimoun, the Saharan oasis, the "capital" of the Gourara and town, a relay between the Touat and the M'Zab, has experienced remarkable population growth since 1954. This demographic boom has resulted in a large spatial spread. Growth was linked to the development of its equipment, the strengthening of its administrative status and its touristic role. Past and present changes in both agricultural and urban dynamics make Timimoun a relevant example of measuring changes in the oasis environment. A number of them are classical effects of urbanization and territorial integration in desert environments. The rural dominance of the oasis has gradually been reduced to the benefit of new economic activities. Economic diversification and induced new attractiveness have also played a full role in substantially modifying the social and spatial organization of the oasis. The palm grove, which still represents an essential component of the oasis visual identity of Timimoun, is increasingly suffering from the consequences of urbanization and the shortcomings of urban management.

1.2.1. The foundations of Timimoun oasis. Timimoun is the historical capital of the Gourara, located 200 km north-east of the city of Adrar. Timimoun has historically been a pole of animation of the surrounding oasis structured along the sebkha or located in the erg (Taghouzi and Tinerkouk). As in the rest of the northern Sahara, the primitive inhabitants of the oases of the Gourara were probably a black population, a Jewish population and an Arab populations, originating from Hilalian tribes, then other Arab components in the centuries that followed. Subsequently, and more recently, nomadic populations from the Oued Righ, the Chaamba country, the M'Gouden and the Algerian-Oranese steppe areas came to settle in the Gourara.

Figure 1 : Localisation of Timimoun



Timimoun was the most dynamic commercial center of the Gourara. The dates and market produce of the palm groves were exchanged for wheat, tea, sugar and butter. A slave trade prospered in the region. If the contribution of these populations to the local substrate must be put into perspective, for "whatever the atrocity and the extent of the land traffic through the channels of Mauritania, Touat or Fezzan, it must not be

forgotten that a large mass of black slaves merely transited through the oases to reach the towns and ports of the Maghreb.

In the early days of colonization, the merchandise trade was appropriated by the Chaanbi who followed the establishment of the French administration in the Sahara. The progressive settlements of nomadic and Chaanbi populations in the Gourara modified the social structure of Zenet dominance. Like the majority of the Saharan oases, human settlement in the Gourara has responded to two concomitant factors, the possibility of mobilizing water resources essential to agricultural practices on the one hand and the existence of networks of exchanges, on the other hand. In order to catch the water and irrigate the palm groves of Timimoun, 2,329 wells of varying depths were dug along with some fifty kilometers of galleries. It was below the M'Guiden, a reg, that the ksar of the oasis of Timimoun was implanted. In order to ensure a gravity flow of water from the foggara, the gardens were developed down the slopes at the edge of the sebkha, this factor having strongly conditioned eventually the evolution of the oasis. The titanic construction and maintenance work was made possible only through collective works (touiza), where labor investment was proportional to the volume of accessible water.

Beyond this historical image of the oasis, the social and political mutations profoundly changed the societal structures of the oases. At the same time, as the technical and economic context evolved, the traditional role of the oases of exchange and agro-system was undermined by the diversification of economic activities and the revival of oasis agriculture, by integration into the national territory and opening-up.

1.2.2. Demographic and employment trends: The population of Timimoun has increased sixfold over the past fifty years, rising from 3,000 in 1954 to 20,607 in 2008. The small Saharan village of the 1950s has become an urban agglomeration in its own right, following a widespread process in Sahara from the "shift from rural to urban". Nevertheless, over the past two decades, Timimoun has been experiencing the same demographic stability trends as other Algerian cities. The change in the employment structure of the municipality of Timimoun is also remarkable. The situation has been reversed in thirty years, from a very clear dominance of the agricultural sector to a marked dominance of the tertiary sector, that doubled over the same period. These changes are linked, on the one hand, to the strengthening of wage-earning in the administration, in trade and various tertiary activities and, on the other hand, to the crisis in oasis agriculture. The decline in the number of workers in agriculture continued during the 1987-1998 decade. Nevertheless, the tendency towards the tertiarization of economic activities is a general fact for the Algerian cities and in particular in the Sahara.

1.2.3. Administrative promotion and urban sprawl. The administrative promotion of Timimoun in the capital of Daïra in 1974 reinforced its role as an attractive and dynamic center. Administrative promotion has been accompanied by a substantial allocation of housing, school, sanitary and other facilities. The effect of this administrative promotion has resulted in a large demographic influx and a split spatial extension along the roads leading to Adrar, Béchar, El-Goléa or even connecting the ksour which surround the Sebkha. At the same time, the role of the administration has asserted itself over time by replacing the traditional local structure, the Djemâa, whose decision-making power in the management of public affairs has been gradually weakened.

Two main types of urban morphology characterize the town of Timimoun, the former form of habitat materialized by the ksar backed by the palm plantation. The urban extension that began during the colonial period was pursued after independence and reached the north-east, south-west and east. The creation of the colonial village with regard to the ksar was the first development of the agglomeration outside its historical enclosure. Nevertheless, the greater part of the urbanization visible today is due to the extensions realized between 1962 and 2006, to which are added the current urban development projects to the north-east and south-west. This more recent urbanization spread over about 600 hectares, is fourteen times the area of the only ksar, while the palm grove spread westwards, reaching the Sebkhha. The political and economic centrality has shifted from the ksar to the new extensions originally inhabited primarily by Chaanbi traders from Metlili. However, the ksar retains a social and economic vitality, as much as an important symbolic value.

Beyond the morphological break between the two urban complexes, it is the very structure of the habitat that has evolved, in the use of building materials, the composition of living spaces, which reflect a shift in rural life towards urban dwellings, or in household furnishings. The realization of electricity and drinking water networks necessitated redevelopment, as did the rehabilitation of certain internal roads in the ksar, which were paved in order to facilitate the circulation. The integration of elements of "modern comfort" clearly contributed to the retention of a part of the population within it.

1.2.4. A palm grove in jeopardy? The local people put in direct relation the drying up of the foggaras and the realization of the drilling. Of course, there is a correlation between the two phenomena, but the problem is also more global and complex. The pressure on the water is perpetual and the drawdown of the water table is further accentuated by the fact that it is currently being de-stocked. The possibilities for renewal exist, but remain very limited. Here urbanization, and the increase in the water consumption of the groundwater, has had considerable effects, both spatial and social. The natural demand for the water table has pushed the boundaries of the Timimoun gardens to the topographically lowest places, the salt areas (sebkha).

Unequal social stratification has prompted Harratines, who are not owners of water and land, to leave agricultural labor for the benefit of wage-earning services offered in the city of Timimoun, as well as outside, in the conurbations of the region (Béchar and Adrar), in the hydrocarbon cities (Ouargla-Hassi-Messaoud region or Hassi-R'Mel) or the northern coastal metropolises.

The town's drinking water needs have increased and their corollary, wastewater discharges. The effects of wastewater rejected daily in the Timimoun sebkha are felt on the palm grove. Intercropping has disappeared in the gardens that are in contact with salt areas. The system of complementation with palm, cereals and market gardening, often practiced by farmers, tends to be reduced to the sole cultivation of the palm. The hydraulic factor has not acted alone to bring about the disaffection of the peasantry, the very structure of landed property has also been a disadvantage for agriculture. The palm grove that meets the needs of a small population has become far too small. This has prompted farmers to seek additional jobs or incomes outside the agricultural sector. The process of cooperative work has almost disappeared in relation to the disintegration of traditional structures.

1.2.5. Conclusions. These various factors of evolution lead to ask many questions about: the modification of the social structures, the role and function of a threatened palm plantation, the urban economic setting, etc. The region has great potential for natural or human-made sites, for cultural and intangible heritage, for discovery tourism, for national and international valorisation, but also of quality infrastructures. The development of a more assertive tourism activity can constitute a path of reinforcement and diversification of employment, while allowing the elements of the oasis to be maintained. The second regional development track is linked to the hydrocarbon exploration systematized in the Gourara, as in the Touat. The discovery of gas resources in 2007 in the Timimoun basin has already an induced effect on employment and economic activity.

On a more general level, in half a century, Saharan space and society have experienced as many mutations as during the previous ten centuries (CÔTE, 1988). It is important to mention that the fragility of oasis ecosystems requires an urgent return to the rational use of water. Given the excessive exploitation of groundwater in the Sahara, the situation of water resources in the oases remains worrying. The alarm has been triggered since 1983, when groundwater transfer to Libya began (RICARD, 2005). In addition to this major operation, there are also heavy cuts in agricultural values under the various programs of Saharan agriculture in Algeria, Tunisia and Libya.

1.3. ALGERIA: THE CASE OF TOUAT: TOWARDS A COMBINATION OF TRADITION AND MODERNITY?

In the Touat, much of the agricultural practices are still based on legacy processes. Here, one hardly composes with modernity and nobody wants to question the ancestral systems. It deserves an objective analysis that will facilitate either the choice between modern and traditional tools or their more or less reasonable combination.

Figure 2 : Region of Touat, Algerian Sahara



Source : <http://eur.il.yimg.com/eur.yimg.com/i/fr/enc/jpeg/cartes/ac060f0.jpeg>

In Algeria, the country of the foggara or the region of the Touat was organized according to the production of water and irrigated agriculture. This organization and its importance are reflected in social, cultural and economic facts. The Algerians of this region attribute to the foggaras a sacred character comparable to that of the Koranic schools, the zaouias and the mosques (KASSAH, 1998).

On the level of traditional agricultural production, the oasis agrarian landscape is characterized by the ubiquity of the date palm and tiered crops, such as arboriculture, cereal farming, market gardening, and non-food plants such as tobacco, henna, etc. Cereal cultivation has long occupied an essential place in the oasis gardens of Touat. Oasis agriculture requires a permanent and sustained presence of the farmer in his garden. Agricultural activities take place between autumn and spring (GUILLERMOU, 1993). Families in search of more earnings then prefer to increase their irrigation. The complexity of the organization of the foggaras has social consequences that deserve mention. As the construction of foggaras requires considerable investment, it can only be realized by a gathering of small landowners. The Algerian Sahara due to the importance of its water and hydrocarbon resources is an important part of the national economy. The State, while implementing a set of economic and political-legal reforms, has encouraged a pragmatic combination of tradition and modernity.

1.4. EGYPT: SIWA: AN EXAMPLE OF INTEGRATION OF AN OASIS THROUGH SUSTAINABLE TOURISM

Siwa oasis in the northwestern desert of Egypt was recognized as a Globally Important Agricultural Heritage Site (GIAHS) under the respective FAO program. Siwa is a globally significant in situ repository of plant genetic resources, especially of uniquely adapted varieties of date palm, olive and secondary crops. Situated in a remote region of the Sahara, Siwa oasis is distinguished by a range of archaeological treasures going back to Pharaonic and Ptolemaic epochs. Its long isolation from outside influences, a population tracing its origin to Berber civilization and speaking an indigenous language, and environmental constraints have given Siwa a unique local culture embodied by its architecture, peculiar social institutions and a rich heritage of handicrafts. Challenges to oasis agriculture, biodiversity and cultural identity are effectively addressed by a number of national and local initiatives, including sustainable agricultural practices, improved irrigation management, protection of wildlife in and around the oasis as well as sustainable tourism.

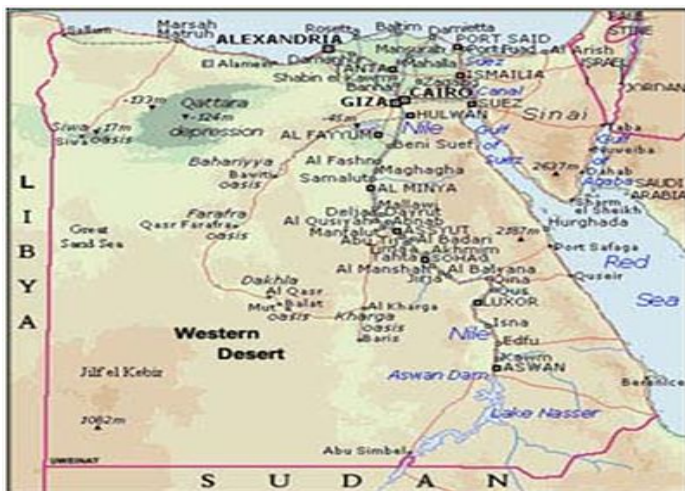
Aggressive advertising campaigns and renewed interest in cultural tourism raised a tourism boom in Egypt at the turn of the new millennium. Traditional tourism in Egypt continues to far outweigh sustainable tourism in terms of profits, (ZARACOSTAS, 2004). However, particularly following the recent civil unrest in the region, Egypt remains a nation reliant on tourism for its economic survival. Tourism in Egypt is estimated to account for 11% of the GDP. According to Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS), in 2010 the total number of tourist arrivals in Egypt was approximately 12.5 million (CAPMAS Annual Bulletin for Tourism Statistics in 2010). But, in 2011, the total number of tourist arrivals was approximately 9.8 million – 21% less tourists than the year before.

The Siwa Oasis, in Egypt's Western Desert, is a frontier region of Egypt which extends across the border into Libya and south to the Sudanese border. This desert region, which covers 7,000 square kilometers, is approximately two thirds of Egypt's land area. The primary governorates that are contained within the Western Desert include Marsa Matrouh (in the northern half of the desert) and Al Wadi al Jadid (the New Valley) to the South. Major geographical features include the Jilf al Kabir Plateau, the Great Sand Sea, and seven large depressions; of these, six are oases and the Qattara Depression, the largest, is a salty depression, covered in salt marshes and salt lakes.

There are permanent settlements in the oases, which sustain a limited amount of agricultural production. The Siwa Oasis is well known for the number and quality of its springs, and as such has been a destination for visitors from ancient times (BURMIL, 2003).

There are a number of oases within the Western Desert. These oases are Al Fayum, Bahariyah, Farafrah, Dakhla and Kharga. The Siwa Oasis is not the most popular of these oases due to its isolation and distance from major cities in Egypt such as Cairo and Alexandria. Only lately has Siwa been granted attention amongst Egyptians. There is an interest to develop Siwa as a sustainable tourism destination amidst concerns regarding the degradation of its integrity.

Figure 3: Egypt's Western Desert



Source: <http://www.centre4sinai.com.eg/westernDesert.htm>

Figure 4: Great Sand Sea, Oases of Western Desert, Egypt



Located in the Matrouh governorate, approximately 750 km from the capital, Cairo, the 1,125 km² Siwa Oasis is well known for its lush palm and olive trees and natural springs. It is said to host 300,000 date trees, 70,000 olive trees and 1,000 natural springs. However, it is considered fairly new to most people, as its indigenous people had been isolated from the world until the Egyptian government built a paved road in the early 80s connecting the remote oasis to civilization. There are now paved roads in Siwa allowing better accessibility to various tourist attractions.

Figure 5: Map of Siwa Oasis.



Source: Case studies in Egypt: Marsa Matrouh, Al Alamein, Siwa Oasis (Matrouh Governorate). Rady, 2011.

Given the recent developments, including better accessibility, there seems to be an increasing interest in Siwa as a tourism destination in Egypt. Despite this positive factor, it is also important to note that there may be negative impacts on Siwa, should tourism practices follow suit those of other tourism destinations in Egypt.

Concerning economic and environmental sustainability, despite Egypt's efforts to implement the CBD's Guidelines on Biodiversity and Tourism Development, it is clear that its implementation of the CBD guidelines is unmethodical, due to the lack of financial and human resources, the lack of technical expertise and many other factors. The only sustainable tourism strategy developed for Siwa largely focused on the management, promotion and conservation of Siwa's protected area. Siwa displays some forms of sustainable tourism, with economic sustainability practices. This is in large part due to the town's isolation and the necessity to sustain itself, rather than trying to reach the goal of sustainable tourism, which is to foster a mutually beneficial relationship between the tourism industry and the local community.

However, sustainability seems to be a growing trend in Siwa. This is due to some private businesses in town with sustainability on their agendas, interventions and projects launched by NGOs, as well as the perceptions of Siwa (sustainability, nature tourism, etc.) which visitors share with locals. There are no indications that the government is keen on taking concrete steps to ensure that Siwa does not follow other tourism destinations that are now considered damaged because of conventional tourism practices.

1.5. LIBYA: AGRICULTURAL SYSTEMS IN THE LIBYAN FAZZĀN

The agricultural systems employed in the Libyan Fazzān can be classified into two types: the traditional garden systems and the modern large-scale agricultural system. Irrigated agriculture in the area dates back to prehistory, when thousands of foggara, known elsewhere in the Middle East as qanats, were excavated along the Wadi al

Hayat, (MATTINGLY et al., 2003). The traditional oasis gardens comprise a multi-storey vegetation canopy. The first species to be established is the date palm, which forms the upper layer of the canopy and provides the shelter required for the lower storey crops. The double cropping system adopted throughout the region is recorded by a double peak, the larger peak is the winter crop, but the summer peak is easily identified too, both for the traditional garden (Wadi al Hayat) and agricultural project oases (Wadi Irawan, Wadi Burjuj, Maknusa). There are several possible explanations for this pattern. It may indicate a decline in groundwater availability. However, this trend could also result from socio-economic factors.

Economic sanctions have been imposed on Libya for most of the study period, limiting access to spare parts and expert technology (RODMAN, 1995). The reasons for this are uncertain; one possibility is that pumping rates are more in equilibrium with the hydraulic conductivity of the aquifer, but as outlined above, many other factors, apart from groundwater availability, control agricultural productivity of these oases. A pattern of declining productivity since 1997 is evident in three oases, but one oasis shows lower inter-annual variability. Continued monitoring of these environments is essential to examine the impacts of large scale exploitation of Saharan aquifers.

1.6. MAURITANIA: THE OASES AMIDST SYSTEMIC CHANGES AFTER INDEPENDANCE

Mauritania's rural society has long been characterized by a sharp opposition between nomadic herders and sedentary farmers, which correspond to an ethnic distinction: Moors on one side, Soninkés, Halpularen and Wolofs on the other. This distinction refers to differences in ethnicity, social status, lifestyle, etc. that remained remarkably stable during the colonial period, and even until the early 1970s. This stability of the rural world is also the result of a political choice made in the decade following Independence.

The development projects of the last decade concerned sectors other than irrigated agriculture. One of the most important is the OASIS project (1986-1992). Its importance is due less to its economic contribution than to the place held by the palm groves in areas particularly difficult and threatened with depopulation. The continuous expansion of the Moorish palm grove, which began in the mid-19th century and continued under colonization, suddenly stopped in the late 1950s. The main reason for this is the exodus of slave labor. The owners' response has been to use motor-pumps to simplify the watering operation. This use resulted in a rapid depletion of the aquifers exploited more and more deeply, the palm grove then requiring a constant irrigation, or even disappeared. In fact, the OASIS project, probably under the pressure of the owners, has pursued this policy leading to the degradation of natural resources: between 1983 and 1992, the number of motor pumps increased from 800 to 2,549 in Adrar, from 40 to 386 in the Tagant And from 50 to 216 in Assaba. Date production continues to declined.

However, changes are taking place in the rural sector, which foreshadow social and cultural developments. Livestock and agriculture have so far represented a way of life associated with a social structure, tribal in the first case, lineage and village in the second case, and a strong social stratification. There is currently a sectorialization of these activities, as part of the national economy, due to several factors:

- As a result of the rural exodus, the number of people in the rural sector has not really increased.
- The stability of rural production, in spite of the degradation of resources, masks in fact the consequent structural changes.
- Capital investment has grown considerably; there is a trend of private investment in the irrigated sector.

The sectorialization of rural production activities is therefore to be part in the context of a market economy characterized by the gradual establishment of a national market. The Mauritanian society, known since the pre-colonial period by the importance of commercial activities, was particularly prepared for this development: traditional caravan exchanges with the emergence of the shopkeeper trade in the years 1930-1940, then with the constitution of the sharikas, trading companies after Independence, and the reappropriation of the banking and financial sector by nationals which accompanies the creation of a National currency in 1973. The Moorish diaspora in neighboring countries, benefiting from commercial activities, has contributed to these developments. Growing urbanization, the development of the national road network and the closure of borders after the 1989 events 1989 have reinforced them.

The land issue arises with increasing acuity: the land system translates the territorial and spatial inscription of social relations. The new legislative framework defined in 1983 emphasizes the private ownership of land, essentially conceived in the context of agricultural production. Abolishing the "traditional" rights of a collective nature, tribal or lineage rights, it defined two regimes of land ownership: private property, and State property. The relationship between the formal abolition of slavery in 1981 and the land law of 1983 was often justified. This law has also favored the movement of ownership of irrigated land by private investors. In this context, social, political and economic power relations have emerged: private investors in the agricultural sector have benefited from the support of the administration.. In many cases, the traditional agricultural communities of the Valley have given up their rights for financial compensation to the new representatives of 'agro-business'. However, the land issue remains at the heart of current political developments. (BONTE, Pierre).

Continuing support is needed in order to strengthen the ability of the AGPOs and reinforce their structure. One of the most crucial postclosure issues of OSDP concerns the need to rationalize the management of scarce water resources in the oases.. It was recommended that the financing of pumping systems by FADES be made subject to the prior conduct of an in-depth study of their foreseeable impact on the available underground resources. It is necessary to introduce local cost-sharing mechanisms that are equitable and able to cover the foreseeable costs of proper maintenance, repairs and equipment replacement. The MICOs are already playing a crucial role as stimulators of agricultural and other economic and financial activities. IFAD and the Government should take the opportunity offered by the new COSOP to envisage support for the drafting of a strategy aimed at promoting access by rural dwellers to financial services.

1.7. MOROCCO: TRENDS OF OASIAN TRANSFORMATION IN A CHANGING POLITICAL AND ECONOMIC CONTEXT

In Morocco, there are 11 provinces producing dates (Figuig, Errachidia, Ouarzazate, Tata, Tiznit, Guelmim, Tan Tan, Laayoune, Smara, Boujdour and Oued Ed-Dahab,

located in the South and Southeast of the country, representing two-thirds of the national territory. They are limited to the north by the chain of the High Atlas, to the east by the Moroccan-Algerian border, to the south by the Moroccan-Mauritanian border and west by the Atlantic Ocean. The major ones are the oasis of Tafilalet (Errachidia) and of the Draa Valley. Draa valley is a rural area characterized by an oasian agriculture, this oasis has been declared as «Biosphere Reserve» by UNESCO, covering an approximate area of 7.2 million ha over the provinces of Errachidia, Ouarzazate, and Zagora. Middle Draa valley oases occupy about 27,000 ha in six palm groves characterized by a vegetation management in stratum dominated by the date palm that promotes micro-hot and humid climate conducive to diversified agricultural production. This canopy provides protection against the arid climate for the lower levels of fruit, tree crops such as henna, grenadiers, gardening, and livestock fodder. "The local economy is dominated more than 70% by extensive agriculture and pastoralism, but these activities are inefficient and do not always meet the daily needs of the population.

1. In several of the oases under scrutiny, traditional forms of agriculture are more or less continuing, demonstrating the high persistence of oasis systems (BENCHERIFA & POPP, 1990). Traditional agriculture is particularly persistent where surface waters are relatively abundant year-round. The persistence of largely traditional forms of oasis agriculture is the general pattern in the upstream parts of most river oases and water-rich spring oases (BENCHERIFA, 1991, 1993; DE HAAS, 1999), which are particularly numerous in Morocco (Ziz, Drâa, Dadès, Todgha).

In these oases, agricultural change remains mostly limited to changing cropping patterns, particularly as witnessed by the increasing importance of fodder crops, such as alfalfa, and certain fruit trees, and the decreasing importance of cereals. In most traditional oases, agricultural innovation and the mechanisation of agriculture is hampered by the high complexity of ancient and collective agricultural structures, extremely small plot sizes and their dispersion. The continuity of agriculture is often guaranteed by a new agricultural division of labour in which female labour is becoming increasingly important. Since able-bodied men are often absent or have other local occupations outside agriculture, gender roles in agriculture are changing.

2. This reflects a general pattern in certain water-scarce oases of the Maghreb where limited natural water resources can only be exploited by utilising labor-intensive water extraction techniques. This is particularly the case for traditional khettara systems in Algeria and Morocco. The fact that traditional social organization has been undermined partly explains why most traditional khettara systems are now breaking down today (DUBOST & MOGUEDET 1998; DE HAAS & EL GHANJOU, 2000). Traditional oasis systems were based on the mobilisation of cheap labour which was possible through the existence of rigid socio-ethnic hierarchies.

Moreover, the high complexity of land tenure and irrigation systems constitute a major obstacle for agricultural development. The increasing importance of non-agricultural sources of (cash) income, the integration into the market economy, the decline of the feudal socio-ethnic relations and rising individualism have all at least partly eroded communal land and water management. The incongruity between the 'inherited' physical structures and institutions on the one hand, and the fundamentally altered socio-economic structures on the other, remains important.

Therefore, oasis agriculture seems to be seriously threatened by marginalization. The opening up of arid regions and increased mobility have provoked mass emigration to the urban areas and to Europe. Nowadays, migrants' remittances constitute the most important revenue for the oases. Presently, agriculture only provides supplementary revenue and is often subject of strong aversion. Land use has become more extensive; in some cases, fields are even entirely abandoned. The individualisation process has undermined collective soil and water conservation measures. The general neglect may lead to the breakdown of the agricultural infrastructure. Nevertheless, under particular circumstances money has been invested in the development of 'modern' irrigated agriculture. The collective maintenance of irrigation systems is labor intensive, and generally requires a high degree of central political organisation at the community level. A strong ethnic hierarchy was fundamental to the functioning of this system.

However, due to the recent socio-economic and political changes, and in particular migration, this traditional oasis agriculture seems to be seriously threatened. Rural areas in the Maghreb are generally characterised by mass migration to the urban centres and to Europe. Recent studies revealed that migration is generally strongest in the regions that are the most disadvantaged in terms of ecological conditions, such as aridity (BENCHERIFA, 1991). Migration has led to a rapid increase of the importance of non-agricultural revenues. Furthermore, due to the collapse of ancient caravan trade, the decline of nomadism, the formation of state-borders, and political and economic integration in the 'modern' national and international context, oasis agriculture has now been economically marginalised. For the oasis inhabitants, migration has created the possibility to gain a higher income outside agriculture, which has 'liberated' them from their former absolute dependence on this sector. Finally, migration provided a means to literally escape from the strong ethnic hierarchy. Nowadays, migrants' remittances constitute the most important revenue for most oasis households. These processes appear to have provoked a rapid decline of traditional, intensive oasis agriculture (BENCHERIFA, 1991).

Paradoxically, one often simultaneously perceives an increasing overexploitation of the natural resources (FASSI, 1982, SKOURI; 1990). In the Moroccan context, climatological determinism is still very dominant among government officials and other policy makers, who are declaring 'war' on desertification (LARBI, 1989, RAFII, 1993). Especially, the term 'aridity' has become symbolic of their narratives, employed to explain and depolitize almost any agricultural problem in Morocco. (DE HAAS, Hein, 1998).

1.8. MOROCCO: THE CASE OF FIGUIG: FIGHTING ISOLATION

Figuig is an oasis in extrem eastern Morocco, surrounded by the Algerian border. It is geographically isolated. Since 1994, it is also economically and politically isolated and kept out of national development programs. If this isolation did not favor the economic activity of the oasis, it had the effect of keeping it away from the driving influences of modernization, as has been the case in other pre-Saharan oases (SANMARTIN, 2011). At present, the oasis consists of an urban core of seven ksour built from earth. It is located on two levels, separated by the jorf (escarpment comparable to a cliff). The upper part contains six ksour; the lower part, the plain, is occupied by the Zenaga ksar and by the greater part of the palm plantations.

The ksour designates the human communities that are specific to them. They are distinct communities that have long been organized independently. Each ksar has its own palm grove, springs, channels and basins. The ksour are thus independent from a hydraulic point of view, each managing and controlling its sources and its irrigation networks. The strategic position of Figuig at the gates of the desert allowed it to play, throughout its history, a role of relay on the axes of the trans-Saharan caravan trade. Thus, the cultural and economic influence of the oasis far exceeded the regional scale (MADANI, 2006). The oasis that has retained its architectural originality, the landscape of the palm grove, its cultural, religious and social traditions (GILLOT et al., 2011, BATTESTI, 2005). Figuig benefits from important water resources, thanks to about twenty sources. (BENCHERIF and POPP, 1992). This system of irrigation of the palm plantation constitutes another material element of the patrimony of the oasis and corresponds to traditional practices and know-how.

In 2008, the city had 12,613 inhabitants, it has been relatively stagnant since the beginning of the 20th century (SANMARTIN, 2011) . This stagnation is partly due to large migratory movements. Emigration has always been a structural component of oasis demography in general and Figuig in particular. The 1960s marked the beginning of the massive emigration from Figuig, which was part of the wider context of post-colonial emigration, due to economic and socio-political reasons. This emigration induced economic and cultural effects on the oasis.

From the economic point of view, this emigration induces financial flows (transfers, pensions) which place Figuig at the center of its globalized diaspora. Most of the capital circulating in the oasis comes from abroad. These financial transfers can take the form of investments for the maintenance and development of gardens of the palm plantation or the renovation of the traditional building, but also rent for the members of their families left in Figuig. The economy of the oasis is now completely dependent on the remittances of emigrants. This situation is not guaranteed in the long term, as transfers are likely to decrease or cease with the decrease in emigration to Europe and the lesser investment of generations born outside the oasis. But this emigration has also negative effects; in addition to reducing labor, it has led to a decreased interest in agriculture, and to the use of salaried labor in the palm grove.

Figuig has developed many interactions with the outside world. In order to break its isolation, which has aggravated the socio-economic situation of the oasis, and thanks to Figuig diaspora, the municipality has entered into diverse cooperation agreements with various international partners (Spanish and Italian NGOs, University of Seine-St. Denis, etc.). Integration of the oasis into global networks has been a true strategy in various fields (local governance, sanitation, architectural restoration, etc.), to help it obtain expertise to carry out its development policy. Cultural interactions are not just the result of the emigrant diaspora. For the sake of development, the municipality has also begun organizing numerous festivals to allow new sources of income for the local population and to value the oasis.

Aspirations to the economic development of the city have led it to open up to the logics of a globalized economy. These aspirations are illustrated by the steps taken by the Municipality to obtain the international label PGI (Protected Geographical Indicator). This label represents an opportunity to promote the marketing of Figuig dates on the international market (JANTY, Gwenaëlle).

1.9. MOROCCO: THE CASE OF THE MIDDLE DRAA VALLEY

Located in pre-Saharan regions, the oases suffer from severe aridity and scarcity of water resources. The largest part of surface water comes from the High Atlas Mountains, while the use of groundwater resources is provided by digging wells. The ancestral populations have shown a major form of adaptation to aridity constraints through the development of knowledge and heuristic expertise on a traditional water supply system called 'Khattara'. In 1888, Charles De Foucauld reported that the Draa region was very rich in terms of water resources and biomass.

Agriculture and farming are the main economic activities in the area. Agricultural development might provide economic development and food security, thanks to date palm, used as food for humans and even livestock. In fact, it is the main source of income for the community oasis, as a finished product and as a series of byproducts. In the last decade; 93% of Moroccan territory was affected by desertification, and the province of Zagora (Middle Draa Valley) was considered among the most barren of the country. The problem of silting became threatening from the 1970s, threatening homes, farmland, irrigation canals and road infrastructure in the palm grove. Advancing sands constitute also a real threat for the poor rural population.

The oasis areas have suffered strong genetic erosion due to the introduction of new varieties. Some local varieties may disappear completely in a few years if they are not carefully collected and stored. To genetic erosion is added the introduction and expansion of unsustainable cultures, especially like watermelon. Cultivation of henna or watermelon in the dry season seems absurd and unsustainable. Pumps spit huge amounts of water to irrigate the crops at this time, knowing that the groundwater level continues to decline. Farmers switch to more profitable crops but this practice is harmful in the long run, especially the cultivation of watermelons which exacerbates the demand for water. .

Table 1: The impact of drought on potential resources: the surface water resources.

	Average Year		Dry Year	
	Mm ³	%	Mm ³	%
Potential resources				
Surface water resources (Draa and tributaries)	225	85	102	56
Extracted groundwater resources	40	15	80	44
Total exploited resources	265	100	230	100

The impact on water resources is seen especially on yield. In fact, on average, palm trees can yield 18 kg of dates per tree in the southern regions of Morocco. Production strategies are strongly related to climatic conditions. Water stress caused by drought and salinity is the most important abiotic factor limiting plant growth and crop productivity in arid lands. Regarding the livestock, it is not only a source of income, but also plays a role in food supply. A high number of cattle, sheep, and goats assure meat consumption for a large part of the local population. There is evidence that intensively managed livestock systems are potentially more adaptable to climate change than crop systems, because they adapt better to extreme conditions. The

combined actions of these factors have gradually degraded the oasis, and have made it reliant on financial transfers by migrants. The environmental vulnerability has radically changed the socio-economic situation. Table 3 shows that farmers recorded a margin negative due to high amount of costs.

Table 2: Gross margin of wheat per ha in the Draa valley in 2005. (HEIDECKE, 2013).

Charges	Total costs from survey dh/ha	Total costs US \$/ha
Total costs	7123	854,76
Total revenues	3472	416,64
Gross margin	-3651	-438,12

Moreover, tourism is a growing but limited sector. A declining agriculture and an almost absent industry can hardly offer jobs for an increasing population. These problems drive people to leave their areas for migrating. In fact, 65% of households in the Middle Draa valley depend on remittances from migrants. Oases communities are geographically at the periphery, often living in remote and isolated areas on ecologically fragile lands, increasing their vulnerability to climatic events.

Table 3: The social aspects of Middle Draa Valley.

	Urban area	Rural area
Population	42 802	240 566
Illiteracy	34.75%	55%
Rate of access to drinking water	86%	63%
Poverty rate	12.75%	37.64%

All these factors contribute to accelerate poverty in rural areas and the reliance of the poorest on fragile ecosystems. Traditional oasis is less and less productive and modern plantations are often based on farming systems that are fragile and present a high economic and ecological risk. In the recommendation part of this study, we will raise the question of alternative strategies to improve participatory irrigation management. Oases are a model for efficient resource-management for the whole planet; they can become a new model for development and economy through the actions undertaken to safeguard and value them.

Agriculture in the Draa region is mostly for subsistence and local consumption; marketable products play a minor role. One exception is the production of dates, which generates additional income. Agricultural activity is an essential source of life for the majority of the population. Nowadays, traditional agriculture has become almost totally incompatible with modernization lifestyle. This makes the region very vulnerable and adaptation is related to water management (KARMAOUI, Ahmed).

1.10. TUNISIA: A HIGHLY DIFFERENTIATED TRANSFORMATION OF OASES

The abovementioned trends seem to take place at the same time but to different degrees in different places. The decline of traditional forms of agriculture may operate simultaneously with the rise of relatively 'modern' forms of agriculture, and both processes tend to reinforce each other (DUBOST & MOGUEDET, 1998). Both processes (i.e. the decline of traditional agriculture and the rise of pumping) can operate at the same location (i.e. transformation of the ancient oases) or in different places (extensions outside the traditional oases, decline of traditional oasis). Nevertheless, a strong decline of traditional agriculture is not necessarily accompanied by the rise of new forms of agriculture. Similarly, the persistence of traditional forms of agriculture can coincide with a rise of motor pump-based agriculture in deserts surrounding the ancient oasis. In most oases, 'modernisation' is a slow or only a partial process. One of the first signs of such a transformation is the introduction of motor pumps, often followed by the gradual introduction of fertilisers, pesticides, new crop varieties, changing horticultural and irrigation techniques as well as cropping patterns. Although these changes are taking place rather slowly and are even absent in some oases, an increasing number of peasants are producing specifically for markets. In Morocco, oasis agriculture still has a far more traditional character and tends to be less capital-intensive than in Tunisia.

In Tunisia, studies concluded to the worst problems of agricultural decline and land degradation. In general, oasis agriculture has proven to be persistent. It is clear that oasis agriculture in the Maghreb is not disappearing but undergoing a gradual, though highly differentiated, transformation. Although several oases are suffering from serious water scarcity due to the demise of traditional irrigation system, oases are generally more intensively cultivated than half a century ago, and the total irrigated surface has been extended significantly over the same period. (BENCHERIFA and POPP, 1990)

2. INCLUSION/EXCLUSION AND OPPORTUNITIES/ THREATS IN THE GLOBALIZING PROCESS

2.1. MOROCCO: THE COMPLEXITY OF CHALLENGES FACING THE MOROCCAN OASIAN SYSTEM

A brief overview of the twentieth-century meteorological data shows that droughts in Morocco have gradually become longer and more insistent (BAHHOU, A., 2002). The effects can be varied and are perceived to be an additional cause of degradation. They derive from the fact that northern Saharan margins have been naturally and continually fluctuating. Alternative and repetitive quaternary climatic variants have sometimes allowed the incursion of the Saharan breath into the Gharb or the Saïs, sometimes the transgression of Mediterranean biotic elements into the central Saharan massifs such as the Hoggar (FASSI, D., 1999).

The regional population has acquired over the ages such a mastery of this difficult natural environment, that it has succeeded in developing a true Saharan civilization in balance with the inadequacy of natural resources. The oasis of Morocco thus holds its exceptional value: the great duration of its close relations with the great Sahara, allowing the maturation of links and complementarities. But, it took no more than a few decades for the bankruptcy of the whole economic, social and environmental system to become general. Today, the most sophisticated landowners are beginning to abandon their unconditional admiration of the oasis world of yesterday, and to be

won over by the despair of ever seeing the oases recover from what appears to be an irreversible structural decay.

Indeed, the introduction of economic models based on abundance condemns these regions to progressive environmental bankruptcy. Innovative and clear substitution strategies are difficult to conceive and to implement. The problem of oasis space in Morocco or Egypt concerns more than half of the national territory, and can only be at the center of concerns. However, regardless of the abundance of resources, one should worry about the fate of the whole world when one realizes that while the general population has multiplied by three, water demand has multiplied by six! The current trend indicates that by 2025, two-thirds of humanity is expected to experience some water shortage, varying from severe to moderate (ERDELEN W.R. and DALEY R.J., 2006). The problem is no longer that of a relegated minority, but that of a destiny feared by all.

After considering for obvious commercial reasons that there were universal technological remedies for the problems of the world without any regional distinction, we are now rediscovering that the spatial specificities and the diversity of cultures are to be taken into consideration in the decision-making process. The creation of a National Agency of Oases was a strong signal for a serious grasp of the destinies of the oasis world. Its mission is to put into practice an appropriate policy and a reference management plan. (CHAHHOU, D., 2009).

2.2. TUNISIA: OASIAN SOCIO-ECONOMIC CHALLENGES

In Tunisia, the sustainability of oases is confronted with socio-economic challenges of various kinds:

- The fragmentation and co-ownership of plots limit their intensification and in some cases encourage abandonment. Abandonment is sometimes wanted to subsequently use the land for construction. Attachment to property does not favor sales and re-parcelling of plots. Absenteeism from homeowners in other parts of the country also favors abandonment.
- The oases lack labor. Employment in the oasis is seasonal, low-paid and socially considered devaluating. Operators are mainly part-time workers. In Djerid, the number of sharecroppers (Khemmas) regresses and ages.
- There are uncertainties about the future of the date sector. The employed workers with little experience and little motivation, provide little maintenance to the palm and crops and this affects the pollination operation and the quality of the dates. (The osases of Tunisia, Avril 2012).

2.3. TUNISIA: THE CASE OF NEFTA AND THE DECLINE OF TRADITION

Located in south-western Tunisia, in the governorate of Tozeur and 36 kilometers from the Algerian borders, the city of Nefta was characterized by an architectural and agricultural know-how inherited for generations. Throughout its history, the city has enjoyed long periods of prosperity, and has been an important point at the crossroads for various trade exchanges. The city, where a multitude of scholars lived, was also known as a center for sharing knowledge. Oasis agriculture was the main economic activity of Nefta, playing an important role in the hierarchy of social classes between notables (Mallak) and workers (Khammas). Historically, it has been in continuity

with its oasis and local environment. The traditional city has always respected the different principles of sustainable development both on urban and architectural scale.

Affected by globalization, the city has undergone important changes at the social and urban levels. The different urban extensions have thus been accompanied by changes in architectural forms as well as in materials and building techniques. The old town is in continuity with the oasis at the urban and the architectural scale with all the relevant details. However, the relationship between the current architecture and the oasis tends to reach an end. In fact, the oasis does not play anymore a decisive role neither at the level of the urban organization of the city nor on the scale of new housing. Indeed, the traditional dwelling area is located near the oasis; the new one is situated in a remote area. Traditional houses were built with traditional materials and know-how, while the new buildings are made with industrial materials used in most regions in Tunisia. This new architecture reflects a better balance between the city and its environment. The current city having adopted or experienced the new world models and standards, is beginning to lose the social and architectural features that have been a landmark of its history. (GUEDRIA, Asma, DRISS, Houda, KHARRAT, Fakher, 2013).

3. THE ISSUE OF OASES SUSTAINABILITY

Sustainability means meeting certain needs without compromising the ability of future generations to meet their own needs. In addition to natural resources, people also need social and economic resources. Sustainability is not just environmentalism. In most definitions of sustainability we also find concerns for social equity and economic development. The concept of sustainability is a relatively new and the movement has roots in social justice, conservationism, internationalism and other considerations that came together in the past decades to call for 'sustainable development.'

3.1. ALGERIA: THE PASSAGE TO MODERN AGRICULTURE AND THE DECLINE OF SMALL OASIAN PRODUCTION

In the post-independence era, Algeria has completely changed its vocation. Algeria underwent two major phases of agrarian reform. The first phase corresponds to that of Algerian socialism relayed by a second phase of capitalist economy. In the early 1970s, the Algerian State decided to direct part of the efforts to develop the Sahara to the peasantry. This decision was followed by a diversification of investments that affected the oases and their proximity. Uniformity aimed to satisfy a greater number of farmers. The State took charge of the viability of agricultural land, delimited the plots, installed windbreaks and also planted palm trees. It was up to farmers to collectively manage water resources through existing foggaras and new wells operated with motor pumps. From the early 1980s onwards, the development of new lands increasingly distant from oases began to appear. This choice fell within the framework of the 1983 law named AAPO (Access to Agricultural Property Ownership, or APFA, Accès à la Propriété Foncière Agricole).

The State was responsible for major infrastructures (roads, electricity, drillings). It therefore prepared the conditions for the development of parcels intended for farming. Often coming from the big cities of the north, investors seized this opportunity and created farms of several tens of hectares. They financed deep drilling and engaged in specialized agriculture, including irrigated cereal crops. These

investors equipped their plots, installed pivots for cereal farming and plastic greenhouses for market gardening (CÔTE, 2002). The Algerian State has based its southern development policy on the potential of its subsoil. However, small oasis production is still present, but severely challenged by the introduction of new production methods that help modernize agriculture. It has integrated the different circuits of the market and has adopted the logic of profitability and economic rationality that gradually takes it out of the small oasis production and its traditional irrigation system. It is important to note that some developments have succeeded in combining the satisfaction of the oasis farmers with the satisfaction of the public authorities. This new dynamism of the oasis agriculture has certainly generated great changes to which the peasants have adhered. The participation of oases in state-induced changes is reflected in the participatory management model, which is based on a strong involvement of the population in the various development projects (ZEGHICHE, 2005, KERROUMI, Brahim).

3.2. EGYPT: OASES DEVELOPMENT THROUGH ECOTOURISM

Sustainability has become an important concept for tourism development all over the world. As an example, Egypt has witnessed a severe reduction in the flow of tourists after the revolutionary wave of the Arab Spring. Nowadays, the country is taking several steps to diversify its tourism product. Beside its traditional tourism products, Egypt is developing new products in order to enrich the tourism industry, such as ecotourism in desert areas. One of these places is AlFayoum, a beautiful oasis that is endowed with rich natural and cultural heritage. However, the vast potentials it holds has not yet transformed into economic value. Therefore, it is necessary to identify the problems that hinder its development and to understand how sustainability can be applied and managed efficiently to deal with the challenges of integration into the global market economy.

Ecotourism has become an important economic activity in natural areas around the world. It has the potential of yielding enriched travel experiences and generating enormous revenues. (DRUM et al.). At the same time, ecotourism generates income for conservation programs and economic benefits for communities living in rural and remote areas. However, planning for ecotourism is relatively a difficult task. This is due to several factors:

- The complex and unbalanced relationship between tourism and the environment. (WONG).
- The multidisciplinary nature of sustainable development in general and ecotourism in particular. (ARONSSON).
- The diversity of stakeholders involved in planning and managing ecotourism. The most influential stakeholders in tourism are : government, private sector organizations, tourists, competitors, employees and other suppliers (ALVAREZ et al., RAMZY, Y. H.)

Egypt, being rich with its natural resources and archaeological sites, has a great potential for ecotourism. Egypt's interest in sustainable tourism development is essential because the country is quickly learning the need for balancing between environment and development, amid concerns that tourism is stressing the country's fragile ecosystem. Unregulated tourism is usually unfriendly towards the natural environment because with an excessive intensity and pace, it consumes especially nonrenewable resources. (SKOV, P.), (ANTOUSKOVA et al.).

In Egypt, sustainable tourism refers to projects and initiatives operated by private business, organizations and government bodies. The Egyptian government is starting to take actions towards sustainability efforts. Government supervision is essential in this case because the private sector cannot be relied on due to its profit oriented activity. Additionally, the ministry of tourism has taken serious actions by establishing a department inside it to promote ecotourism and sustainable development in 2011. Ecotourism in Egypt is concentrated mainly in three areas. These are the eastern desert, the protected areas of the western deserts and the oasis and finally the Sinai desert. Many oases were chosen by researchers for their biodiversity. We will focus here on the case of AlFayoum oasis because it is the largest oasis in Egypt and because of its undevelopment.

3.3. EGYPT: ALFAYOUM OASIS: A POTENTIAL ECOTOURISM DESTINATION

AlFayoum is located in the heart of Egypt, between the Nile Delta and Upper Egypt. It is located in the north of Western Desert and 90 kilometres southwest of Cairo. AlFayoum benefits from its proximity to Cairo and is accessible through several highways. AlFayoum occupies a significant place in the history of Egypt. From prehistory up until modern times, AlFayoum has attracted the attention of dynasties, rulers and invaders, historians and explorers, researchers and archaeologists (SANTAGATA et al.). AlFayoum is blessed with natural and cultural endowments. It is considered one of the most important tourist areas as it comprises tourism attraction elements, the most significant of which is the meeting between the three agricultural, coastal and desert environments. Archaeological monuments are abundant. Lakes, fossils, desert, fertile land, a unique flora and fauna, and water management system through a historical network of canals together with its distinctive human cultures give AlFayoum a high cultural value.

However, this vast potential has not yet been transformed into economic value. Although the diversity of Al Fayoum's ecosystem provides a huge potential for combining different types of tourism products in the same area, being a magnificent blend of desert, green oasis and lakes. Furthermore, one of the unique sites in AlFayoum oasis, "Wadi El Hitan" (Whale Valley) has been declared by the UNESCO as a world heritage site in 2005 (ERAQI), (RAMZY, Y. H.).

3.4. EGYPT: ACHIEVING SUSTAINABILITY THROUGH THE SIWA OASIS PROJECT

As an example of achieving sustainability, we will take the example of the Siwa Oasis Project (SOP). This project is part and parcel of the wider Egyptian-Italian Environmental Program, referred to as the Egyptian Italian Environmental Cooperation Program (EIECP), which is being carried out within the framework of donor initiatives aimed at assisting the country in the implementation of the National Environmental Action Plan (NEAP). The national institution responsible for the whole Program is the Egyptian Environmental Affairs Agency (EEAA), under the Ministry of Environment.

Siwa is probably the last refuge in Egypt for several highly endangered mammal species. Eleven traditional tribes live in the region totalling some 20,000 people. The communities in Siwa needed support to deal with socio-economic and environmental problems. Major issues were the introduction and diffusion of sustainable

agricultural practices, the improvement of participatory processes, the strengthening of the capacity to develop collaborative management agreements and institutions. The EIECP was to contribute to the protection of Egypt's natural and cultural resources, through strengthening EEAA's capacities in planning and management. Specific objectives were as follows:

- Strengthening Egyptian capacities to analyse, plan and implement adequate measures for the rehabilitation and conservation of natural, cultural and man-made environments.
- Enhancing current strategies and approaches to protect and expand the available natural resources base, aiming to increase productivity, reducing migration and improving the living conditions in the rural areas.
- Contributing to reinforce the role of EEAA and of its partner institutions for the protection of the environment.

Within this framework, the main objective of the SOP was to enhance the capacity of key stakeholders and institutions to manage in a sustainable way the natural and cultural heritage resources, while supporting the development of community initiatives. The SOP has three specific objectives:

- Establishing of a collaborative management system for the protected area,
- Preserving biodiversity and cultural heritage through their sustainable and equitable use,
- Contributing to the development of the Siwa region as a leading ecotourism site, by engaging local communities, the private sector and other key stakeholders, including NGOs.

Expected outputs were:

- To strengthen the institutional capacity for field conservation through legal, human resources and infrastructure development,
- To operationalize the collaborative management of the protected area on the basis of an appropriate, equitable and sustainable use of resources., and
- To establish an Interdisciplinary Collaborative Management (ICMT) to assist the Protected Area Management Unit (PAMU) staff in developing and implementing collaborative management agreements.

The local and national constituencies for biodiversity conservation were to be established through education and communication activities. During the first phase of the project implementation, the following activities were carried out and some results were achieved:

- Detailed study and research of the area.
- Development of income generating activities.
- Involvement of the local traditional authorities in the management of project.
- Establishment of a local NGO, which represents the Siwan Community in credit management;
- Capacity building of local Project staff;
- Environmental awareness activity, through the diffusion of thematic messages and campaigns, slogans and advertising material.

The Egyptian Radio and Television Union produced and aired in 2009 on national Egyptian TV a series of documentaries, featuring Siwa oasis. Conceived to further national interest in the oasis and promote environmentally sound tourism, the documentaries featured the archeological attractions of Siwa, cultural customs, and

the many manifestations of traditional handicrafts. They also covered karshif architecture and the linguistic and agricultural peculiarities of Siwa. Currently there are 28 registered hotels in Siwa. But, since the Egyptian revolution in 2011, the number of tourists from foreign countries has declined.

3.5. MAURITANIA: THE IMPLEMENTATION OF THE OSDP

Mauritania has conceived and implemented an Oasis Sustainable Development Program (OSDP) to provide the foundations for oasis economies, the empowerment of oasis communities and the improvement of their production conditions. The key to achieving this result was the implementation of a participatory approach to encourage beneficiaries to build their own planning and management capacities. In Mauritania, the OSDP served as a point of reference for the Government, IFAD and other donors regarding interventions in oasis areas.

Despite the positive results of the program, some challenges still lie ahead. These include: program sustainability and the capacities of water users associations in place, which remain fragile. Let us briefly present the findings of the Project Performance Assessment (PPA) which accompanied the implementation of the OSDP in Mauritania. The central focal point of OSDP (2004-2014) was date-palm growing, which provides the foundation of oasis economies and the center of the social organization of oasis populations. The eight-year OSDP came into force in November 2004 and was extended until 2014, following two previous Oasis Development Projects that ended in 2003. This overall goal was pursued through three specific objectives: (I) To develop local organization and management capabilities, promote the effective participation of oasis populations, notably women and young people, in the process of community and local development; (II) To promote the rational exploitation of the productive potential of oases, particularly water resources; and (III) To develop a network of privately managed proximity financial services.

These objectives were pursued by carrying out a set of actions under five components: (I) Structuring of the oasis communities; (II) Sustainable development of oasis production capacities, financed mainly through the Global Environment Facility (GEF); (III) Development of proximity financial services; (IV) Development of basic infrastructure (parallel financing from the Arab Fund /FADES); and (V) Coordination, monitoring and evaluation.

The lead agency was the Ministry for Rural Development. Loan administration and supervision was assured by UNOPS (United Nations Office for Project Services). A relevant strategic focus of the design consisted in adopting oasis development and rehabilitation as entry points for promoting the organization and structuring of producers in the framework of local AGPOs.

1. In terms of impact on rural poverty, OSDP is rated moderately satisfactory. Direct support to the oasis populations through the delivery of financing from the Community Investment Fund (CIF) and GEF aimed at improving social structuring, training and other accompanying and substantially increasing the incomes of beneficiaries. Sources of income were diversified, notably through the development of date-palm production (66% of total income), market gardening (27%) and income-generating activities (7%). The expansion of irrigation has resulted in increases both of yields and incomes and health has improved as a result of the building of safe water systems.

2; In terms of institutional development, OSDP has helped to consolidate and expand the enabling environment for self-help initiatives and the empowerment of oasis dwellers. Their enthusiasm with regard to this community-based financial service delivery model has attracted the attention of national institutions including those specialized in financial service delivery.

3. In terms of long term sustainability, its achievements are not encouraging. This is attributable to failure of OSDP to comply with the MTR recommendation (made in 2010) that a coherent exit and sustainability-enhancing strategy be developed and implemented with a view to transferring real responsibility to the AGPOs and their unions, while at the same time anchoring them firmly within the institutional framework of the forums at oasis level. But, the foreseeable sustainability of the land development and irrigation systems is deemed weak for lack of proper maintenance.

4. In terms of gender equality and women's empowerment, OSDP carried out a broad range of targeted initiatives, including literacy training for women, promotion of women's membership in the cooperatives and associations, and support to women's income-generating activities, by facilitating their access to training and financial services through the MICOs and the FIC.

In conclusion, the overall performance of OSDP was rated satisfactory. Overall, OSDP has attained the specific objectives and its achievements have laid the organizational foundation for generating the anticipated socio-economic transformation of life in the oases. Some major challenges remain: the low likelihood of sustainability of infrastructures that may jeopardize the long-term durability of OSDP's achievements; a modest level of policy dialogue that has prevented the full integration of the AGPOs into institutional planning at local government level; the failure to foster synergies and complementarity with the Value Chains Development Program for Poverty Reduction (ProLPRAF, also financed by IFAD); and the weak managerial ability of the water users associations. (REPORT No. 4063-MR, May 2016)

The overall objective of the OSDP was to create a basis for sustainable development and enabling conditions for oasian communities to take responsibility and participate effectively. The OSDP was able to respond to the varied needs of the oasis populations by adopting a participatory, partnership-based, decentralized approach. By focusing participatory diagnosis and negotiating solutions to problems at the oasis level, the OSDP has given the most vulnerable the opportunity to express their needs and participate in the search for solutions adapted to their situations and constraints.

Interventions have been supported by the development of microfinance services offering products adapted to the needs of the poor and the establishment of a Community Investment Fund (CIF) which has provided concrete support in local participatory planning. The promotion of MICOs proved to be more than essential. They offer local financial services appreciated by rural populations. The OSDP has made several investments in basic socio-economic infrastructure, supervision and support for the establishment of financial services in the oasis zones of the Wilaya of Adrar, the Tagant, the Assaba and the two Hodhs. The measures envisaged were to provide for the establishment of an agricultural extension system. In summary, the OSDP has made significant efforts to strengthen, institutionalize and implement a participatory community approach, backed by coherent human resources and coaching. These have largely favored the mobilization, federation and organization of

population and community structures around the problems of oasis development. Nevertheless, the effectiveness of the Program has been somewhat qualitatively weak.

Social capital has also made undeniable progress. The OSDP contributed to the empowerment of populations through participatory planning and promotion of local project management. In terms of social cohesion, the OSDP has contributed to a relative improvement in peace and solidarity within the oases, through the involvement of the different social components.

3.6. MOROCCO: ENHANCING ENVIRONMENTAL POLICY

The Environmental Performance Review (EPR) of Morocco began in 2012. It analyses the progress made by the country from 2003 on environmental protection, and proposes recommendations on how Morocco can improve its environmental management and address recurrent environmental challenges. As for policy framework for environmental protection and sustainable development, since 2003 Morocco has been establishing the foundations for enhancing its environmental policy, which until then was very general and addressed primarily water management issues. Three important environmental laws were approved in 2003, namely laws on the protection and conservation of the environment, combating air pollution and environmental impact assessment.

3.7. TUNISIA: TOWARDS ADAPTATION OF OASES SYSTEM

The CCC / GIZ project supported the Tunisian Observatory on the Environment and Sustainable Development (OTEDD) for the completion in 2010 of a major study on "sustainable management of oasis systems" that highlighted both the strategic importance of oasis ecosystems, economically, socially and ecologically, and the threats to the sustainability of this agro-ecological heritage which are likely to become more severe. The adaptation of oasis systems is necessary in the future, knowing that the oasis populations have acquired a valuable knowledge in the management of water scarcity and the natural variability of the climate in arid environment.

The area of oases has grown steadily from 16,720 ha in 1973 to 41,710 ha in 2010 and is about to be multiplied by 3. Around one-third are traditional oases. The oases represent 9% of irrigated areas and 0.8% of the agricultural area of the country. They are located to the south mainly in the 4 governorates of Tozeur, Kebili, Gabes and Gafsa. Some oases of small size exist in the governorate of Medenine. There are approximately 210 oases with 5,462 million date palms. The irrigated perimeters of the four governorates of Gabes, Kebili, Tozeur and Gafsa (mostly oases) represent about 30% of irrigated areas of the country, 25% of irrigated forage crops and 10% of irrigated market gardening crops.

PART II

ENVIRONMENTAL CHANGE IN THE OASES



Oases in the Sahara Desert, and elsewhere, are currently undergoing considerable environmental change (JIA et al., 2004; WILKINSON, 1978). This is driven by a wide variety of causes. In the central Sahara, these agricultural systems are dependent totally on groundwater resources (BROOKS et al., 2003). Excessive exploitation of these resources can lead to rapid decline in ground water level. Such a decline can result in significant land degradation and impose severe limits to development. Other physical factors can also result in declining productivity of oases, such as salinization of the soil and water due to poor management (BROOKS et al., 2003). However, analysis reveals that human activities are the driving forces behind ecological deterioration; much of the observed decline in oases is related to socio-economic changes affecting drylands, such as urbanization and migration to cities, especially of the younger population (ZHANG et al., 2003; WILKINSON, 1978), changes in the demand for oases products such as dates, or geopolitical effects such as imposition of economic sanctions in the case of Libya which limited access to irrigation technology (RODMAN, 1995).

1. FACING EXTREME WEATHER CONDITIONS IN THE CONTEXT OF CLIMATE CHANGE

From Morocco to Libya, the desert oases of the Sahara's Maghreb region are disappearing as temperatures rise and rainfall decreases. Facing daunting odds, local residents are employing traditional water conservation techniques to try to save these ancient ecosystems. In Morocco, where oases are found in the desert south of the country's Atlas Mountains, rising temperatures, deepening drought, and spreading desertification are undermining the water sources on which oases depend. Over the last century, roughly two-thirds of Morocco's oasis habitat has vanished. This trend is also affecting the rest of the Maghreb, the North African zone that encompasses the arid Saharan nations of Morocco, Algeria, Tunisia and Libya. Layer by layer, the key components of these fabled desert ecosystems are being stripped away. At the United Nations climate conference in Marrakech COP 22 this year, the Maghreb and the threats it faces from climate change were a major focus, and oases were held up as a symbol of the impacts already playing out on the landscape.

As a result of the degrading ecosystem, the oases no longer provide sufficient means of subsistence. Thus, the oasis populations are forced to resort to seasonal migration and are increasingly dependent on the income earned from migrating. This results in the abandonment of practices adapted for the oasis zone, and leads to a loss of environmental services. The overall objective of oasis sustainability project is to improve the adaptability of populations in oasis areas to face climate change. The specific objectives are:

- To improve the adaptive capacities of the water sector;
- To diversify income sources and improve the living conditions of the populations vulnerable to climate change in the targeted areas;
- To improve the ecosystem's resilience in response to climate change and variability;
- To improve the awareness of all stakeholders through the management and sharing of knowledge; and
- To strengthen the capacities of participants in the design and implementation of adaptation measures.

Oases owe their existence to human ingenuity in sustainable water management. In Morocco, ancient water systems are being restored to irrigate and replenish oases. The U.N. is helping Moroccan women to cultivate important, water-efficient medicinal plants to slow the spread of the desert into oases. In Tunisia, scientists and farmers are employing plant-breeding techniques to make their oasis crops more resistant to drought and high temperatures. But much more needs to be done. By tapping into natural underground aquifers and channelling rainfall, people have kept these habitats lush for centuries. The MENA climate zone is already one of the world's most water-scarce regions. The world is now aiming to limit global warming to 1.5 to 2 degrees C above pre-industrial levels. The 2014 World Bank report said that even if we cap temperatures at the 2-degree target, countries in the MENA region will experience heat waves for 30 percent of the summer months. The report predicted that with a global temperature rise of 3 degrees C, the Maghreb would experience 1.5 months a year of moderate drought. At 4 degrees and above, that rises dramatically to 6 months a year. The number of drought days could increase by more than 50 percent by the end of the 21st century. (BRYCE, Emma, 2016).

- In a handful of oases, including in the nearby province of Errachidia, locals are reviving old technologies, such as the *khetarras*. These 2,000-year-old irrigation systems intercept a water source upstream, then carry it via a downward-slanting underground canal to areas that need it. The *khetarras* and renovated irrigation canals will provide drinking water for oasis inhabitants and will also allow locals to boost date production.
- In the Ferkla region, another adaptation project has been launched by 15 women who are farming climate-resilient medicinal and aromatic plants to replace crops, such as barley and wheat, that are no longer faring well under drought conditions. Their herb plot is just one site in a wider network of herb-growing projects across the Tafilalet region, run by UN Women, the organization that advocates for the rights of women and girls globally. The women hope to expand their project to other areas.
- The Moroccan government has launched the Sustainable Oasis Initiative (SOI) aiming, among other objectives, to carry out a full census of oases and to

emphasize the need to prioritize oases as climate adaptation funding becomes available.

- Farmers in eastern Tunisia's Chenini Gabes oasis are using plant-breeding techniques to strengthen their crops — and, by extension, the oasis — against rising temperatures and low rainfall.
- Without these kinds of actions and global support, however, some fear that the centuries-old battle to maintain the oases will be lost.

1.1. MOROCCO: A PROJECT TO ADAPT TO CLIMATIC CHANGE FOR RESILIENT OASIS: PACC/OASIS

Today, the maintenance of economic, ecological and social services provided by the oasis (defense against the desert, refuge for biodiversity, climate regulation, and agricultural products) and the development of practices adapted to climatic change are of huge importance. Therefore, PACC/Oasis was launched. It is part of the "African Program of Adaptation to Climatic Change (Programme Africain d'Adaptation au Changement Climatique) which includes 20 different African countries. The project has an integrated and multi-sectoral approach to the regional and local dimensions, both in terms of institutional capacity building and demonstration of adaptation options. This approach is taken in order to strengthen the broad lines of Morocco on decentralization and development of each region.

The PACC/Oasis Program (over the period 2009-2012) has involved international partners: UNDP, the Government of Japan, and also national partners: HCEFLCD (Haut Commissariat aux Eaux et Forêts et à la Lutte Contre la Désertification), different ministries, provinces and agencies. It is intended for strategic actions in the provinces of Errachidia, Guelmim, Ourzazat, Tata, Tinghir and Zagora. The project was active in the following spheres:

- Improving knowledge on climate change;
- Strengthening the monitoring and warning systems against climatic hazards;
- Integrating climate change into strategic planning operations;
- Capacity building;
- Initiating of adaptation patterns including: higher dikes, land consolidation, improvement of water use efficiency and crop management, etc.;
- Funding mechanisms; and
- Communication, education and training.

Its primary objectives are the management and reduction of the risks posed by climate change. Its expected results were :

- Strengthening leadership and institutions dealing with the risks of climate change;
- Implementation of appropriate policies and measures;
- Establishment of long-term dynamic planning to manage climate change risks;
- Development of observation and implementation tools for warning systems against climatic hazards;
- Generation and dissemination of knowledge to adjust to national development processes;
- Data collection on climate change and vulnerability of oasis systems;
- Taking into account systemic vulnerability and integrating adaptation measures;
- Identification of possible funding to cover the costs of adaptation;
- Communication and extension plan to disseminate knowledge;
- Realisation of some pilot projects dealing with the adaptation to climate change.

1.2. MOROCCO: A PROGRAM TO COMBAT THE THREATS OVER THE TAFILALET REGION

The world's largest oasis, in the Tafilalet region of south-eastern of Morocco, is also threatened by climate change, according to the COP 22 Organising Committee. Some Moroccan NGOs have been working to protect the oases by planting hundreds of palm and olive trees. It is also raising awareness among oasis communities about the importance of plantations that help sustain the region's fauna and flora and resist desertification. To reduce its vulnerability, the government has been advised to better manage water resources through innovating irrigation techniques and reducing waste, implementing long- and short-term strategies to fight desertification and continuing to invest in renewable energies. (GUERRAOUI, Saad, 2017).

Morocco has three major objectives: recognising issues related to climate change, preserving oases, and developing them to a single model of resilience. Morocco has launched a sustainable environmental protection program promoting local products and ecotourism as well as the conservation and development of oases. The Moroccan government has adopted a National Action Plan that focuses on the ways and means to promote practical tools and to disseminate information on combating desertification. This plan calls for participatory approaches and the implementation of mechanisms for sustainable use of natural resources while introducing monitoring mechanisms on the dynamics of ecosystems. The plan also calls for conserving natural resources through emphasizing control of wind and water erosions and by rehabilitating natural and oasis ecosystems, as well as implementing water resource harvesting and the integrated management of natural resources.

The 2001 National Action Program on Combating Desertification (NAPCD) constitutes an important stage in the process of its commitments within the UN convention for combating desertification (MAPM, 2003). Morocco realized scattered activities in the 1970s and 1980s to combat degradation in one or more of the land use categories. The activities were based on sectoral approach through governmental institutions and public authorities. Activities included surveys, studies, formulation of pilot programs. These activities were of limited duration and discontinued nature. Morocco's approach to sustainable development is mainly environmental. The two main strategic documents are the National Strategy for the Protection of the Environment and Sustainable Development (with French acronym, SNPEDD) from 1995 and the National Plan of Action for the Environment (with French acronym, PANE) of 1998.

In light of the 2001 NAPCD, various partners have supported the country financially and have provided intensive back-up through consultation. The Program links efforts to combat desertification with poverty reduction and rural development. These efforts are designed to:

1. Alleviate poverty, vulnerability, marginalization and social exclusion by improving the incomes and the living conditions of vulnerable people;
2. Establish of a sustainable dynamic in favor of human development, the prosperity and well-being of the whole population.

An analysis of current systems of natural resources use shows immense difficulties in securing renewal and sustainability. It also identifies crucial policy inconsistencies and dysfunctions, developed over many years which have resulted in the degradation

of the productive base of natural resources. Under certain conditions, they have resulted in diminished productivity of some agricultural systems, leading to a drop in rural populations' incomes, aggravated by an ever-increasing pressure on natural resources. The major concern of the NAP focuses mainly on ways and means to promote the dissemination and sharing of information on combating desertification. There is also a crucial need for a sustainable participatory approach, on the basis of knowledge and on monitoring the dynamics of ecosystems. On the other hand, initiating the NAP implementation under the best possible conditions requires the following:

- Organizing an awareness building and extension campaigns in the framework of a communication strategy involving all stakeholders.
- Translating the NAP into final projects on a territorial-based approach and give core priority to many themes, among which : –in-depth knowledge of natural resources and desertification typology; –water resources harvesting; –conserving natural resources through emphasizing control of wind and water erosions and through rehabilitating natural and oasis ecosystems; and –conserving and upgrading the value of fauna and flora biodiversity.

The vast and varied core research fields includes the following areas:

- Tap into new crops with high added value likely to diversify rural activities and to generate job opportunities for young project developers;
- Identify and develop plant and animal genetic material tolerant to water stress;
- Develop ecosystems monitoring tools, a sort of long-term watch, leading to the setting up of observatories;
- Adapt and establish new water saving techniques and rehabilitate those techniques engineered by populations themselves;
- Deepen knowledge relating to the economic and social coverage of desertification;
- Promotion of rainwater harvesting.

Local programs were to harvest rainwater through retention dams or other forms of reservoirs offering real possibilities to compensate, even if partially, for the water deficit issue that is becoming acute in Morocco. They had also to monitor and evaluate the ecological, economic and social impacts of the drought They were supposed to strengthen the network for ecological monitoring and evaluate the impact of desertification control programs.

The NAP's implementation was backed by an awareness building campaign targeting politicians and elected councils and civil servants, with the purpose of removing any ambiguity in connection with the significance and the stakes of desertification, which needs to be dissociated from drought and sand encroachments, its most widely known manifestations. There was also a need to rethink the procedures for managing public funds or, at least, making them more flexible.

1.3. MOROCCO: TOURISM AS A RESPONSE TO CHANGING ECONOMIC AND SOCIAL CONDITIONS IN THE TATA REGION

The Tata region is one of the hottest regions of Morocco. The region s major resource, the oasis, has been rapidly degrading because of climate change, reduced available water and consequently decreased management. The reduced viability of the

agricultural production also has a significant impact on lifestyle. It is increasing the cost of urbanization, leaving the communities with fewer young people. The region has not traditionally been a tourism destination. While many tourists stop in the region, their length of stay is typically very short and there is little economic contribution from tourism. The decision was made to establish the region as a destination that holds these passthrough travelers and attracts destination-bound tourists. Because of the interest in climate change from the major source markets to the region, including France, Germany, Spain and England, it was decided to highlight climate change as a theme suggested by tourist development committees.

Two sub-themes were also developed:

- Living with a hotter climate: the people of the region are familiar with adapting to and coping with 50°C plus temperatures.
- Visiting a low-carbon destination: this implies converting the region into one that seeks to reduce carbon emissions.

The Tata Tourism Destination Region is located approximately 200 kilometers south of Agadir on the Northern limit of the Western Sahara. The area is also strategically positioned between the interior Moroccan city of Ouarzazate and the Atlantic Coast. The region has traditionally relied upon oasis agricultural production, including dates and other cash crops as well as growing food for local consumption. The oases themselves have been an excellent source of natural resources used in the production of a variety of products that have sustained the “oasian” lifestyle and economy for generations. Water is truly the source of life in this region. It is channeled from the higher altitudes through a complex series of canals that bring water to the individual plots of land in the oasis. This system of irrigation has been effective for centuries because it ensures equal distribution of water resources to each family.

Tourism was identified as the leading economic opportunity despite relatively little infrastructure and the complete lack of recognition in the domestic and international tourism marketplace. Nevertheless, there are about 40,000 tourists coming to the region every year, particularly from December to April. But for the most part, they were passing through and rarely spent one night in the region. The challenge then was to increase the length of stay as well as reinforce the recognition of the region as an appealing Moroccan tourism destination. The decision was made to aggressively pursue the tourism market. UNDP and the regional economic development agency were approached to contribute a partnership funding and expertise.

Despite the abundant natural and heritage resources throughout the region, the consultants immediately recognized the need to go beyond the traditional strategic tourism-planning process. Furthermore, there was an understanding that the impressive mix of cultural, heritage and natural resources was sufficiently attractive to support a viable tourism sector. However, it was the stakeholders’ strong sense of protecting their resources that most impressed the consultants. Perhaps it was because these people live in such a harsh environment that the combination of sharing, intelligent use and conservation of the limited resources are an integral part of their vocabulary and behavior. The physical size limitations of the oasis suggests that every square meter must be protected and managed with great care.

1.4. TUNISIA: THE ACTIVE ROLE OF THE STATE

Since the 1960s and 1970s, but gaining full momentum in the 1980s and 1990s, new agricultural extensions can be found in almost all the Tunisian oases and in the oases of the lower Todgha where sufficient uncultivated arable land outside the traditional oases is available. Besides new extensions adjacent to the old oases, completely new agricultural zones have been developed as well, such as Mareth II in Tunisia and the Ghallil plain in the lower Todgha. The Tunisian State has actively promoted the creation of new agricultural areas outside the traditional oases. The development of agricultural extensions often coincides with the mechanisation and partial modernisation of agricultural techniques (increasing use of machines, fertilisers and pesticides), and a growing orientation towards a limited number of 'cash crops' such as dates or almonds, which are sometimes for export (in particular Tunisian dates), but mostly for the local markets.

The development of pumping-based oasis agriculture seems more advanced in Tunisia and Algeria than in Morocco. This is perhaps related to the fact that oasis households without a substantial or stable income outside agriculture cannot normally afford to invest in digging a well and purchasing a motor pump. In Morocco, it seems primarily peasants involved in international migration are able to make such investments. (BISSON, 1991).

In Tunisia, the general standard of living is higher than in Morocco, and more non-migrants also seem more able to invest. Other factors might also play a role in explaining the lagging modernisation of oasis agriculture in Morocco. In Tunisia and Algeria, the state seems more active in establishing central drilling sites that tap fossil groundwater for urban and agricultural uses. This has further accelerated the decline of traditional oasis systems but increased water availability for agriculture. State-initiated central drillings for agricultural use are rare in Moroccan oases. Another possible factor is that Moroccan oases are generally endowed with far more abundant water resources than in Algeria and Tunisia (ZAIMECHE, 1992), making such interventions less necessary, and allowing the persistence of traditional forms of agriculture in water-rich river and spring oases.

Oases are increasingly polluted. They are affected by various pollutants. The primary source of pollution comes from household waste that is widespread inside and outside the oases. To this must be added the protective plastic of the date schemes abandoned after the harvest. The oases are also affected by industrial pollution, especially in Gabes. Anarchic urbanization gnaws the land in the oases.

In the past, the oasis was strictly reserved for agricultural production. The population lived in cities and towns. For several decades, anarchic extensions of buildings have eaten away oasis lands. This phenomenon is very striking and alarming, especially in the governorate of Gabes where the area of oases has decreased from 7,300 ha in 1957 to 7,000 ha in 2009, a loss of 300 ha. The oases where the Déglet Nour palm is dominant are to a lesser extent affected by this phenomenon. The phenomenon has been amplified since the revolution of January 14, 2011 following the relaxation of control. The lack of coherent management patterns, the lack of land for housing and other uses, the high cost of land, the low profitability of agricultural plots, the economic prevalence of many emigrants, and land speculation explain these anarchic extensions. (GIZ) GmbH Projet CCC/GIZ).

It is, therefore, only in particular oases with many poor non-migrant or exclusively internal migrant households that a partial withdrawal from agriculture is common. However, even in this case, total abandonment is rare. It is, in fact, soil salinity which seems the most immediate threat to oasis agriculture. Soil salinity is variable, and its degree depends essentially on the following factors: (a) soil management and tillage: no-tilled and poorly tilled plots present a clear surface salinity; (b) irrigation water: where irrigation water is saline there is a continuous input of salts by irrigation; and (c) drainage and the depth of the water table. Soil salinity and soil sodicity seem to be on the rise due to increasing irrigation and the lack of drainage in some oases.

In combination with changed irrigation methods, lack of drainage and water-logging problems, this might cause land degradation via sodification and salinisation (CÔTÉ, 1998, FASSI 1992, SKOURI, 1990). The intensification of agriculture puts increasing stress on water resources and this may threaten the long-term sustainability of oasis agriculture.

In many oases, the growing need for irrigation water may lead to an increasing scarcity of water resources and increased costs for water extraction. In general, the digging of new wells takes place in a chaotic way. The risk of the over-exploitation of water resources is apparent and poses a potential environmental threat. In many areas throughout the Maghreb, excessive pumping of water for agricultural and urban-industrial or touristic use has resulted in falling water tables (ZAIMECHE, 1992, KASSAH, 1999, BENNADJI et al. 1998, CÔTÉ, 1998). If the anarchic boom in water pumping remains uncontrolled the increasing stress on water resources may in the end lead to a resource crisis. Government intervention, hydrological research and control on pumping, seem necessary. (BENCHERIFA, 1991, 1993).

2. MANAGING BIOLOGICAL DIVERSITY AND WATER SCARCITY IN DESERT ENVIRONMENT

The oases especially excelled in the field of water. They have developed a great ingenuity in catching, transporting and sharing water equitably and practicing irrigation. Where the aquifers are not artesian, draining or foggaras/galleries have been dug to collect surface water and gravity to the surface to the palm plantations. Community organization imposed strict rules for good water management. The oasis community organized chores to periodically clean up the springs and foggaras. In Islam, water is sacred, it is rare, precious and must not be wasted.

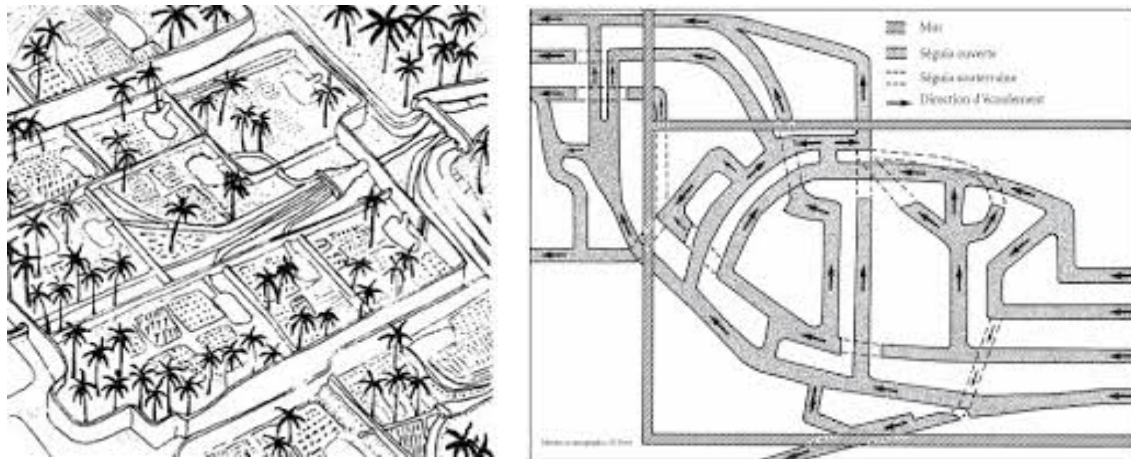
The three-stage cultivation creates a microclimate that reduces evaporation and allows the cultivation of several species, thus enhancing water and soil. Several traditional farming techniques helped to make better use of water resources, such as the planting on the banks of the Seguias of water-demanding trees such as pomegranate and vines. The oasis effect reduces the effect of hot and drying winds, evaporation, the aggressiveness of solar radiation, provides shade for several crops and enhances the value of water and soil. The oasis is probably the agro-ecological environment where the richness of biodiversity is most astonishing. (GmbH Projet CCC/GIZ, 2012).

2.1 ALGERIA: THE FOGGARA OASIS AND THE RATIONAL WATER MANAGEMENT

In Algeria, the country of the foggara or the region of the Touat was organized according to the production of water and irrigated agriculture. This organization and

its importance are reflected in social, cultural and economic facts. Algerians in this region attribute to the foggaras a sacred character comparable to that of the Koranic schools, zaouias and mosques (KASSAH, 1998). Its site is due to the precise topographic and hydrogeological conditions that control the existence of palm groves. The foggara comprises two major sections: the gallery which penetrates the aquifer or the essential and most useful part. It drains water from the aquifer via a steep slope. Located downstream of the first section, the second consists of superficial galleries which evacuate the water to the surfaces to be irrigated.

Figure 6: Foggara system.



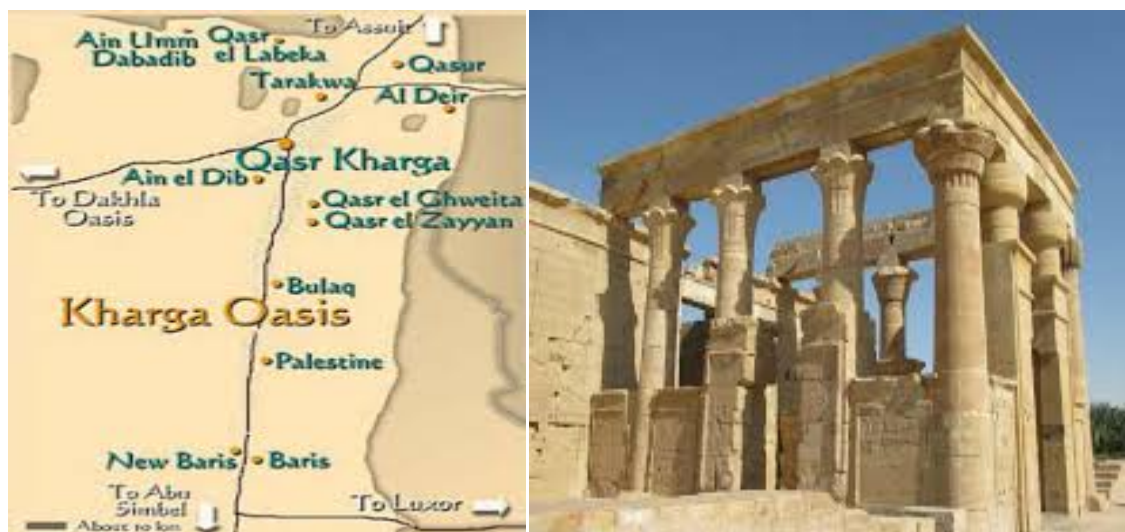
The wells that punctuate the first section of the foggara only allow access to the groundwater for the digging and maintenance of the galleries. They have only functions of evacuation of cuttings during the works of the clearing and cleaning and ventilation of the underground gallery. The foggara is therefore not a series of wells connected by a gallery, but a gallery aerated by service wells. (RCJT/CJTG, 2014). Exploited collectively, foggara belongs to a group of co-owners who oversee the individual distribution of water (GARNIER, 1980). The distribution of the water is done by a system of combs called "el qasria" which starts at the end of the underground gallery. Thus, several branches connect to the drains which evacuate the water towards the gardens and which is called seguia.

The occupation of the soil in the oasis environment remains an individual initiative specific to the farmer. The oasis agrarian landscape is characterized by the ubiquity of the date palm and tiered crops, such as arboriculture, cereal farming, market gardening, and non-food plants: tobacco, henna, etc. Agricultural activities take place between autumn and spring (GUILLERMOU, 1993). In the Touat oases, the hydraulic factor cannot be dissociated from the land factor. The value of land in the region is insignificant. The oasis cadastre has a very strong relationship to water and foggara. It is well known that a very long water flow is accompanied by large losses by evaporation. Families in search of more earnings then prefer to increase their irrigation water flow rather than expanding cultivable areas. Since the construction of foggaras requires large investments, it can only be realized by a gathering of small landowners who thus bind their fate. Despite the attachment of oasis to ancestral values, the Algerian Sahara due to the importance of its water and hydrocarbon resources, is an important part of the national economy. This importance is reflected in the implementation of economic and political-economic reforms.

2.2. EGYPT: KHARGA, A DESERT CROSSROAD OVER THE MILLENNIA

Kharga represents a special case, for two main reasons. First of all, it contains evidence of the human and environmental evolution that took place the last 12,000 years, and then it contains the archaeological remains of one of the most impressive operations of strategic control of a desert area: the well-preserved chain of Late Roman forts and fortified settlements.

Figure 7: Kharga Oasis



Kharga Oasis (site a)

The architectural remains were accompanied by agricultural installations. The desert climate is the main responsible for the astonishing preservation of the ancient agricultural systems. All Late Roman sites in Kharga were endowed with their own agricultural installation consisting of water sources (manawir and wells) and fields. The historical importance of Kharga is that it has always allowed travelers to access the Western Desert and to bypass the Nile Valley, thus reach faraway destinations.

The small southern oases (sites b and c)

The small oases that punctuate the vast expanse of the desert to the south of Kharga concentrate in their tiny extent the entire history of a vast portion of Western Desert. They show links with other small oases in the area as well as with a broader network of desert settlements.

Settlements in the Kharga Oasis represent a unique case of perfect exploitation of the environment paired with a careful strategic plan to control the area at a regional and trans-regional scale. Installing large communities in semi-desert areas was possible thanks to the ingenuity of the ancient engineers and builders, who managed to identify, adopt and implement the most effective method to retrieve and spread water on the fields and install large cultivations on previously barren soil. The installation of the subterranean aqueducts called manawir represent an important example of cross-cultural transmission of knowledge and know-how. Today, both Kharga and the smaller southern oases are facing a significant change due to the modern

exploitation of the deepest water sources. It is certainly necessary to find a balance between legitimate modern activities and the preservation of the evidence of 12,000 years of human activities.

Kharga, being large and near to the Nile, shows the best and clearer the everlasting effect of this connection. The isolation of oases in the Nubian Desert allowed two important features of biodiversity: (1) retention of some species that disappeared and are in their areas of origin, and (2) appearance of new species that evolved within the oasis. For example, research on Kharga dogs has thrown light on the origin of dog domestication in Africa and Asia. Kharga oasis and the small oases near it contain springs and miniature permanent lakes that constitute important and significant natural habitats for in-situ conservation of biological diversity.

2.3. EGYPT: WATER MANAGEMENT AND AGRICULTURAL BIODIVERSITY IN SIWA

Siwa oasis is eco-geographically and culturally isolated by more than 300 km from other agrarian communities. The perennial crop inventory of Siwan Berbers has remained relatively stable through time and few traditionally cultivated annual species or landraces have been lost. However, additional crop species from other parts of Egypt have been adopted since a paved road was completed to Siwa in 1986.

The common irrigation method in Siwa is traditional surface irrigation by gravity in small basins. The advantages of this method include simplicity, low energy and capital needs, and the ease of the leaching process. Irrigation losses with this method are high owing to seepage from wells, storage pools and irrigation canals, which are often very long and built of sandy and porous soil. There are 226 old "Roman" aiun, and 1600 abar, which were drilled starting in the 1960s and especially after 1980. Aiun denotes natural springs or wells dug in the remote past, with some indeed going back to the Roman era. Abar are artesian wells drilled by contemporary generations. Abar include also those nine deep wells drilled since the 1980s that produce water of low salinity.

Water rights are entitlements for the time during which the water of a well can be used entirely or partially. They are associated with specific plots of land and can be traded together with them. A group of farms fed from one well is traditionally called a hattiyya. Continuous flows to these low points formed the lakes now known as birak. The hasib is the supervisor overseeing the distribution of water to the plots of individual farmers. He determines the precisely timed schedules for opening and closing of irrigation canals. A respected individual called locally rakib maintains a registry of water rights, and arbitrates conflicts over water use.

2.4. MOROCCO: ANIMAL HUSBANDRY AND WATER MANAGEMENT

1. The importance of animal husbandry - particularly cows - seems to be increasing for sedentary oasis populations. Some studies suggest a relationship between this phenomenon and migration (AIT HAMZA 1995; BENCHERIFA 1991; DE HAAS, 1998). Livestock numbers, especially cows, have significantly increased in oases and nowadays peasants are buying more and more exotic, imported cow breeds. In most cases, dairy products are destined for self-consumption, but an increasing number of peasants envisage trading their livestock and market dairy products. The development of urban centers near oasis areas seems to create growing markets for meat and dairy products.

Two underlying factors appear to act upon this development. Firstly, the presumed 'feminisation' (BENCHERIFA, 1991; STEINMANN, 1993; VAN ROOIJ, 2000) of the agricultural work force, which, in part, is largely due to out-migration and the general reorientation of men to other activities, has probably encouraged animal husbandry. Women are also allowed to harvest the alfalfa, which serves as fodder. (BENCHERIFA, 1991; DE HAAS, 1998). In most oases, the cultivation of alfalfa has gained ground at the cost of other crops. In particular, cereals now seem less important. Besides alfalfa, there is also a tendency to concentrate on the cultivation of on almonds in the Moroccan oases (as is the case with dates in the Tunisian oases), which are largely destined for the market.

2. Irrigation water management is crucial for agricultural production and livelihood security in Morocco as in many other parts of the world. Implementing an effective water management system, however, is a complex task for policy makers. One important requirement for success is sufficient knowledge about farmers' demand or willingness to pay for irrigation water. This information is important for the adequate implementation of water pricing policies, for accurate cost benefit analyses of investments in water supply or water market infrastructure, and also for determining an optimal distribution of the scarce resource between different users. Knowledge about farmers demand for irrigation water is an important requirement to manage the scarce resource successfully. (STORM, Hugo, HECKELEI, Thomas, and HEIDECKE, Claudia, 2010).

2.5. MOROCCO: THE ISSUE OF WATER MANAGEMENT IN THE DRAA VALLEY

In the future, water supply is likely to be reduced which increases water scarcity in the region and tightens water supply for irrigation. An analysis of agricultural production using results of an agro-economic survey conducted in 2005 focused on the relationship of water availability and farmers' strategies to cope with periods of drought. It was shown that farmers do not only adjust the area cultivated, but also change their cropping patterns under water scarcity. Also, crop yields decrease if water requirements are not satisfied. It was found that a groundwater charge leads to more stable groundwater tables, and a less drastic depletion of the groundwater aquifers.

The aquifer recharge was introduced into the groundwater balance and was found to be a very sensitive factor for groundwater use and thus influencing the results of the water pricing scenarios. Agricultural income is consequently reduced. The implementation of a groundwater charge leads to conservation of the groundwater resources until surface water is extremely scarce. Shadow prices for irrigation water are more stable over the years; this demonstrates the stabilizing role of groundwater and the positive effects of a groundwater charge. Agricultural income is likely to decrease in the future. Water pricing in the Drâa valley is currently discussed by the official authorities as one option of more sustainable management in the future. Any water management solution for the Drâa region has to fulfill two objectives. First, water resource conservation is essential for long-term sustainable water use. Second, income security of farmers is a necessary political objective to ensure feasible living conditions for the rural population. (HEIDECKE, Claudia, 2009).



The boom in mechanised water pumping is a tendency in all the Maghreb's oases in general. In the Moroccan oases studied, this shift is entirely the result of investments by individual peasants. In the general absence of successful State intervention, the change towards motor pumping can only be made if peasants have sufficient financial means. This explains why this shift occurs mainly in those oases with many international migrants. In many cases, however, peasants use a combination of traditional and modern water sources. The Moroccan State is more actively intervening in the water management of the larger oasis areas, notably the Drâa and Tafilalt, mainly by constructing large dams. Nevertheless, its general level of involvement in oasis agriculture is lower as compared to the Tunisian State.

Thanks to motor pumping, peasants are able to cultivate all their fields throughout the year or at least part of their plots (instead of cultivating them only in the cool winter season as was traditionally the case in water-scarce oases). The increasing use of fertilizers and pesticides is another indication of such 'vertical' intensification of agriculture. The rise of motorpumping seems to further undermine the willingness to participate in the maintenance of the traditional agro-hydrological infrastructure and to obey the common law. This can lead to the desiccation of the khetaras and natural sources on which the traditional systems rely. There is, therefore, a vicious circle which is eroding the willingness to maintain these traditional systems. However, the decline of traditional systems is certainly not inevitable. In the Moroccan Todgha valley, for instance, some khetaras have been successfully preserved by relatively simple technical interventions.

In contrast to Morocco, the Tunisian State has established collective village pumps and created modern water users' associations, aimed at replacing the 'obsolete' traditional village council (Djemâa). Despite many organisational problems, this development has at least guaranteed water provision to poorer households not able to make investments themselves. Nevertheless, the water provided by the central drillings in Tunisia is generally insufficient. This also explains why in Tunisia many peasants have installed additional private motor pumps. Morocco has limited water resources, and faces substantial pressure on its sustainable water management and its protection. Water use is already under severe water stress, mainly due to climate change, pollution and population growth. The WASIS project was meant to contribute to the expansion of the most recent

technical solutions with an innovative work based on modeling tools for integrated water management (WASIS, 2017 – 2020).

2.6. TUNISIA: THE NEGATIVE EFFECTS OF OVEREXPLOITATION OF WATER

- In the governorate of Kébili, in 2008, overexploitation exceeded 200% of the allocated volumes and the degradation of water by salinization was observed in Souk Lahad and Douz.
- In the Gabes governorate, the Djeffara aquifer is overexploited and may be contaminated by the intrusion of marine waters.
- In the same governorate, the overexploitation of the North Gabes aquifer due to the creation of the industrial zone, the increase in drinking water requirements and the creation of numerous boreholes for agriculture has been exacerbated in recent years by wells.
- The governorate of Tozeur, following the situation in Kébili, will likely experience the negative effects of the stress on water resources.
- The Gafsa governorate is also suffering from the overexploitation and continuous reduction of the aquifers used for the oases.

Significant efforts have also been provided by the State to safeguard several oases, but unfortunately, in several cases with delays. The management of irrigation water suffers from a multitude of problems:

- The water tower for irrigation is generally remote; irrigation doses are exaggerated and exceed the capacity of the soil.
- Little maintenance is granted by users for irrigation networks; many water leaks and wastes are noted.
- In several geothermal areas, heating water is not valued for the irrigation of oases and is thrown into the wild, especially in winter.
- GDAs sometimes allow irrigation of illegal extensions. This is done at the expense of regulatory oases and disrupts their water towers. In some places, irrigation water is polluted by domestic waste water.

The oases have been experiencing a loss of biodiversity for several decades, and this trend is constantly accelerating. The market economy has favored the exaggerated extension of the Déglet Nour dates at the expense of other varieties. Palm trees are no longer pollinated. Palms of low economic value are either exploited for the Legmi or torn to be planted as ornamental trees, especially in tourist areas. Several local varieties of market garden crops and fruit trees are becoming increasingly scarce. Inventories in the Gabes region have shown that 16 plant species are threatened. Several wildlife species are also threatened such as Corncrake among birds, chameleon among reptiles, painted discoglossus and toad of Mauritania among amphibians and several insects (more than 13 species). 19 cultivars of fruit trees and market gardeners are at risk and many are considered vulnerable.

Oases of southern Tunisia will be the most affected in Tunisia by climate change, due to an increase in temperature and a decrease in precipitation, as follows:

- Increased crop water requirements resulting in worsening water resources with a steady decline in the level of drilling, salinity and increased pumping costs;

- The gradual rise in sea level, favoring the intrusion of marine waters into the water table in coastal oases and making it more difficult to drain natural water;
- The risk of non-hibernation for tree species requiring refrigeration, resulting in a decrease in their production;
- A drying of the dates in case of succession of days of high heat;
- A higher frequency of cases of attack of the palms by the mite Boufaroua; and
- Reduced tourist frequentation due to the hot weather especially in summer, among other factors (THE OASES OF TUNISIA, 2012).

PART III

MONITORING SOCIAL AND CULTURAL CHANGE IN THE OASES



Oases have a heritage role; they can be considered as a public good in many ways. They constitute a rich and varied historical and cultural heritage. This heritage is related to culture, biodiversity, architecture, religion, farmers' know-how in irrigation and crop management, literature, poetry, theology, art, crafts and original culinary habits. The oasis regions are the cradle of prehistoric civilization. They were at the crossroads of trade with the Saharan regions of Africa and between the eastern and the western Muslim and were a place of cultural mixing. Historically, this way of life which has articulated religious values and economies based on agriculture, tends to integrate the consumption systems induced by the globalization. The evolution to a tertiary economy, the modernization of agricultural practices and the development of transportation have contributed to social change in the oases. New opportunities are created, between evolution and resistance to change, and the oasian model is questioned in its unity at local scale and in its diversity at a larger scale.

The late 19th and 20th centuries brought many fundamental changes to oasis societies in the Maghreb. Beginning with the French colonial expansion (Algeria in 1830, Tunisia in 1883, Morocco in 1912), these regions were gradually integrated into a modern, central State as well as in the national and international market economy. The demise of nomadism led to the subsequent sedentarisation of most nomads in or at the fringes of oases. These processes, which have continued in the post-colonial era, created important income earning opportunities outside agriculture for oasis peasants, sharecroppers and slaves, especially through migration towards large towns and foreign countries.

Oasis territories are subject to a double marginalization: political, with a national model that does not think of development in these territories, and economic with the competition of productive spaces for access to resources and the market. Considered by the public authorities as structurally unsuited to the demands of modernity and national development (BATTESTI, 2005; BRAS, 1996), the oasis territories are managed like irrigated perimeters, like any other perimeters, like "shadow" territories (BATTESTI, 2005; GACHET, 1987). The diversity of the functions of the oasis

territory is not taken into account (ABDEDAIEM, 2015). On the economic front, the liberalization policies that accelerated in the late 1990s (GANA, 2008) led to question the place of old oases in development processes.

1. SOCIAL TRANSFORMATIONS, MIGRATION MOVEMENTS AND DIVERSIFICATION OF ECONOMIC ACTIVITIES

Oases in the Maghreb have been fundamentally transformed over the the past century following their gradual integration into both the state's political structure and the capitalist market economy. International migration in particular, has increased the income of many oasis households, decreasing their dependence on agriculture and enabling a greater diversity of economic activities. Such changes have, of course, led to important transformations in the agricultural realm, claiming that migration has contributed positively to agricultural development. We might, however, see it is as responsible for the demise of oasis agriculture. The IMAROM research project (1998-2001) was able to explore these issues through multidisciplinary fieldwork in the oases of Morocco (Todgha valley) and Tunisia (Mareth, Fatnassa).

It is concluded, in contrast to some prevalent pessimistic views, that oasis agriculture in the Maghreb is not in fact declining but undergoing a spatially differentiated transformation. Several oases are indeed suffering from the phasing-out of traditional irrigation systems, but the majority are more intensively cultivated than half a century ago, and the total irrigated surface has been extended significantly. Migration has generally contributed to agricultural transformation in a positive way as international migrant households often show a relatively high willingness to invest in agriculture.

1.1 ALGERIA: EMANCIPATION, URBANIZATION AND STANDARDIZATION

During the second half of the 20th century, the North African countries experienced considerable economic and social changes. In Algeria, these changes, coupled with a political will to liberalize the agricultural sector, resulted in the unlocking of access to water and land. This was accompanied by the social ambition of young people from the oasis communities, who colonized new spaces and accessed groundwater during the 1980s. This resulted in the upward social mobility of the sharecroppers and their descendants in these oases. Several authors have analyzed the pioneering dynamics in the Maghreb Sahara (BISSON, 2003), (KHIARI, 2002), (AMICHI et al., 2015). However, in most situations (El Ghrouss and Sidi Okba), the motivations of the social actors remain the same: the rise in society is linked to an economic ambition and the creation of a heritage based on date palms. (BISSON, 2003).

The oasis communities have the ability to associate "tradition and innovation, peasant wisdom and openness to modern ideas". This has had a significant impact on the reorganization of local society and social relations both within and outside the country, thanks to the encounter between individual initiatives and political voluntarism (COTE, 2002), (OTMANE and KOUZMINE, 2013). These various agricultural forms are complementary and interdependent for the oasis population, economically and socially. The process of unlocking the access and use of land and water was initially sought by the State from a social justice perspective. (HAMAMOUCHE, Meriem Farah, KUPER, Marcel, LEJARS, Caroline, 2015).

The Algerian State has carried out a series of actions to develop these areas in the agricultural sector as well as in services, transport and housing. Road infrastructure has been developed and facilities have been built to stabilize the population. The housing constructed by the State was allocated to the most vulnerable strata within the framework of social promotion. As a result, the oases, laden with history and dominated by traditional social practices, were modernized, transformed and ultimately standardized. Although the process of opening up the Sahara was initiated during colonization, it was only after independence that it was almost completed. Major efforts have been made in the realization or rehabilitation of airports, and air transport has been chosen as a support for land transport. Indeed, the introduction of new transport infrastructures combined with the development of motorization has revolutionized the way of travel in the Saharan areas of Algeria's southwest, resulting in a new organization of space. (Bechar, Adrar and Timimoun)

The Ksourians find new employment prospects in the cities following the decadence of the oasis agriculture, while continuing to keep the same links with their original spaces, and much more, by continuing to live there. This trend has been accentuated by the creation of infrastructure and equipment (schools, hospitals, etc.). The new villages built on the road developed outdoor spaces to constitute the new residential and economic spaces. Shops and transit services were born. If the shift of the ksour towards the roads is dictated by a logic of mobility, the Ksourians become more and more dependent on the towns of the region.

Water is today used politically to convey new forms of governance and territorial control. By losing control of the water, the local aristocracy is deprived of its traditional role. The owners of water are challenged by a powerful new actor: the State. The diversification of family resources has had direct effects on the improvement of living standards; urban employment has generated new patterns of consumption, two of which are very important: densification of housing within the ksours and the construction of new housing.

These changes were manifested by the break-up of the oasis, which occurred as a result of the abandonment of the ksour with the creation of new entities of extramural habitat along the road. A deep crisis affects the organization of the traditional rural space; the oasis is deprived of its labor force and its inhabitants who migrate towards the new perimeters of agricultural development, the new villages built nearby and towards the city. The oasis society is "normalizing" according to a liberal model.

1.2. EGYPT: URBAN DEVELOPMENT AND REVIVAL OF THE CULTURAL HERITAGE IN SIWA

There are very few formal guidelines or architectural codes for the development of Siwa. The aesthetic qualities of the traditional Siwan architectural style is one of the most important legacies and attractions of the oasis but it is being abandoned in favor of "modern" building styles which are expanding and jeopardizing Siwa's unique architectural identity. Growing housing needs exert further pressure and Siwa is now in danger of being overwhelmed by alien styles and unattractive structures. The oasis is lacking a coherent master plan, with proper zoning, building heights, tourist district planning, sidewalks, lighting, etc. Several initiatives to create awareness

amongst locals and visitors for the unique traditions of the oasis and to document and preserve those traditions exist in Siwa.

- Built amidst gardens, the House of Siwa is a museum of Siwan customs and traditions containing displays of Siwa's ancient handicraft, household and agricultural tools and know-how. The museum was built in karshif architecture, to showcase ancient building techniques.
- The Siwa administration has established a Center for Integrated Development of the Local Traditional Industries. It teaches girls and unmarried women handicraft techniques, thus providing opportunities for self-employment, and offers workshops on weaving, embroidery, pottery and silverware.
- South of the old Shali fortress, there is an old manual olive oil press inside a private karshif courtyard. Built in 1920, the press is still working and is used in the harvesting season.

1.3. LIBYA: PROFOUND STRUCTURAL TRANSFORMATIONS

In the late 1960s, the Swedish scholar Lars Eldblom published an extremely detailed study of the socio-economic life in the three Libyan oases of Ghadames, Ghat, and Mourzouk. Life in Libya has changed profoundly since then. The phenomena of oasis life documented in his work hardly or no longer exist. The aim of his comparative study was to elucidate the different social and economic systems, along with the social structures and organization of the Libyan oases. It was easy to ascertain that these communities differed greatly from each other in their exterior formats. Mourzouk is a scattered oasis, with widely spread cultivated areas, whereas Ghat has an intermediate position with wide spread gardening areas. Although the internal functional organization and mechanisms (how the economic, social, political, religious and cultural factors function and interact with each other) were considerably difficult to analyze, a certain connection was detected.

Thus, for example. the compact and "closed" community~ Ghadames - which has been dependent on one single spring - exhibits an exceedingly more regulated and complicated social organization than Mourzouk with its scattered wells and widely spread cultivation and building structure: water is the ultimate cause of the consolidation of the intricate pattern of social organization. As a rule, it seems that the general character of the oases is formed by the interplay of the external economic and social factors; the external factors constitute the foundation on which the economic and social system is build. Local commerce flourished in Ghadames and Mourzouk, whereas gardening was obviously on the decline. In Ghat and Mourzouk gardening was still necessary for the subsistence of the inhabitants. In all oases, the emigration of men in the age groups 15 – 30 and 30 - 45 was very high.

More recently, in the case of Libyan Fezzan, generalized access to higher education, permitted through the multiplication of small academic centers and the tertiarization of the economy, contributed in fact to the increase of these deep transformations. (ELDBLOM, Lars. 1961 , 1968, 1971).

1.4. MAURITANIA: THE IMPACT OF SOCIAL AND CULTURAL DEVELOPMENTS

The most obvious manifestation of social evolution is that the majority of the population, once nomadic, is now settled in towns, in large boroughs, and in villages.

The landscapes of the valley of Mauritania were also upset. Irrigation is most developed. New organizational structures emerge slowly in this rural world. There is a need for more investment to maintain production (drainage, fertilizer, etc.). The question of access to land of the harâtîn is not definitively settled; The after-effects of the events of 1989 are far from being erased. Private investment in the rural sector remains marked by speculative interests. (BONTE, Pierre).

Environmental degradation and desertification are among the major causes of rural poverty. But they are also an effect. The acceleration of the desertification process is largely due to global climatic phenomena, over the last two decades. In Mauritania, a largely desert and dry country, this change has had effects that may be more marked than in other Sahelian countries. Efforts to adapt rural populations to new environmental conditions have only contributed to the acceleration of the processes under way, leading to a reduction in the productive potential of natural resources. The effects are felt most strongly by the smallest farmers and herders who do not have financial or technical means for maneuver.

The agricultural production of Mauritania is very clearly insufficient, even in the best years. Unequal access to productive resources is another important cause of poverty in the country. In pastoral areas, rangelands were customarily considered collective resources. This status was formally transformed after independence. The State in fact affirmed its rights over all the rangelands and the bushes used as pasture. The use of pastoral resources has now become open uncontrolled to all. The free access to the courses is thus translated today by overexploitation of the resources.

In the oases, the lands and waters traditionally belonged to tribes that divided them among the lineages. Wells and palm trees were family-owned, but no property rights were recognized for the Harratine workers, having servile status, who had dug wells, planted palm trees, exploited trees and irrigated the land. The formal change in servile status and the numerous departures of laborers forced the owners to find new arrangements with the Harratines that remained in the oases. They introduced sharecropping contracts for the management of palm trees and for crops, and they accepted that part of the new plantations could become property of the Harratine.

1.5. MOROCCO: THE DIFFERENTIATED IMPACT OF MIGRATION ON OASIS SYSTEMS

In the past century, rural areas in the Maghreb have witnessed a mass migration of their people to urban centers within their own countries as well as to Europe and the Arab oil countries. Studies also suggested that migration was generally strongest in the regions that were relatively disadvantaged in terms of ecological conditions, (BENCHERIFA, 1991; MICHALAK, 1997, HEINEMEIJER, 1960). This is particularly the case for oases where the high demographic growth, the limited means of subsistence and the rigid ethnic hierarchies all seem to have further propelled migration. International migration started in colonial times but has gained full momentum since the 1960s. with France being the primary destination for people of almost all oases. Countries such as the Netherlands and Belgium (for Moroccans) have also been important destinations, while Spain and Italy have grown in relative importance since the 1980s.

It is particularly through the experience of migration that abstract processes of integration in the modern State and market economy or globalization are concretely manifested for oases inhabitants. In most countries of the MENA region, it seems that migration has offered “a clear avenue of upward mobility for those able to migrate” (RICHARDS & WATERBURY, 1990). In oases, this has resulted in the partial socio-economic emancipation of the formerly inferior groups and contributed to the partial breakdown and/or reversal of the traditional ethnic hierarchies (BELLAKHDAR et al., 1992; BÜCHNER, 1990) and, hence, the traditional institutions regulating land and water management (DE HAAS, 1998; OTTE, 2000; KASSAH, 1998).

The dominant scenario in the Maghreb in particular is rather pessimistic. Because migration has provoked the stagnation or even the decline of agriculture and the local economy in ecologically ‘marginal’ places such as oases and mountain areas. Moreover, traditional agriculture has often become the subject of strong aversion, particularly among the rural youth. (DE MAS, 1990), (BENCHERIFA, 1991). Migrant remittances are mainly used for the construction of opulent houses, the purchase of ‘unnecessary’ luxury goods and other investments evaluated as ‘non-productive’. Therefore, the expected positive impact of migration on development in the oasian regions of departure is modest. In fact, more often, migration is negatively contributing to the ‘development of underdevelopment’ (cf. HEINEMEIJER et al., 1977; KAGERMEIER, 1997; LEBON, 1984; LAZAAR, 1987).

The breakdown of extended families, the erosion of the traditional ethnic hierarchies and the concomitant disintegration of the power of traditional village institutions induced labour shortages (CHAROY & TORRENT, 1990; DE HAAS, 1998; DE MAS & KRUIHOF, 1992; AÏT HAMZA, 1999; KERBOUT, 1990). This leads to land degradation and desertification, and an ‘unhealthy’ dependence on external revenues. Clearly, migration has the potential to play a positive role by enabling investments through migration remittances (CLOUET & DOLLÉ, 1998; DE HAAS, 1998, 1999, 2001; DUBOST & MOGUEDET, 1998; NASR, 1999; POPP, 1999; KASSAH, 1998).

Like many oases in southern Morocco, Agadir-Tissint was an important junction in the trade network between the Moroccan urban centers in the North and West-African centers such as Timbuktu and Jenne (BELLAKHDAR et al., 1992). However, because of the decline of nomadism, the collapse of ancient caravan trade, and the political and economic integration in the Moroccan State, the oasis has economically and politically been completely marginalised. For the majority of the oasis population, formerly slaves, sharecroppers or small peasants, this massive migration has meant a dramatic economic advancement and has entailed the emancipation with respect to their former patrons.

These migrants, generally aged 20-40 are still considered as household members as long as they maintain strong economic and social ties with their family. Women are generally not allowed to migrate individually on a temporary basis. Consequently, the current oasis population is dominated by women and small children. The vast majority of the temporary migrants (93%) stay within Morocco. Most migrants stay in the urban centers Marrakech, Agadir and Casablanca. About 7% of the temporary migrants live abroad. More than 90% of the households have more than one revenue. Only a minority of 10% are uniquely involved in agriculture. This resulted generally in a more extensive land use.

Necessary activities are hardly executed by many of these households and the maintenance of date palms is generally minimised. The general pattern is that irrigation is sustained, but all other activities are minimised. Nevertheless, total abandonment occurs rarely. Even when the economic importance of agriculture is minimal, the strong attachment to the ancestral land guarantees a minimum of maintenance. Land is an important cultural status symbol; former sharecroppers and small peasants tend to purchase land once they have acquired some wealth, whereas they do not really capitalise on this land. Nowadays, there is a general demoralisation of the oasis inhabitants with respect to collective maintenance activities. The disintegration of the power of the community makes it increasingly difficult to enforce traditional common law, which used to regulate maintenance activities. (AÏT HAMZA, 1995; BENCHERIFA, 1991; STEINMANN, 1993; DE HAAS, HEIN, 1998).

Migration has also accelerated the breakdown of ancient socio-ethnic hierarchies in migrant-sending communities. In most of rural Morocco, migration has contributed to the creation of a new social stratification (FADLOULLAH et al., 2000; MTER, 1995), with international migrant households forming a new kind of “migration elite”. (CRAWFORD, 2001; OTTE, 2000). Consequently, members of formerly subaltern groups increasingly reject traditional authoritarian structures. They often refuse to work as sharecroppers or agricultural laborers for traditional elite groups (KERBOUT, 1990; DE HAAS, 1998). Consequently, traditional village councils (jemâas), the most important local political institutions, have lost much of their effective power to settle intra-community conflicts (AÏT HAMZA, 1988; OTTE, 2000), (DE HAAS, 1998; KERBOUT, 1990; OTTE, 2000). Moreover, international migration is perceived as the main avenue of upwards socio-economic mobility (SCHOORL et al., 2000), (FADLOULLAH et al., 2000). Migration has enabled households to invest in housing, agriculture, private enterprises and the education of male and female children. The relatively high and stable remittance incomes improve the living standards of households.

1.6. TUNISIA: MIGRATION AND AGRICULTURAL TRANSFORMATIONS

In the IMAROM research oases, 39 per cent of the households on average were involved in international migration. Nevertheless, the variation is high, with percentages on oasis level varying between 21 and 61 per cent. Higher aspirations, better education, a whole process of ‘opening up’ seems to have led to an increased emphasis on migration. Migration also seems to have accelerated the erosion of ancient socio-ethnic and religious hierarchies as well as the role of old community institutions regulating village life and managing the agro-hydrological infrastructure. However, there are important differences between Morocco and Tunisia in this respect. Two clear trends emerge concerning agricultural investments.

- First, the mean agricultural investments per households tend to be far higher in Tunisia than in Morocco. This perhaps reflects better agricultural investment conditions in Tunisia, and, possibly, higher incomes.
- Second, international migrant households tend to invest higher sums than nonmigrant households in almost all oases. In the Moroccan oases, migrants invest four to five times more (on average) than nonmigrants in agriculture.

The proportion of nonmigrant households investing in agriculture seems to have increased over the past decades in Tunisia. The installation of a motor pump, well digging and land purchase involve costs and risks that many poorer nonmigrants or internal migrant households cannot generally afford. This is especially the case in the

Moroccan oases where the State has not intervened to install central wells, forcing peasants to install private motorpumps.

The role of migration is much more complex. The current shifts in cropping patterns and the rise of motor pumping can also be attributed to general transformations in the environmental, political, economic and social realms which have created a fundamentally different environment for agricultural production. For most oasis households the current agricultural production is insufficient to sustain even an extremely basic livelihood. Oasis agriculture is witnessing important changes which can partially be attributed to the same general economic processes of market integration and income diversification. Subsistence agriculture has lost its former imperative of self-sufficiency. Moreover, technical innovations have changed the conditions under which oasis agriculture is possible. Peasants seem to specialize in crops that are relatively well adapted to local production factors, such as the available labour, gender roles, climatic factors, and specific soil and water characteristics. A growing number of peasants are partially producing for regional, national or even international markets. (DE HAAS, Hein , 2001).

2. CULTURAL CHANGE: DEALING WITH BREAKINGS AND DISCONTINUITIES

There is new spatial logic, where the distinction between old and new oases perimeters gave way to a duality between attractive territories and marginalized spaces. If some oases oriented towards agriculture export are considered “real world-regions”, those that are in isolated areas seem to subsist with difficulty. New activities (such as the exploitation of hydrocarbon resource in the Sahara) or demographic explosion associated with urban oases, profoundly alter former socio-economic and spatial balances. All these factors put a threat on the sustainability of some oasis. The stakes are multiple:

- Social, because it is a matter of offering a viable model to the local populations, and thus fighting against the flight of the workforce,
- Political, because it is a question of integration into the national space, and finally
- Environmental, because the oases are a threatened and fragile environment.

2.1. ALGERIA: DYNAMIC TRANSFORMATIONS IN THE OASIS OF OUARGLA.

Ouargla, formerly known as the "Capital of the Oases", has been regarded since Antiquity as important because of being at the center of an old commercial activity for caravans and nomads. Until the early 1950s, the oasis agricultural system, based on the cultivation of the date palm, was the main economic activity of a population in constant transformation. Since the conquest of the Algerian Sahara and the strategy of occupying enormous spaces in 1966 in the city of Ouargla, the population of the town of Ouargla has not stopped increasing. Thus, in 1977, the agglomeration of Ouargla had 73 900 inhabitants, 185 999 in 1998 and 253 362 inhabitants in 2010. The origin of this new population is diverse. To accompany these transformations, the Algerian State has invested in the development of means of transportation, services, incentives (wage increases of 80% compared to the North, housing program). This has contributed to shaping new spatializations and urbanizations, as well as a new form of occupation of the palm grove.

The different categories of actors do not have the same representations, practices or the same strategies in the implementation of the development of the oasis of Ouargla. The phenomenon of urbanization within the palm plantation has stimulated agricultural activity and could be a new opportunity for the redeployment of agriculture and the safeguarding of the oasis of Ouargla. But it could also lead to a reconfiguration of the socio-economic vocation of the palm grove which would become an urban park "or residential area of greenery, with a shift of agricultural productive activity towards the outskirts of Ouargla. (SALHI, Abdelkader, 2013).

2.2. MOROCCO: PROMOTION OF CULTURAL HERITAGE AND INCLUSION OF WOMEN

Morocco possesses a rich and varied cultural heritage, perceived as a source of national pride, Morocco has always tried to value its cultural heritage and creative industries within government policies and strategies relating to human development, poverty reduction and gender equity, as well as boosting local socio-economic development and sustainability. Morocco sought to create a balance between preserving its cultural heritage and using it for the purpose of economic development. This purpose has been recognized and incorporated into a national strategy of modernizing and decentralizing development sectors that particularly promote local and marginalized populations, including women and youth. The objective is to improve the living conditions of the population. The benefits of cultural heritage in economic and social development were identified and integrated into national strategy and into municipal development plans in the southern oases region. The cultural heritage inventory was upgraded and a management mechanism for Living Human Treasures developed.

One of the sociocultural issues addressed was the situation of women in the oases. Migration and the position of women left behind. Intra-household relations in Morocco tend to be based on strong patriarchal principles. This is manifested in the fact that only men have historically been allowed to migrate alone (CRIVELLO, 2003). Traditionally, migrants leave their wives and daughters behind with their extended family. In this context, remittances are destined for the entire family household as the literal price that the migrant pays for this control. In this way, men were able to migrate without risking their families' honor. (DE MAS, 1990). However, nuclear family households have increasingly become the norm over the past decades. (AÏT HAMZA, 1995; FADLOULLAH et al., 2000). In the absence of their husbands, women's responsibilities, autonomy and power are said to increase (AÏT HAMZA, 1988; 1995; BOUZID, 1992; FADLOULLAH et al., 2000).

To promote and strengthen the role of women in development, one of the MDGs programs supported the integration of gender into community development plans; the political representation of women in Guelmim; the training of 100 women in administrative and financial management; the production and sale of tents by women of the Saharawi people; and a socio-cultural study of the values and traditions that influence the inclusion of women and enhance their role in achieving the MDGs in oasis provinces. Interventions had a visible and very positive impact, increasing women's empowerment, mobility and participation in decision-making.

The program envisaged also to enhance the skill level and capacity of cultural heritage professionals, particularly in the management, conservation and promotion of cultural heritage. Training modules were developed and organized at national level and in four target areas. Strategic plans for the development of the crafts, music, books and cultural tourism sectors were elaborated and implemented in the areas of intervention. Support was provided for the marketing of artisanal couscous and crafts (basketry and tents), training kits on new prototype production were supplied to cooperatives, and art workshops and cultural projects were undertaken.

2.3. TUNISIA : AGRIBUSINESS AND TERRITORIAL MARKETING AS RESPONSES TO CONTRADICTIONAL DYNAMICS

The agricultural sector has not escaped the tendencies of modernization and globalization of recent decades, with the liberation of the Tunisian economy started since 1986 and the free trade agreement signed with the European Union in 1995. The effects of this liberal policy are particularly visible in the oasis farming system. The profound changes in the conditions of access to agricultural resources which accompanied the liberalization and disengagement processes of the Tunisian state have favored the rise of social tensions and demands in rural areas. The priority given to the development of services and the anchoring of the national economy in globalization have led to a sharp decline in the contribution of agricultural activity to employment and incomes of rural households. The oasis economies of southern Tunisia do not escape these developments. In a context of profound changes of economic activity, contradictory dynamics characterize agriculture and oasis spaces today. In particular, accelerated urbanization and desertification processes contribute to a profound transformation of the very structure of the oasis territory.

As a very well documented case study, the two traditional oases of Tozeur and Chenini have been confronted with fundamental changes in their traditional socio-economic organization, and their agriculture has been profoundly affected: the chemical industry complex in Gabes, and mass tourism developed in Tozeur. It is urgent to rethink the traditional model in a profoundly different context in order to find a new way to endogenous local development. This should allow the various sectors to be linked in order to ensure that the heritage value is not solely for the benefit of tourism. It is the multifunctionality of the oasis territories that is at stake. (CARPENTIER, Irène).

Since 2011 and the emergence of a debate on development models, ancient oasis territories appear in the discourses of the various actors involved (farmers, producers, associations, administration, etc.) as a "common good". (GIZ and Ministry of the Environment, 2012). This commitment to the emergence of a new model, is part of the "territorial turning point of the global economy". The processes of "reterritorialization of the local development organization" are multiplying, as a "solution" to the crises of globalization (CAMPAIGN and PECQUEUR, 2014); (THÉRY, 2008); (PECQUEUR, 2006).

2.3.1. The oasis agribusiness model: In a first category, the innovations and transformations of traditional farming systems and territories are carried out within the classical modernist system which contributes to the consolidation of capitalist farms integrated into the national and international market. It is the model of the oasis agribusiness, present especially in Tozeur. By means of strong investments, the

projects of private investors are the norm. These agro-business projects are fully rooted in the logic of integration with export-oriented markets, based on international customer networks and landscape models. These discourses of valorisation of agricultural activity as a local economic resource that can promote the sustainability of the environment are part of a regional context of setting up new logics of economic valorization.

2.3.2. Territorial marketing and tertiarization of oases: In the context of this diversification of forms of development, there is a second category of farmers who promote the model of "territorial marketing", producing services activities, especially leisure or tourism as means of enhancing the "oasis decor" with a national and international tourism clientele. But in the context of the tourism crisis in the oasis, these recreational and restaurant spaces are increasingly being invested by the local population and entrepreneurs are trying to adapt to this specific demand. Thus, the productive function of agriculture becomes marginal and is intended for direct use by customers and staff. The oasis territory is no longer considered as a nourisher, but as a space of leisure and "marketing". The diversification of oasis activities, responding to both international and local demand, is a means of seizing the opportunities of an ever more restricted market, both in agriculture and tourism.

2.3.3. Diversified and multi-family farming: There are still forms of "peasant" development. It is the "traditional" model that makes reference, despite the growing influence of the modernist model. Traditional know-how remains the basis for adapting to the constraints that affect this category in particular: water shortage, sectoral competition and marketing. Self-consumption remains the main function for these oasis crops, especially vegetable and arboricultural crops. Productions are not always economically profitable, but contribute to food security for families.

2.3.4. Specialized and intensive family farms: Some actors are turning to models of intensification and specialization of farms, under the impetus of State programs to support cattle breeding and market gardening projects (in Gabès). It is on the specialization of production and integration into regional markets that these producers build their strategies. However, the oasis landscape is more or less preserved, especially through the date palm, which plays a role of maintaining the ecosystem. These projects develop in a logic of profitability.

2.3.5. The Oasis militants: A final category, that of "oasis militants", carrying an alternative development project based on the rehabilitation of the oasis environment by mobilizing the know-how and the promotion of agro-ecological practices, remains deeply rooted in an ideological and political approach to questioning the modernist and liberal model. The model is based on the diversification of the territory's activities, such as the transformation of products and the establishment of ecological tourism activities, and is part of an associative dynamic, concerned with providing answers to local problems faced by small holders. Their projects are deployed at the heart of diversified associative networks for oasis safeguards, in Tozeur and Chenini. Since the revolution, the multiplication of associations for environmental protection and local development has contributed to the diversification of the actors concerned.

The conquest of autonomy in the management of resources is one of the main stakes of the projects of the associations facing the crisis of the environment. These operators try to create, through associative projects, local and urban demand, anxious

to improve the quality of the products, helping to preserve the environment. Projects are deployed locally, and sometimes through community networks. This is the case of the export managed by the association of safeguarding the oasis of Chenini (ASOC). In the long term, the objective is often the development of services activities related to tourism, culture or handicrafts in the oasis. Alternative tourism is at the heart of these diversification strategies.

This typology of the forms of adaptation of the oasis territory clearly shows that the impacts of these changes linked to the processes of liberalization and globalization are far from being uniform. (CARPENTIER, Irène et GANA, Alia, 2014). Faced with these new economic difficulties, competitive relations over human resources have provoked a new social dynamic. Will the oasis systems, whose incontestable sustainability over several successive generations has been tested for the last few decades, disappear through the exhaustion of hydraulic resources and the reduction of the place and functions of peasant agriculture? It is the responsibility of governments to make the choice of sustainable development, the only way to end this competition on resources, to keep peasants on their lands, to preserve ecosystems and protect the biodiversity of the oasis system. (KHEMIRI, Emna, 2014). It is necessary to analyze the processes of reconfiguration of the territory, in a national political context of questioning the modes of management of resources. The sustainability of oases is not so much a matter of conservation or development projects as of the diversity of local dynamics that mobilize the pluralistic functions of the territory. (ABDEDAYEM AND VEYRAC-BEN AHMED, 2014).

PART IV

ON PALM DATES ECONOMY



The date palm (*Phoenix dactylifera*) is the dominant component upon which the sustainable biophysical and socio-economic structures of the oasis ecosystem are based; a fruit tree with unique nutritional, biochemical and biophysical characteristics, a rich source of aesthetic and cultural values, and a genetic resource. The date palm is the only indigenous wild desert plant definitely domesticated in its native harsh environment. It is closely related to a variable aggregate of wild and feral palms distributed over a desert belt across the Middle East and North Africa. Along with the camel (*Camelus dromedarius*), the date palm was responsible for opening the vast desert territories for human activity and the development of oasis agroecosystems.

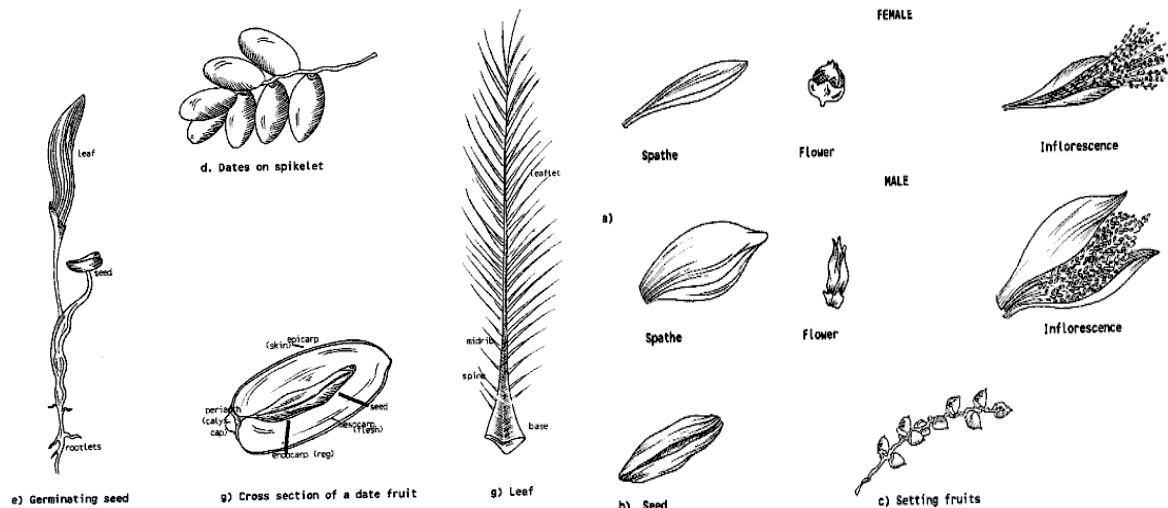
The exploitation of the date palm is an important source of financial income for the inhabitants of the oases. All parts of the date palm can be used: - dates are used for man's feeding; - palm leaflets and nuclei feed domestic animals; - the wood of the stipe, as well as the main rib and the petiole of the palms, serve as building materials. Traditional oases continue to play a vital role in the maintenance and enrichment of date palm genetic resources and their genetic diversity through multiple processes and dynamic conservation practices.

A thorough understanding of date palm genetic diversity and how it is structured in different oases, populations and cultivars is essential for its dynamic conservation and sustainable use. Genetic diversity studies on date palm have clearly demonstrated that there is a clear association between population characteristics and the oases environments in which they grow; whereas, ecological factors largely determine the extent and distribution of genetic diversity.

Local date palm cultivars with outstanding adaptation to climatic and management factors are the products of centuries of interaction between farmers, the genetic and breeding systems of the date palm, and the environment. The breeding system of date

palm as well as several ecological pressures affect the distribution of intrapopulation variability and determine the genetic composition of cultivars within oases. (ZAID, A. and DE WET, P.F.).

Figure 8: Date palm components



1. Origin of date palm

The exact origin of the date palm (*Phoenix dactylifera*) is considered to be lost in Antiquity. However, it is certain that the date palm was cultivated as early as 4000 B.C. since it was used in Southern Iraq/Mesopotamia (POPENOE, 1973) and in Egypt's Nile Valley (DOWSON, 1982). This is confirmed by archaeological research into ancient historical remains of the Sumerians, Akadians and Babylonians. Date palm is probably the most ancient cultivated tree in the world. The reason for mentioning dates and date palms in the Jewish, Christian, and Islamic religions was due probably to the influence of Prophet Abraham, who was born and raised in the old city of Ur, where date palms were grown. The Jews consider the date as one of the seven holy fruits and they celebrate Palm Sunday. But no other religion has stressed the holiness of the date and date palm as much as the Islamic religion. The Holy Koran mentioned date and date palm in 17 Suras (chapters) and 20 verses. Prophet Muhammed (PBUH) is reported to have said that the best property is date palm, that dates cure many disorders, and he urged Muslims to eat the date and **tend** the date palm.

The spreading of the date palm and its cultivation occurred during the past centuries following two distinct directions:

- One starting from Mesopotamia to Iran, to reach the Valley of the Indus and Pakistan; and
- The other starting from Egypt towards Libya, the Maghreb and Sahel countries.

The original establishment of date palm in MENA countries was initially localized in: Tunisia/Djerid; Algeria/Souf, Oued Rhir, Tidikelt and Saoura; Morocco/Tafilalet and Draa Valleys; and Mauritania/Adrar. The old world of date palm stretches from east

to west ($\pm 8,000$ km) and from north to south ($\pm 2,000$ km). Date palm covers 3 % of the world's cultivated surface. (DOWSON, 1982).

2. Geographical distribution of date palm

Date palm is found in both the Old World (Near East and North Africa) and the New World (American continent) where dates are grown commercially in large quantities. The date belt stretches from the Indus Valley in the east to the Atlantic Ocean in the west. The world total number of date palms is about 100 million, distributed in 30 countries, and producing between 2.5 and 4 million tons of fruit per year. Accurate statistics on the number of date palms are not always available and not easy to collect. Asia is in the first position with 60 million date palms (Saudi Arabia, Bahrain, UAE, Iran, Iraq, Kuwait, Oman, Pakistan, Turkmenistan, Yemen, etc.); while Africa is in the second position with 32.5 million date palms (Algeria, Egypt, Libya, Mali, Morocco, Mauritania, Niger, Somalia, Sudan, Chad, Tunisia, etc.).

Iraq is leading with 22 million palms, followed by Iran 21 million and Saudi Arabia with 12 million, Algeria 9 million, Egypt and Libya 7 million each, Pakistan and Morocco 4 million each. The remaining date growing countries have less than 1 million palms each. Table 1 illustrates the date palm cultivated area per country. Morocco has 84,500 ha while Saudi Arabia, Algeria and Egypt have approximately 45,000 ha each. In the remaining date growing countries it varies from 2,500 to 22,000 ha. In each case, the planting density varies tremendously from 50 palms/ha.

Table 4 : Areas and total number of date palms in MENA Region and Saudi Arabia.

Country	Number of palms (in 1,000)	Part of the world's total (%)	Superficies (in 1,000 ha)
Saudi Arabia	12,000	12.00	45
Algeria	9,000	09.00	45
Egypt	7,000	07.00	45
Libya	7,000	07.00	27.5
Morocco	4,250	04.25	84.5
Tunisia	3,000	03.00	22.5
Mauritania	1,000	01.00	-
WORLD	100,000	100	770
TOTAL			

Source: Djerbi, 1995; "Options Méditerranéennes", 1996.

Table 2 illustrates the increase in the number and percentage of the date palm culture in four North African countries. Morocco, because of the damage caused by Bayoud disease and in order to rehabilitate its plantations, is programming the production by tissue culture techniques and the plantation of approximately 2.5 million palms by the year 2007. Once implemented it will ensure an increase of 58.88%. If we look at the annual percentage increase, Morocco and Egypt are the leaders with 3.93 and 2.63, respectively. Tunisia and Algeria follow with an annual percentage increase of 1.84 and 1.10, respectively.

Table 5: Increase in number and percentage of date palm in Algeria, Egypt, Morocco and Tunisia

Country	Years	Increase (in 1,000 palms)	Total increase (%)	Annual increase (%)
Algeria	1970-1994	1,488	16.53	1.10
Egypt	1990-1994	920	13.14	2.63
Morocco	1992-2007 (*)	2,500	58.88	3.93
Tunisia	1970-1991	1,161	38.70	1.84

Data for Libya and Mauritania are lacking. Source: "Options Méditerranéennes", 1996.

During 1996, the top 10 producing countries with regard to harvested areas are in the following order: Iran (153,000 ha), Iraq (116,000 ha), Saudi Arabia (95,000 ha), Algeria (87,000 ha), Pakistan (73,915 ha), Morocco (44,400 ha), United Arab Emirates (31,005 ha), Tunisia (29,480 ha), Oman (28,000 ha), and Egypt (26,000 ha). These 10 countries, on their own, make up approximately 88 % of the world's total harvested area. It has not been possible to obtain more recent data.

Table 6: Area harvested in date palm growing North African countries and Saudi Arabia (hectares) - (from 1961 till 1996)

Country	1961	1968	1975	1982	1989	1996
Algeria	38,000F(*)	59,000F	61,000F	68,000F	78,000	87,000F
Egypt	20,000F	20,000F	20,000F	21,000F	25,000F	26,000F
Libya	-	-	-	-	15,000F	15,000F
Mauritania	4,500F	4,700F	3,500F	3,500F	5,000F	12,000F
Morocco	18,000F	20,000F	23,000F	21,900	20,900	44,400
Saudi Arabia	22,000F	28,000F	53,121	68,583	68,305	95,000F
Tunisia	10,000F	17,000F	12,000	18,000	20,000	29,480
World	238,522C	290,679C	327,275C	414,198C	611,946C	770,795C

(*) **F** stands for FAO estimate and **C** for calculated figure. Source: FAO Trade Stat. 1997. It has not been possible to obtain more recent data.

This clearly indicates that most of the world's date production is concentrated in a few countries in the same region. Date production of Egypt alone represents about 20% of the total world production, while Tunisia, Algeria and Saudi Arabia are among the five leading date-exporting countries (ZAID, 2001). North Africa is the second most important growing area for date palms in the world with approximately 30% of the world's total number of date palms; its production is about 1,500,000 tons of dates (OIHABI, 2001).

Table 7 : Palm Dates Production for the 6 countries studied : Algeria, Egypt, Libya, Mauritania, Morocco and Tunisia, 2010-2014.

Countries	Year	Quantity		Nature of Data
Algeria	2010	tons	644741	Official data
Algeria	2011	tons	724894	Official data
Algeria	2012	tons	789357	Official data
Algeria	2013	tons	848199	Official data
Algeria	2014	tons	934377	Official data
Egypt	2010	tons	1352954	Official data
Egypt	2011	tons	1373570	Official data
Egypt	2012	tons	1400072	Official data
Egypt	2013	tons	1328468	Official data
Egypt	2014	tons	1465030	Official data
Libya	2010	tons	168667	Im FAO data based on imputation methodology
Libya	2011	tons	166157	Im FAO data based on imputation methodology
Libya	2012	tons	168191	Im FAO data based on imputation methodology
Libya	2013	tons	170224	Im FAO data based on imputation methodology
Libya	2014	tons	172258	Im FAO data based on imputation methodology
Mauritania	2010	tons	22349	Im FAO data based on imputation methodology
Mauritania	2011	tons	22718	Im FAO data based on imputation methodology
Mauritania	2012	tons	22297	Im FAO data based on imputation methodology
Mauritania	2013	tons	22482	Im FAO data based on imputation methodology
Mauritania	2014	tons	22667	Im FAO data based on imputation methodology
Morocco	2010	tons	101351	Official data
Morocco	2011	tons	102961	Official data
Morocco	2012	tons	101862	Official data
Morocco	2013	tons	111924	Official data
Morocco	2014	tons	102201	Official data
Tunisia	2010	tons	174000	Official data
Tunisia	2011	tons	180000	Official data
Tunisia	2012	tons	193000	Official data
Tunisia	2013	tons	195000	Official data
Tunisia	2014	tons	199000	Official data

Source : FAO Departments and Offices © FAO, 2017

3. Date nutritional value

Dates are very nutritious, assimilative and energy producing. With the present uncertainty in the world food supply and the expected increase in demand, the date palm could be a good source of food of high nutritional value. The date fruit consists of 70 % carbohydrates (mostly sugars), making it one of the most nourishing natural foods available to man. The water content is between 15 to 30 % depending on the variety and on the maturity stage of the fruit. Date fruit is called a mine in itself because it is very rich in minerals. It contains phosphore and magnesium (± 600 mg/1kg of dates). Date consumers in Saharan areas are known to have the lowest rate of cancer diseases, a fact attributed to the magnesium found in dates.

4. Date products

Modern technological developments have made it possible to look at the palm as a raw material source for industrial purposes. Practically all parts of the date palm, except perhaps the roots, are used for different purposes. The fruit of the date is a drupe and has one seed, which can vary in size, shape, color and quality of flesh. (SAWAYA, 2000), (EI-MOUSLY, 1998). In recent times, there has been a renewed interest in the date as a component in food preparations like sweets, confectionery, baking products, institutional feeding and health foods (BARREVELD, 1993).

Listed below is a brief summary of the main date products:

- Home-made delicatessen: pastry, bakery, confectionery products, and beverages, sandwich spreads, party snacks, salads and appetizers;
- Semi-finished date products: whole pitted dates, macerated chips, date paste and date paste mixtures, extruded date pieces and diced dates, dehydrated dates, date flour (dietetic baby foods), breakfast foods (dates with other dried fruits, cereals, almonds and nuts);
- Ready for use date products: sweets and snacks (date nut roll), chocolate-coated and stuffed dates (with nuts), date jams, date butter or cream, date preserves and cardiments, caramel products, date desserts (with juice, ice-cream, whipped cream, etc.);
- Derived date fruit products: date juice and syrup, liquid sugar (saccharin as a low calorie sweetener for soft drinks), protein yeast and vinegar, fermentation products (wine, alcohol, organic acids, etc.).

Figure 9: Sacred date palm in Sumerian and Babylonian era.

(Soussa, 1969)



Figure 10: Adam and Eve with a date palm between them

(Soussa, 1969)

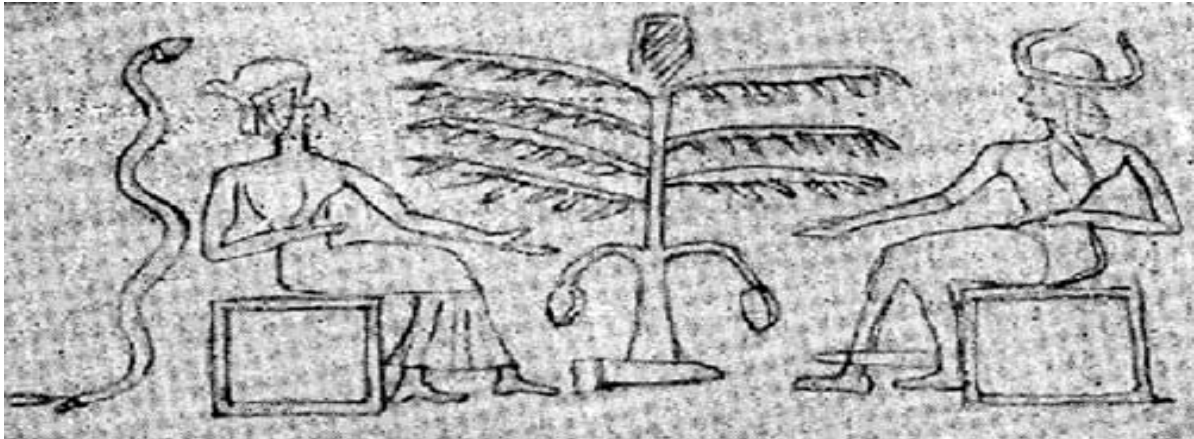


Figure 11: Place of origin and distribution of date fruit in the world.



Figure 12: Geographical distribution of date palm in the world

databases for date cultivation, marketing and manufacturing, replacing overage trees with new good quality ones and increasing the distance between trees.

But there are constraints to rehabilitation (IBRAHIM, 2004) that can be summarized as follows: high cost of production due to employing manual labour, insufficient replacement of low-quality varieties, weakness of marketing services, weakness of post-harvest processes, lack of cold stores, lack of interest in applied research, increase in the costs of storing dates in general and fresh dates in particular, reliance of local date manufactures on governmental authorities, increased infestation of pests and diseases, improper transporting, handling, and storage that result in increase costs and neglect of most date producers and marketers of the marketing opportunities provided by international exhibitions (LOUTFY, I., EL-JUHANY, 2010).

1. ALGERIA: DATES AS A KEYSTONE TO THE OASIS ECOSYSTEM

Date palm culture remains the basis of the desert ecosystem which occupies almost 80% of the whole surface of Algeria (TOUZI, 2007). Algeria ranks fifth among producing countries with 0.52 M tons in 2005 from some 10.4 million trees (BACHIR et al., 2008). The Algerian palm groves currently have 45% of the cultivar Deglet Nour (BOUGUEDOURA et al., 2008) and it is the world second largest producer of this variety (1 million trees) (FAO, 2003). Tunisia and Algeria have focused on the high value confectionary market in Europe (BACHIR et al., 2008).

Date palm sector in Algeria is suffering from problems such as potentialities, technical and environmental constraints and socio-economic preoccupations. Many palm groves were hence fully destroyed, ever buried under sand dunes, or under the influence of drought, and seriously damaged by Bayoud disease (TOUZI, 2007). Poor marketing on a national and international scale is also a problem because of a lack of adequate organizations. (BAAZIZ et al., 2000). Moreover, the absence of rapid means for transporting dates from farms to markets contributes to the deterioration of dates. This problem seems to be either solved or reduced as the Algerian government has set up a "green corridor" for exporting dates in September 2006.

According to data compiled in 2015, the date palm covers about 167.000 hectares in Algeria with more than 18.6 million palms and a date production (all varieties) of nearly 990.00 tons. The date-producing regions are generally located in the south of Saharan Atlas and cover 17 wilayas (the wilaya of Msila lost its date-producing potential).

There are more than 300 varieties of dates, but only few of them have a commercial importance. The main date varieties produced in Algeria are: Deglet Nour, Ghars, Degla beida ou Gerbai, Tafezouine.

In terms of export, quantities are constantly growing up from nearly 21.000 tons in 2013 to more than 28.000 tons in 2015. France remains the first client of Algeria with approximately 13 400 tones, followed by the UE with 1 600 tons, Canada with 1 200 tons, India with 1 100 tons and finally the USA with 1000 tons. On the world level and according to FAO statistics , Algeria is ranked as the fourth in terms of date production, with about 14% of the date's world production and it exports less than 3% of its production while the world average is nearly about 12%. (BOUGUEDOURA, N., BENNACEUR, M., BABAHANI, S., and BENZIOUCHE, S.E.).

1.1. Current Agricultural Problems Date palm is the keystone species of the Algerian oasis ecosystem which is affected by multiple factors. Besides, the human population of the Algerian Saharan region has quadrupled during the past 30 years, creating urbanization and demographic pressures.. Desertification and sand dune encroachment are threatening the oases. Salinization of soil and water, due to poor drainage management, is reducing the number of palms and fruit yield. Finally, the aging of many date palms as well as diseases are causing degeneration of date palms and altering the fruit quality and a significant drop in yield. Farmers seem to be abandoning dates in favor of more profitable crops such as vegetables. (BENZIOUCHE, 2012)).

1.2. Date Palm Status and Perspective in Algeria Ghardaia is a phoenicole region, which produces excess amounts of dates. In fact, after 2013? the production of dates in Ghardaia is growing faster (189%) than overall consumption (56%). This was due to considerable development of date palm programs initiated to support this sector. Until 2012, new plantations, which were not productive, represented 16% of the total number of palm trees, estimated at 1 225 000 trees (MARD, 2013). It is therefore essential to make the best of this excess production for the benefit of farmers' incomes and food security of the population.

1.3. Limitations and Prospects A lack of means to counteract abandonment of some maintenance work in most date groves and the insufficiency of prophylactic treatments (maintaining orchards and collecting fallen fruit) are the main causes of unsatisfactory yield returns. Other factors, such as the lack of remedial and chemical control of date pests, which are rarely performed or done improperly (dose, scheduling), contribute to this situation. Moreover, a lack of extension services, the low availability of recommended pesticides, and their high cost are also negative factors. Date farm operations do not apply the appropriate technical practices fully and properly such as artificial pollination, pruning, irrigation regimes, and harvest.

The fight against diseases caused by pests requires a considerable investment. Many studies have been devoted to bayoud; chemical eradication was performed in the infested location of El Meniaa, and since then, this oasis remains unscathed. Attempted fumigations were also tested in the oases of M'zab. Actions carried out to combat bayoud on the ground are diverse. The main recommendation of distribution of the cultivar Taqerbucht involved establishment of a date grove exclusively of Taqerbucht as a field of mother palms (in M'Guiden, Timimoun, and El Meniaa). The gradual spread of this cultivar is remarkable in Tidikelt. In the settlement of In Salah, Taqerbucht became among the most abundant cultivars. Elsewhere, the farmers have continued the distribution of this cultivar even if it does not appear to be well adapted.

1.4. Conservation Efforts Both scientists and farmers have observed that some date palm regions are experiencing a significant decline in date palm diversity. There is a disappearance or shortage of certain cultivars specific to some oasis soils. In this context, a project, entitled Participatory Management of Date Palm Genetic Resources in the Oases of the Maghreb, was implemented in Algeria, Tunisia, and Morocco for the period 2001–2005 (UNDP, RAB98/G31).. The project's main objective was the preservation and sustainability of oasis ecosystem production by maintaining date palm genetic diversity. In Algeria, the project was launched in the M'zab oasis region (Ghardaia), where efforts are focused on two factors: first, the replacement of traditional cultivars with a small number of cultivars as favored by the

national development programs and, second, the fight against market forces promoting certain cultivars of major national and international commercial value to the detriment of local cultivars.

1.5. Cultivar Production Statistics and Marketing Production of date fruits is now estimated at more than 500,000 mt per year. The level of export is expected to increase to 60,000 mt by the 2014/2015 season. According to experts, the potential of the sector can exceed this volume. Agricultural services have 40 processing and packaging units scattered across the Saharan region. Over a period of 6 years, 83,000 date farmers have been identified. In eastern Algeria, cv. Deglet Noor fruits intended for export to the north continue to increase and now represent close to 50 % of the planted population of dates. Fruits of dry date cvs. Degla Beida and Tinnaser are exported to countries in sub-Saharan Africa. Sometimes, dates such as the cv. Hmira are exported to Russia and China. Among the emerging cultivars, Tafezwin is exported to South American countries. Bentqbala cv. fruit, in a frozen state, is renowned in the local market in Ghardaïa (East). Agaz, an early-bearing cv., grown in Tidikelt (West), is frequently marketed in Ouargla and Ghardaïa.

The date sector faces great difficulties in its operations and has not yet achieved its upstream and downstream objectives, although various support policies have been implemented to benefit the industry. Studies of some Algerian date groves reveal that the date cultivation practices are good in some regions such as the Zibans (BENZIOUCHE and CHEHAT, 2010). However, practices occasionally fall below the standards recommended.

Analysis of the production structure by cultivar shows that the lion's share of production is dominated by cv. Deglet Noor (nearly 49 %), followed by Degla Beida with 32.50 %, while Ghars and similar cultivars accounted in 2011 for 18.5 % of the total production. Higher yields recorded during the period of analysis (1990–2011) are significant, from 33 kg/palm increasing to over 50 kg/date palm in 2011.

At the national level, the best average yields per palm are recorded in the oases of El Oued and Biskra with 61 kg/tree, but they do not exceed 29 kg/tree in the oases of southwest and 37 kg/tree in the south-center. However, the best producers realize up to 150 kg/tree in Tolga with cv. Deglet Noor. The analysis of per cultivar yield shows that the highest average value is recorded by the Deglet Noor cv. with 60 kg/date palm. Other common cultivars including Ghars do not exceed 39–50 kg/date palm. (BENZIOUCHE and CHEHAT, 2010).

1.6. Harvest Mechanization and Postharvest Operations Date harvest throughout Algeria is strictly traditional, and no mechanization is reported except for a few attempts made in the palm groves of D'haouia in Oued Souf between 1998 and until 2000. Unfortunately, this attempt to modernize the harvest failed due to mechanical constraints of sophisticated machines and because of the local topography. (BENZIOUCHE, 2006). All these obstacles to mechanization leave it to manual operations to complete the harvest on time, and especially to avoid any risks related to climate conditions during harvest, disease outbreaks, and price fluctuations (BENZIOUCHE, 2012).

In the Saharan regions of Algeria, date fruit sorting is homogeneous among all producers with the operation accomplished through traditional means. No

modernization of the sorting is practiced. After harvesting and transporting the fruits to sheds in plastic crates, dates are sorted into different categories of maturity to create homogeneous lots. (BELGUEDJ, 2004).

1.7. Marketing and Research

- Date marketing in Algeria is not very successful and fails to meet the expectations. The date market in Algeria is clearly segmented, and each segment is justifiable for a particular approach in terms of marketing mix. Indeed, analysis shows that Algerian dates are known and do not need improvement, but merely effective treatment against pests and diseases and a reliable classification to satisfy world consumers.
- For packaging, at the national level, there are two types of presentation: bulk or packaged dates. Nearly 90 % of the dates are mostly sold loose. Marketing to gain a niche with European consumers, in the case of some processing units, uses fancy packaging to differentiate the requirements of importers.
- For advertizing and promotion, and with a view to develop the export of dates, Algeria has established several approaches. However, they are not used effectively and are not well attuned to the international economic date trade. However, Internet advertizing is experiencing a boom in recent years. Some exporters and packaging facilities have begun to use the Internet for advertising and e-commerce. The other method of dates promotion is through participation in national and international fairs and exhibitions.

Research on Saharan agriculture is currently the responsibility of several research institutions of different disciplines. Research is mainly focused on improving the technical and economic performances of the date sector, identification of water-conserving irrigation systems, protection against pests and diseases, improvement of crop management, and mechanization of date palm farming operations. The present situation is characterized by the absence of a coherent research program and the inability and inefficiency of some researchers in solving practical field problems experienced by farmers. This situation is explained to a large extent by technical, economic, political, and social constraints.

1.8. Current Date Imports and Exports Despite the increase in production, the growth of date exports from 1990 to 2011 shows that Algeria exported only 12,743 mt per year, on average, with a maximum of 26,000 mt in 2011 and a minimum of 3,763 mt in 1994. This data series is characterized by fluctuations, but the quantity of exports increased during the most recent season, 2012/2013. The average value of Algerian date exports was USD 27,660 million in the same period. This value varies between a minimum of USD 10,440 million in 2001 and a maximum of USD 79,120 million in 1995. Statistics confirm a general upward trend of value due in part to rising prices. Algeria exports mainly the Deglet Noor cv. and small amounts of other fresh dates such as cv. Tafezwin. Deglet Noor cultivar continues to dominate with 86% of the average quantities of dates exported between 1996 and 2011 and accounting for nearly 94% in terms of value. Regarding soft dates, two categories dominate: Ghars cv. fruit and date paste with a total of 12% of exports in volume during this period. The remainder consists of dry and similar cvs., e.g., Degla Beida and Mech Degla, which represent only 2 % of the export volume. Most of these exports are principally intended for the European Union accounting for 94.82% of Algeria's exports of dates in value and 95.46% in quantity exported in 2011. In the EU, France is the largest importer with 77% of the quantity and 80% of the value of

date exports between 2000 and 2011, due to the lack of efforts to diversify exports to other markets. Algeria occupied the seventh place with 3.12% of the average global exports of dates during the period 1990–2010.

1.9. Processing and Novel Products. Industrial Processing Activities In Algeria, there is little processing at the industrial or semi-industrial scale for secondary or by-products from the date palm. There is almost a total lack of production of finished products based on date fruits, such as jam, juice, and vinegar; existing technology allows for the production of Ghars date paste, a secondary activity

of processing dates. There are ten processing units of this product line. New units have recently begun the manufacture of pulp as exclusive activity. Insufficient knowledge of appropriate technologies, lack of a potential market, high cost of this operation, lack of coordination between research and industry, satisfaction of producers who benefit from the trade of this untreated fruit, and financial questions are the main impeding factors. By-products are neglected and of low commercial value while they could be an additional source of income for both the date palm farmers and processors.

To improve its exports qualitatively and quantitatively, Algeria was among the first date-producing countries in the world to be interested in packaging techniques and to develop an important infrastructure for packaging. Historically, Algerian date packaging was done in Marseille, France, and tradesmen in that city opened offices in Algeria in the early years of independence, i.e., since the 1960s. Currently, Algeria has decided to take advantage of technological advances in processing and packing with the launch of a major investment program. The packaging sector now operates an industrial factory serving about 35 private processing factories with different capacities. However, the majority of these facilities are poorly designed and do not meet industry standards. Although the capacity of processing and packaging of dates has more than doubled over the last decade, it is still insufficient and characterized by an uneven geographic distribution. There is a high concentration of facilities in southeastern Algeria such as Biskra, which has 29 private factories, while in the southwest region, there is no modern packaging factory (BENZIOUCHE, 2012).

1.10. Bioenergy The goal of bioenergy technology is to recycle waste, utilizing it as fuel to produce energy and provide a partial alternative to non-renewable fossil fuels; in Algeria, bioenergy is under development on an experimental basis (AZIZA et al., 2008). Several pilot projects are planned, such as the Center for the Development of Renewable Energies (CDER) project studying methane recovery from cull dates and fruit processing of by-products. The proposed project involves the development of a method of treatment and extraction of bioethanol or fuel after fermenting date juice. (HOUARI, 2012). Thus, a project is being implemented in Biskra as the first facility to manufacture Nakhoil, a nonpolluting date-based ethanol.

Table 8: Palm Dates Production, Algeria, 2010-2014.

Country	Year	Quantity		Nature of Data
Algeria	2010	tons	644741	Official data
Algeria	2011	tons	724894	Official data

Country	Year	Quantity		Nature of Data
Algeria	2012	tons	789357	Official data
Algeria	2013	tons	848199	Official data
Algeria	2014	tons	934377	Official data

Source : FAO Departments and Offices © FAO, 2017

1.11. Conclusions: In recent years, the date palm sector has been marked by strong momentum and a significant rise in production. This increase is due to various agricultural development programs launched by the government, as well as monitoring of date palm grove health and preventive treatment for several diseases. However, participation of the date sector in Algerian exports remains weak. More efforts should be made to establish a better international market position.

The main socio-economic constraint hindering the development of the sector is the social phenomenon of date palm grove abandonment because of aging farmers and lack of interest by their heirs to continue date production. This trend is particularly serious in the case of small farms. This makes it difficult to increase production and investment on small landholdings. Another impediment is the advanced age of a large proportion of the producing date palms; 13% of them are above 80 years and another 19.6% are close to that age (BENZIOUCHE and CHERIET, 2012). Cultivation is constrained by the substandard level of crop management, lack of know-how of some farmers, low mechanization, water shortages, mismanagement in some groves, as well as a high number of users depending upon a single borehole water source. In addition, lack of efforts to rehabilitate traditional irrigation systems, occasional failure to adopt modern irrigation techniques and falling water tables due to overuse, have forced some date producers to abandon their investments. (BACHIR, B. A.).

2. EGYPT: A BIG PRODUCER WITH AMBITIOUS PLANS

Egypt has been the world's largest producer of dates since 1974 (FAOSTAT, 2009), demonstrating a very high average yield compared to other countries. This is said to be due to good access to water by palms growing along the Nile valley (BAZZA, 2008). Cultivation of new date palms is continuous, in particular in the new reclaimed land in the desert and in saline-affected areas. The date palm sector in Egypt does not have a national marketing authority in charge of designing a clear strategic policy for exporting dates, in addition to the lack of care in categorizing dates for export or grading them in terms of quality and pricing. Furthermore, Egyptian dates face a strong competition in the markets from those of Saudi Arabia, Iran, Tunisia and United Arab Emirates (RIAD, 1996).

Siwa's native date varieties can be broadly classified in four categories: 1) the famous Saidi variety (clone) considered among the finest in the world. In a diversity assessment, Saidi and two related accessions (from Assiut and Faiyum), shared a distinctive genetic profile compared to some 27 other accessions included in the genetic analysis. Accounting for some 80% of all date palms in Siwa, Saidi is a semi-dry type of date. Siwa Oasis produces 65% of all Saidi dates in Egypt. 2) Freihi is the second most important clonal variety accounting for 20% of Siwa's date production. With an average fruit weight of 6.5 g, it is a smallfruited "dry date". 3) A third

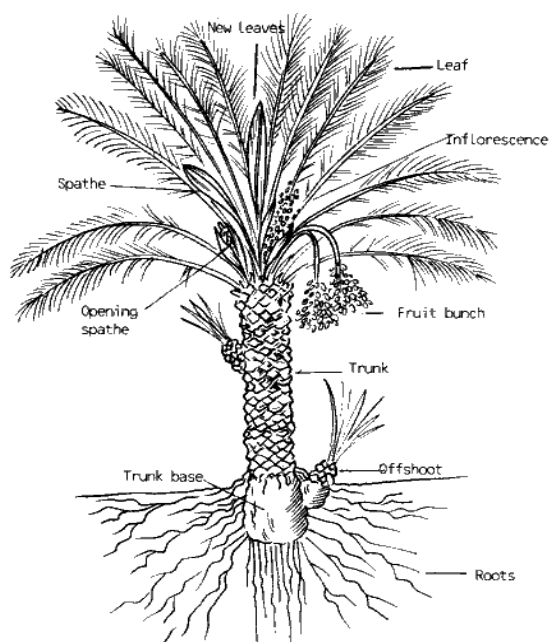
category consists of a diverse set of clonally propagated cultivars with very high fruit quality, but these are difficult and slow to propagate, and therefore represented by a limited number of trees in the oases of Ghazali and Tagtagt, among others. Other clonal varieties exist, like oshikakbil (highest flesh weight percentage), kakwengeb (very large fruits) and abu tawil (long date of up to 10 cm). 4) Some 770 feddan are planted to Azzewi dates, a collective term denoting a diverse set of palms growing spontaneously from seeds. Some 300 “types” of azzewi are identified, ranging from high eating quality dates to very poor quality dates used as animal feed.

2.1. Knowledge systems and adapted technologies: Farmers in Siwa practice artificial manual pollination in order to secure fruit set. Some male trees are grown in date gardens, and pollen is collected for the artificial pollination that is critical for the success of production. Cultivars differ greatly in their fruit set percentage. It is also part of traditional knowledge that different pollen sources can influence the size of fruits, known scientifically as the “metaxenia” effect.

2.2. Date palm harvest and post-harvest knowledge: Unlike most other fruits, dates can be consumed at the four distinct ripening stages described below, with obvious implications regarding their utilization, marketability, nutritional value and processing. These four stages are usually referred to by the local Siwi terms: agingin, irgawin, isimimin, and infit to represent the immature green, the mature full colored, the soft brown, and the hard raisin-like stages, respectively.

2.3. Secondary products from date palm: Secondary edible products include palm cabbage and palm juice. Palm cabbage (called gummar in Siwi) is the tender meristematic apex of the palm and can only be obtained by destroying the palm. Traditionally, consumption of gummar has been reserved for religious festivities. Palm juice, called locally lagbi, does not require to kill the palm, but can be tapped from careful incisions of the apex, which yield several liters per day. There is also a multitude of non-food uses of different parts of the palm. Some of these result from the annual pruning of leaves, fruit stalks and spathes. Leaves are very often used to construct fences providing wind protection for horticultural crops, or to make mats, baskets and crates. They also represent a source of fuel for baking bread and for implements such as brooms. The fiber surrounding the petiole base (asan) is used to make ropes (tasmat). The trunks of date palms are providing construction material for doors, furniture and notably construction beams and ceilings in karshif architecture . Finally, highly nutritious animal feed can be produced from date seeds and low quality dates.

Figure 13 : Schematic Picture of the Date Palm



The first Egyptian date palm festival took place in October 2015 for the first time, with financial and organizational support from Khalifa International Award for Date Palm and Agricultural Innovation of the UAE, Egypt's Ministries of Agriculture and Trade and Industry, the UNIDO and the FAO, the province of Marsa Matrouh, the Council of Siwa City, and the Siwa Community Development and Environmental Protection Association. The festival sought to celebrate the diversity of dates and to promote the awareness for quality dates as well as to find solutions to the problems experienced by the Egyptian date palm producer: the lack of planting material of high-quality varieties, better pest management, and the improvement in processing and packaging for improved value-adding and marketing. Winners of the various competitions were awarded prizes during the closing session.

Table 9: Palm Dates Production, Egypt, 2010-2014.

Egypt	2010	tons	1352954		Official data
Egypt	2011	tons	1373570		Official data
Egypt	2012	tons	1400072		Official data
Egypt	2013	tons	1328468		Official data
Egypt	2014	tons	1465030		Official data

Source : FAO Departments and Offices © FAO, 2017

3. LIBYA: INTERNATIONAL PROJECTS TO PROMOTE THE DATE SECTOR

The data used in this section date back to the period before the war in Libya.

3.1. The project: The project "Improvement and valorisation of date palms" in the Al Jufrah Oases, in Libya, launched in May 2009, is funded by the Directorate General for Development Cooperation of the Italian Foreign Ministry and

coordinated by the Istituto Agronomico per l'Oltremare in Florence, in collaboration with the Libyan Ministry of Agriculture. The aim of the project was to support local economic development through actions benefiting quality date producers and protecting the agro-biodiversity of the region.

The Al Jufrah Oases are located in central-northern Libya. Over many centuries, these oases were at the crossroads of the trans-Saharan caravan routes. There are still dozens of local varieties of dates cultivated in this region today; each variety has its specific features. The most widespread varieties are: Kathari, Saidi, Bestian, Tagiat, Tasfert, Talis, Hamria, Abel, Halima. The Al Jufrah date producers sell the fresh fruit, untreated, or preserve their produce as pressed dates, or make syrup, vinegar or sweets out of them. A sweet, thirst-quenching and highly nutritional juice (lagbi) is made from the palm's sap. Lagbi can be caramelized.

3.2. Date Palm Status and Perspective in Libya: All the production is consumed locally, and the cultivation techniques and the processing industry are outdated and need to be modernized. The program strategy was driven by two main objectives: first, identification of high-quality dates through production protocols that ensure the consistency and quality of the final product; second, protection of the agrobiodiversity by promoting local date palm cultivars and strengthening traditional oasis management systems. For this purpose, 18 Libyan cultivars, representing common genotypes in Al Jufrah Oasis, were studied in detail both from a morphological and genetic point of view. Cultivar descriptions were carried out on the basis of passport descriptors according to international standards to facilitate germplasm passport information exchange together with genetic fingerprinting.

A few years ago, members of the Palmiria Group participated in an important project in Libya focused on sustainable local date palm cultivation. This project aimed at guaranteeing the production of high quality dates by supporting the adoption of best production practices, grading standards for fruit for international markets, valorization of traditional oases management and the protection of agrobiodiversity through low environmental impact agricultural practices. Concerning valorization of date palms, the Istituto Agronomico per l'Oltremare (IAO) coordinated, in collaboration with the Libyan Ministry of Agriculture, the realization of a project to improve date palm cultivation in the Al Jufrah Oases, launched within the framework of an agreement between Italy and Libya aimed at strengthening and further developing relations.

The Project targeted both vertical and horizontal synergies and continuity: from producer to consumer (vertical) and encouraging local producers to join together in associations for the processing and marketing of the product (horizontal). The Project involved all stakeholders in the production chain, promoting and strengthening associations that manage all activities, from production to marketing. The model, taken as a reference in this process, was the experience in Italy in the promotion of typical local products where the goal was to enhance both the product and the entire territory, providing both protection and promotion.

These actions have led to:

- an increase – in both quality and quantity – in date production, through genetic selection and improvement of the local varieties;

- the introduction of cultivation methods capable of optimizing the use of water and energy resources, thus reducing negative impact on the environment; and
- an improvement in the processing and marketing of produce, domestically and internationally.

Table 10: Palm Dates Production, Libya, 2010-2014

Libya	2010	tons	168667	Im	FAO data based on imputation methodology
Libya	2011	tons	166157	Im	FAO data based on imputation methodology
Libya	2012	tons	168191	Im	FAO data based on imputation methodology
Libya	2013	tons	170224	Im	FAO data based on imputation methodology
Libya	2014	tons	172258	Im	FAO data based on imputation methodology

Source : FAO Departments and Offices © FAO, 2017

4. MAURITANIA: IMPLEMENTATION OF AN AMBITIOUS PROGRAM

Located in the Sahelian and Saharan zones, Mauritania has one of the poorest agricultural bases in West Africa. Most important to the rural economy has been the livestock subsector. Farming was restricted to the narrow band along the Senegal River and annual river flooding sustained crop production as well as large cattle herds. A major reason for Mauritania's economic stagnation since the mid-1970s has been the decline of its rural sector. Government planners neglected both herding and farming until the 1980s, concentrating instead on development in the modern sector.

The date palm was introduced in Mauritania between the 7th and 10th centuries AD. The palm plantation consists of about 1.87 million palm trees distributed over the 218 listed oases. These oases cover an estimated area of about 12 000 ha and are distributed in the Adrar in the north, Tagant in the center, Assaba and the two Hodhs in the southeast. Nearly 20,000 people across the country depend on dates for their livelihood. Mauritania's annual production of dates is estimated at 60,000 tons, to which is added a small amount of imports – 1,000 tons from Algeria and 500 tons from Tunisia. Data may vary greatly according to sources (Production varying from 23 000 to 60 000 tons). Around 60 percent of dates are eaten between June and August, during the Guetna (the Arabic name for the season when dates are harvested). The rest is dried for consumption throughout the year. This ranks Mauritania 13th among the producing countries. This production is characterized by the predominance of varieties of medium to poor quality. In addition, national production fluctuates enormously from one year to the next due to climatic conditions, the variety profile and the quality of care provided.

The Mauritanian palm plantation is subject to two types of constraints: - biotic constraints: diseases and pests; - abiotic constraints: siltation, salinization of soil and aging of the plantation. The persistence of constraints has led to the disappearance of

certain cultivars, thus contributing to the impoverishment of the gene pool in the area.

- Biotic constraints: The main endemic diseases affecting Mauritania are: - the disease of black palm dieback; - white Faroun disease whose causal agent is not yet identified. In addition to these endemic diseases, a new disease, called Bayoud, was detected.
- Abiotic constraints: Several abiotic constraints affect the Mauritanian date palms: Silting, wind associated with sand, the aging of the plantations. About 50% of the Mauritanian palm grove has exceeded the age of 70.

Faced with these multiple constraints, the Mauritanian State has developed several programs to safeguard the national phycultural heritage. The two main projects concern the sustainable development of oases and the protection of the date palm. The Oasis Sustainable Development Project (OSDP) implemented since 2002 aimed at alleviating the rural exodus of oases inhabitants: by encouraging them to organize themselves in associations of participatory management of the oases (AGPOs) and, by financing them with income-generating activities (IGA/AGR).

The main tasks of this project were: - to establish the diagnosis of the health status of the palms by drawing up a map of the outbreaks of different diseases and proposing appropriate methods of control; - carry out a program of genetic improvement through controlled crosses. To do this, the following steps were taken: - characterization of Mauritanian varieties; - selection of good, disease-resistant and productive varieties; - launching of a program to restore and rejuvenate the Mauritanian palm grove by in vitro propagation of good, disease-resistant and productive varieties. The date palm project was initiated in 2002 with the support of the Funds to Support the Development of Higher Education (FADES), thus enabling the setting up of the basic infrastructures for research, namely a research station equipped with laboratories.

The focus of the OSDP was date palm growing. The program served as a point of reference for the Government, IFAD and other donors regarding interventions in oases areas. It was distinguished by its relevance to the priorities of the Government and IFAD, and to the needs of the program's beneficiaries, who were subject to soil erosion, degradation of natural resources, poverty and exodus from rural areas. Its successes laid the basis to generate some desired socio-economic transformations.

The IFAD contributed around 37 million dollars. The program focused on organizing farmers around the oases to support the emergence of groups awareness to sustain oasis participatory management associations (AGPOs) and make collective investments. These groups are then eligible for government grants. The project called for AGPOs to manage projects financed by OSDP and a contribution from the farmers themselves. Date palm producers have now to adapt to problems caused by climate change. To help farmers adapt to these changes, OSDP also established field schools to demonstrate sustainable land management techniques. Techniques include intercropping date palms with fruit trees and vegetables, using organic fertilizer, and small-scale irrigation. (BASSILY, Nelly, 2012). In the Adrar region, where nearly half of the country's palm plantations are located, smallholders have proved reluctant to apply modern techniques. In terms of marketing, OSDP has helped to set up a group in Adrar to work together to make transporting dates to the capital, Nouakchott, more profitable. The date palm and the camel – the two pillars of their economy – are well adapted to the climate of the Sahara and the Sahel and remain important assets.

Several field missions were carried out by the laboratory team. Their aim was to collect samples of palms with disease symptoms for subsequent analysis in the laboratory to isolate their causative agents. The program of genetic improvement aimed to identify good male spawners which act favorably, both on early maturity and on formation, for a large percentage of the fleshy part of the fruits. Five males in five different localities of Adrar (Chinquitti, Teyarett, Tweizeguett, Seguelil, Ksair Tochane), one male per locality, and nine female varieties spread over three localities (Teyarett, Toueiweguett, Ksair Torchane). This program is a key step in controlled pollination.

Table 11: Palm Dates Production, Mauritania, 2010-2014.

Mauritania	2010	tons	22349	Im	FAO data based on imputation methodology
Mauritania	2011	tons	22718	Im	FAO data based on imputation methodology
Mauritania	2012	tons	22297	Im	FAO data based on imputation methodology
Mauritania	2013	tons	22482	Im	FAO data based on imputation methodology
Mauritania	2014	tons	22667	Im	FAO data based on imputation methodology

Source : FAO Departments and Offices © FAO, 2017

5. MOROCCO: DATE SECTOR BENEFITS FROM MOROCCO GREEN PLAN

On the socio-economic level, the date palm is the pivot of the oasis ecosystem of the Moroccan Saharan and pre-Saharan regions and the providential tree for more than 2 million inhabitants of these arid regions. Indeed, in addition to its estimated contribution of 40 to 60% to the formation of agricultural incomes (CHETTOU, 1995), the palm provides various other by-products for domestic and artisanal use. Date palm is grown mainly in eleven provinces in Morocco, situated in the southern and northeastern parts of the country (LARBI, 1989). In Morocco, there are 4.8 million trees but only 2.1 million are considered to be productive. However, good quality dates represent only around 25% of total production. This situation contrasts strongly with that prior to the 20th century when Morocco was renowned for dates of superior quality and production levels were much higher (GREINER, 1995). The date palm in Morocco is in clear decline and suffers from a lack of maintenance and interest (DE HAAS and EL GHANJOU, 2000). The status of date production continues to worsen as a result of a combination of factors including prolonged drought, disease and infestation, and sanding up (GREINER, 1995). While date palm is affected by many diseases, Bayoud remains the most serious one.

5.1. The date, lever of south economic development; Despite the advantages of date palm cultivation in Morocco, this providential tree for oases inhabitants still suffers from several problems such as lack of appropriate cultural techniques, protection and post harvest industry. In fact, the use of traditional and empirical

techniques remain a serious constraint to improving quantitatively and qualitatively the date production. In addition, the captive date market doesn't allow to better reward the efforts engaged by farmers to improve the production. This would lead to social problems, especially the rural exodus.

As for the appearance and quality of the fruit, the varieties Mejhoul, Boufeggous, Bourar, Ademou, Bouijjou, Mekt and Jihel are the best among the varieties most represented in Morocco (SEDRA et al., 1996). The varieties Mejhoul, Jihel, Boufeggous, Ademou, Bourar and Aissa Iyoub show the best date appearance (6 varieties out of the 32 studied, 18.7% vs. 40.6% of the varieties with a low quality). The general appearance of soft dates degrades faster than that of dry dates. The varieties with black dates, whose market is less rewarding than that of brown dates, also covered a quarter of the lot.

Moreover, all these clones exhibit characteristics sought by producers and traders, in particular the light brown color and the medium consistency (semi-soft or semi-dry) which offer dates a good general presentation suitable for dates consumed as fruit desert, or filled with almonds. Some of these clones such as Al-Amal (INRA-1443) are already distributed in small quantities to farmers. All these clones deserve to be multiplied on a large scale by the conformed technique of tissue culture in order to fight the Bayoud on the one hand and to improve the quality of the date production at the national level on the other hand.

In order to combat the devastating invasion of the Bayoud of the palm trees and to reduce its impact in the medium and long term, a national plan for the reconstruction and replenishment of palm plantations of the Moroccan palm grove was drawn up in 1986 by the the Ministry of Agriculture. A national committee was set up to oversee the operation, bringing together representatives of various stakeholders in all the palm plantations: Central Plant Production Department, Ouarzazate Agricultural Development Offices (ORMVAO) and Tafilalet (ORMVAT), Provincial Directorates of Agriculture (DPA) of Tata, Figuig, Guelmim, Tiznit, Eddakhla, Laayoune, Tantan, Smara and Agadir, National Institute of Agronomic Research (INRA), Directorate of Plant Protection and Technical Control and Fraud Repression (DPVCTRF), Private laboratory of production of vitroplants. For several years now, this national plan has included another parallel orientation aimed at restructuring the old palm grove and developing new palm groves. In other words, the implementation of this plan requires actions with appropriate consistency and prudence.

As part of this same plan, the varietal profile foreseen for the coming years would essentially include some of the main varieties such as Aguelid, Boufeggous, Bouskri and Mejhoul and selected clones selected such as Najda (INRA-3014), and other new clones. Bayoud susceptible varieties such as Mejhoul, Boufeggous, Bouskri and Aguelid have been proposed for new plantations in disease-free areas. To ensure a long-term, safe biodiversity, it is necessary to continue the program of genetic improvement by controlled hybridization, which will create new high-performing varieties with the desired agronomic traits.

5.2. The Green Morocco Plan: The State therefore intended to put massive subsidies in a multiannual program which will eventually amount to more than 100 million euros. The subsidy rate can reach 100% for those farmers who often own only a few date-trees and whose ownership, usufruct and right of irrigation are sometimes

held by different people. But apart from improving the existing palm plantation, the State is also helping to develop large modern farms. Morocco has 5 million date palms, the 8th largest in the world.

Already 1 million additional plants have been planted since the launch of the Green Morocco Plan (Plan Maroc Vert) in 2009. One of the elements of this project is upstream, namely the production of seedlings. This is indeed one of the missions of NIAR/INRA, and in particular of its station of Errachidia. Here, the most productive or appreciated varieties such as Mahjoul from the field are selected, but there are dozens more, chosen mainly from healthy plants and produced from productive mother plants. The NIAR/INRA of Errachidia has even had a DNA sequencer.

These selected plants, the NIAR/INRA multiplies them by cloning then culture in-vitro. These vitro-plants passed to the stage in vivo (budding strains) are then most often sold. In order to keep pace, NIAR/INRA Errachidia has invested in the extension of its capacity for 2.5 million euros in in-vitro culture rooms and other overpressure seeding rooms to avoid contamination and a glasshouse undergoing finishing for the "hardening" of the vitro-plants. The target was to increase from 20,000 strains produced per year to 45,000 by 2015. The administration acquired healthy and certified plants for distribution to small and large farms.

With 128,000 tons, the production of dates in Morocco reached a record level for the year 2016, an increase of 16% compared to 2015. This record production was reached on an area of palm groves of 50,000 ha, compared to an annual average of 90,000 tons until 2009. In just a few years, the sector has made significant progress, refocused by the rehabilitation of old palm plantations, the creation of new farms, and the introduction of advanced techniques in irrigation. This sector has received particular attention within the framework of the Green Morocco Plan, through the setting up of an upgrading contract signed between the government and the inter-professional organizations of private investors.

To optimize the Moroccan date, an ambitious program of standardization was initiated to facilitate its access to various markets. Another program is being implemented in order to have of 39 units for refrigerated storage and packaging of dates, with a capacity of 8,880 tons, at the level of producing regions, but targeting 30,000 tons by 2020. The value chain contributes 40% to 60% of agricultural income to more than 2 million people and contributes also to the creation of 1.6 million working days per year for a fragile rural population which represents almost 40% of the national population.

In addition to dates intended for consumption as fresh or processed, the date palm ensures, thanks to its sub-products, more than 130 socio-economic uses: feeding of livestock, construction of houses (stipes and palms), barriers to fight against silting, crafts, fuel, consumption of fresh parts of the plant (palm kale), etc. However, the average yield of no more than 20 kgs per foot (2 t / ha) remains too low compared to that of many date producing countries. In terms of marketing, 50% of the production is marketed, 30% is destined for self-consumption and 20% for livestock feeding.

It should be noted that the consumption of dates by Moroccans remains very low, except in production areas, where it can reach up to 15 kgs. To supplement this consumption in fresh, there has recently been a better valorization of dates by the

introduction of processes of transformation of fruit of less commercial value and/or those difficult to conserve, in jams, syrup, paste, nectar, jelly, etc. These high nutritive value products contain no additives and have good organoleptic characteristics, provide added value for consumers. Their diversity and their profitability (one kg of dates allows to obtain 5 to 6 jars of 450 g jam) make them more likely to succeed commercially. One of the most important axes for the future development of the date chain is the improvement of production, both quantitatively and qualitatively. Research is one of the main drivers in this direction. NIAR/INRA was thus called upon to contribute strongly to this vision through its medium-term research program 2009-12. Among the research priorities adopted were:

- Genetic resources management and the creation of new varieties;
- The fight against bayoud;
- In-vitro propagation;
- Improvement of production techniques;
- Management of irrigation water in palm groves; and
- Valorisation of the production of dates.

Morocco supports this culture. The country is the historic cradle of one of the best varieties of dates, the Majhoul, but this activity has been abandoned in the past. This project is also part of the national policy of support for the semi-desert regions, notably through the Agence des Zones Oasiennes et l'Arganier (ANDZOA). This represents a major economic and social challenge for the 1.4 million Moroccans living in the three main oasis areas of the kingdom, i.e. 40% of the territory.

Morocco aims at reconquering its dates market where it has to import 30 000 tons every year from Algeria and Saudi Arabia, which is very bad for the foreign trade of the kingdom in heavy deficit. The palm grove produces only 120,000 tons of dates per year, which does not cover the national demand. Moreover, the supply is poorly organized and many palm plantations are still being exploited in a logic of simple gathering according to the millennium model of the "three floors" (palm trees, fruit trees and ground crops), resulting in losses and quality problems. Marketing, meanwhile, beyond the simple mention of "dates of Morocco" is stammering. Finally, a disease that dries the date palms, bayoud has ravaged part of the Moroccan palm grove in recent decades.

To revive the phoeniculture culture, to vivify the economy of the oasis regions and thus to fix on the spot a part of the population, Morocco launched a vast 4 years development plan in 2011 to boost the palm plantation, both by supporting the traditional agriculture and by relying on intensive operations.

Diseases and pests cause considerable damage to the palm plantations, and traditional production techniques do not make it possible to make the best of the great potentialities of the palm grove: - poor spatial distribution of palm trees - surface irrigation - absence of chemical fertilization - techniques of thinning and bagging of the diets - conditions of harvesting, storage and conditioning. To this, we have to add the fragmentation of properties, the lack of young labor due to the phenomenon of emigration, all being among the causes of low income of farmers.

In terms of marketing, and in addition to competition with imports (cheaper to equal quality), there has been in recent years a growing gap between the production period

and the month of Ramadan during which the consumption of dates in Morocco is at its highest. Hence, the problem of conservation.

However, one of the major constraints to the development of the sector is its weak organization which makes it impossible to cope with these constraints with a view to improving the production, valorisation and marketing of date products. In order to overcome this difficulty, the authorities encouraged the creation of the Moroccan Interprofessional Federation of Dates (FIMADATTES) and the National Federation of Dates Producers (FENAPROD) as well as local farmers' associations in the regions of production.

Like the Berkane clementines, argan oil, Taliouine saffron, Chiadma olive oil, and red sheep meat, the dates Mejhoul of the Tafilalet region have just been awarded the label "Protected Geographical Indication". The PGI, the passport for exports, ensures the protection of the name and its origin against any fraudulent use and national or international counterfeiting. It offers the consumer guarantees of origin, quality and compliance with traceability standards, in accordance with the specifications and verifications for certification.

5.3. Strategic guidelines for the phoeniculture sector: With the implementation of the Green Morocco Plan and thanks to the considerable efforts deployed by the producers, the professionals and the State, the phoenicultural sector has seen a marked improvement in its performance. The production of dates thus reached 108,000 tons in 2013, ie + 15% compared to the year 2010, the date of the start of the program contract signed between the Government and the Interprofession (FIMADATTES). However, in spite of these performances, the sector faces a number of challenges: The development of the date palm is faced with a lack of production of vitroplants and a varietal mix not adapted to the needs of investors, which limits investment in Level of the sector, particularly in the context of Public Private Partnership (PPP) projects. Morocco imports nearly 30% of its needs in terms of dates and supplying the local market with domestic production should be a priority in order to cover demand, especially during the Ramadan period. The deficit in refrigeration capacity limits the timing and marketing potential of producers. Today, Morocco is facing a challenge to accelerate the pace of expansion of the date palm area and improve its productivity in line with the strategic orientations of the Green Morocco Plan, in particular the objectives of the program contract to 2020.

According to data from the Ministry of Agriculture, production of the 48,000 ha (4.8 million feet), representing the current palm grove, is expected to increase from an average of 90,000 tons (between 70 and 100,000 in good years) to 160 000 tons by 2020. This increase of nearly 80% would be achieved following numerous measures, including increasing the area by creating 17,000 ha of new plantations outside the palm plantations, the arrival of new Investors, the use of certified high-quality seedlings, etc. It should be remembered that, at the international level, Morocco was ranking 13th in the world with 4.5% of the plantations (105 million palm trees) and 1.25% of world production (7.2 Mt in 2009) (FAO, 2008). Faced with these challenges, it is essential to solve the numerous constraints of the sector.

Table 12: Palm Dates Production, Morocco, 2010-2014.

Morocco	2010	tons	101351		Official data
Morocco	2011	tons	102961		Official data
Morocco	2012	tons	101862		Official data
Morocco	2013	tons	111924		Official data
Morocco	2014	tons	102201		Official data

Source : FAO Departments and Offices © FAO, 2017

6. TUNISIA: THE EXPERIENCE OF A WORLD LEADING PRODUCER

In Tunisia, date palms are located in the southern part of the country where the conditions are most favorable for the production and ripening of such fruit. Tunisia is the world leading producer of Deglet Nour (FAO, 2003). Although Tunisia represents only about 2% of the world's production, it is the leader in terms of value of exports with 30% of the world's export total and it provides Europe with more than half of its Deglet Nour dates. It occupies approximately 60% of the Tunisian palm plantations and continues to multiply (BOUGUEDOURA et al., 2008). The date palm sector in Tunisia comes in third place in its domestic farm product exports, after olive oil and seafood products. The date producers aim mainly to improve the quality and marketing methods to face the competition of other countries like Algeria and Morocco.

There are about 5.4 million date palm-trees and approximately 50,000 farmers are employed, spreading over four production areas: Tozeur, Kebili, Gafsa and Gabes (GI Fruit, 2008). Tunisia ranks 11th in production, 4th in terms of export volume and 1st in value of exports. Annual production has increased steadily from 47,000 tons in 1982-1983 to 161,650 tons in 2009-2010. Exports increased from 8,900 tons in 1982-1983 to 79,237 tons in 2009-2010 (including 5,328 tons of organic dates). Dates are exported in more than 57 countries. But Tunisia remains very late in the field of valorisation of dates and by-products of the oases. Large quantities of palm date and other crops are scarcely valued. Several associations have undertaken experiments for their transformation into compost, but the gains have not been generalized and the oases remain deprived of such resources to improve soil fertility.

- The oases have long lived under the pressure of population growth. This explains the waves of exodus to other parts of the country and immigration abroad. It also explains the large scale of the illegal growth of palm groves in the Governorate of Kebili, whose regional economy is not very diversified.
- The old social structures were destructured, and the modern institutions, the GDAs, have a rather poor performance.
- The oases continue to show a negative net migration and an unemployment rate above the national average.
- The market economy exposes various products of the oases to competition from other regions and favors the predominance of the monoculture of the Deglet Nour palm (Tozeur and Kebili) and the extension of fodder crops.

- The complexity of oases issues requires the support of a multitude of agents. The absence of a strategy specific to each actor, the lack of coordination and the predominant vision that considers the oasis as a place of production, constitute a handicap for the sustainable development of the oases. (GIZ GmbH Projet CCC/GIZ, Avril 2012)

In Tunisia, the globalization of markets has had a huge impact on the traditional concept of the comparative advantage enjoyed by the country in date exports. In fact, an analysis of the competitive advantage of the Tunisian date industry in the Mediterranean area over the last 20 years shows that Tunisia is still the main supplier of dates to the EU. The Deglet-Nour variety, in particular, puts Tunisia ahead of traditional competitors such as Algeria and Iran. But it is currently facing new competitors like Israel and re-exporting countries like France. New business strategies (conditioning, new non-chemical treatments, packing, opening new markets, new distribution channels) would be positive responses to tackle current market limitations, the emergence of new producers and restrictive EU policies.

In 2011, 7 million tons of dates were produced worldwide of which 2.5% were due to Tunisia, where production reached 180,000 tons. This makes Tunisia the 9th largest producer in the world, and the 3rd in the Mediterranean after Egypt (the largest producer in the world with 25%), and Algeria. The date-growing area covered over 51,000 hectares in 2011 (SIDDIQ et al., 2013). This extension has been steadily increasing over the past 20 years, doubling between 1990 and 2010, and is the 6th most widespread area in the world, after Saudi Arabia, Algeria, Iran, Iraq and Morocco.

The competing countries of Tunisia can be classified into three categories: (i) non-traditional producers that have developed an integrated agro-industry, such as Israel, Palestine and the USA; (ii) re-exporters, which add value to the low-cost imported product, basically France, Italy, Spain, Netherlands, Germany, UK and Switzerland; and (iii) traditional producers of 'Deglet-Nour', like Algeria. Tunisia is in the best position in terms of quantity of exports and related income. But this is not so in product valuation, as it is positioned after the re-exporting countries, such as USA and Israel or Palestine (APIA, 2008). Countries wishing to develop their 'Deglet-Nour' exports to Europe come into competition with well-established and strong suppliers (FAO, 2000). As already mentioned, Tunisia has the highest market share and is the undisputed leader. Despite this strong appearance, there are structural weaknesses, including the disruption of its trading system and the inconsistent quality of the packaged product, as well as a high rate of product infestation (APIA, 2008; JEMNI et al., 2014).

This is noteworthy, given the importance of this sector in the Tunisian economy in terms of export incomes (FAO, 2000). However, it should be noted that there are currently various technical problems including pests and diseases, which are a major threat to the sector (AHMED, 2001; LIKHAYO et al., 2014).

A study was conducted for a group of 11 countries, 10 of which belong to the Mediterranean basin (Algeria, Egypt, Spain, France, Italy, Israel, Jordan, Morocco, Tunisia and Turkey), selected on the basis of date palm export values over the past 20 years. It also included Iran, even though it is not part of the Mediterranean, due to the weight of its date-trade sector, geographical proximity to the Mediterranean, and similarity of climatic and agronomic parameters. The agricultural trade statistics in

general and of dates, in particular, were taken from the FAO. They have been complemented and contrasted with data from the United Nations Commodity Trade Statistic Database (UN CONTRADE), from official records of national statistics for each country. Date export/import missing data were estimated by using data from previous and subsequent years. The period analyzed was 20 years (1991-2010), divided in four sections, of five years each. This study showed that Tunisia is the second most specialized country in date exports after Algeria. It means that Tunisia has made by far the greatest effort to export its dates to international markets, dominating with 26% of global date exports in the last decade (RACHED et al., 2012). A simple analysis of export distribution shows that the main target is the EuroMediterranean area, especially the EU. (AGUAYO, Encarnación and DE MIGUEL-GÓMEZ, M. Dolores). Import prices can vary by up to ten times depending on the variety, origin, packaging and quality (LIU, 2003).

In conclusion, date industry is important in Tunisia, in terms of production and export, playing a key socioeconomic role. Tunisia has a highly important trade position in the Mediterranean area. Nonetheless, recent years have seen a decline in this comparative advantage due to declining competitiveness indices. However, Tunisia is maintaining its market within the Mediterranean, and is well above the index of all competing countries throughout the period analyzed. Although the approach to liberalization of the economy has not achieved the desired impact in either terms of institutions or behavior of the key characteristics of the Tunisian economy (LAAJIMI et al., 2012).

Table 13: Palm Dates Production, Tunisia, 2010-2014.

Tunisia	2010	tons	174000		Official data
Tunisia	2011	tons	180000		Official data
Tunisia	2012	tons	193000		Official data
Tunisia	2013	tons	195000		Official data
Tunisia	2014	tons	199000		Official data

Source : FAO Departments and Offices © FAO, 2017

CONCLUSIONS

This study on the oases facing the major challenges of globalization has prompted us to identify breaks and continuities through the lenses of various social sciences: geography, sociology, economy, history, etc. The oases, as anthropized spaces in arid or semi-arid conditions, have emerged through varied situations. Their histories, dating back to several centuries and sometimes several millennia are different, but somehow certain characteristics are found at different epochs: despotism, colonialism, and more recently integration into globalization, all with moments of opening or closing. In these times of general economic opening, oases are rapidly changing, becoming dependant and requiring new developments.

1. UNITY BEHIND DIVERSITY

Part I of the study has consequently addressed the economic basis of oases, questioning their links with tradition and modernity or rurality and urbanity. The literature shows that an oasis is not just a singular space linked to water; it is also a place that partially escapes power. Scholars retain the singularities of oases in an arid environment and where water is a key to its spatial and social organization. Others deconstruct the eternal oasis and the myth of competent human societies, emphasizing the fact that oases have experienced terrible historical, political and climatic blows. Others dismantle the supposed general solidarity of the oasis models, where the social relations between Berbers, Arabs, and Haratines have evolved. Oases appear as disparate as territories situated rather on the margins of broader societies, and also as the foundation of myths and recomposed political and economic powers.

Part II has addressed the environment changes in the oases, facing extreme climate conditions and the threats to water scarcity and biological diversity, among other issues. A fairly common destiny seems to have pushed many oases to the extreme. They are marginalized by the stakes of the reorganization of world trade, the displacement of resources (water, labor, biodiversity) and the abandonment of specific lands. There remains only little resistance.

Part III has been devoted to the problem of monitoring social and cultural change in the oases experiencing a human and social crisis linked to the scarcity of resources. Oasian peoples no longer function without vast pendular migrations. They are uprooted, deeply detached from the oases, whose development as irrigated space is not independent of pastoral practices any more. Consequences are the contradictory dynamics between different actors in the oasis, who resort to different models ranging from agribusiness to tertiarization (territorial marketing), to secular pluriactivity and/or oasis militancy. Some oases are experiencing new transformations due to the new architectural frameworks and the recomposition of the new habitat, the links with urban structures, the proximity to road networks, but also the abandonment of the techniques of draining galleries (fogaras) and associated gardens. Thus, the heritage evolves, disappears or is redefined otherwise.

Part IV was dedicated to palm dates economy in the six countries studied, as dates are the most important produce of oases. Most of the world's date production is concentrated in these countries, and some of them are leading exporters (Egypt, Tunisia, Algeria). This section of the study aimed at addressing the major problems facing this sector on the levels of cultivar production, optimization of yield,

harvesting, conservation, etc. and the measures that have to be undertaken to improve production, marketing and trade.

2. WIDENING THE DEBATE ON OASES

The study tried to highlight the strength and complexity of current changes, very often accompanied by resilience. Different dynamics are at work, particularly in the framework of the marginalization / integration into globalization, which are the central themes of the study. The oases are of course unequally integrated with the main circuits of exchange today. But the forces at work, local and global, lead everywhere to profound changes and contradictory dynamics. Often, marginalization or decline are witnessed, but not everywhere.

New activities are generally growing to the detriment of old ones: this is the case of tourism (the oases of Egypt and Tunisia) or industry (Gabes, Tunisia). In the same way, urbanization (whether in Tunisia, Algeria or elsewhere) competes with agriculture, where space is limited and water is scarce. New forms of life emerge, as in Algeria's south-west where pluriactivity develops (farmers also having an urban activity). The increasing role of migration is an important and ambivalent phenomenon, integrating populations with the rest of the world, but having a strong negative impact on agriculture with the departure of young people and a shift in income sources. Different categories of new actors appear, having a major influence on the current dynamics of these spaces. This is the case with foreign investors increasingly involved in various forms (capitalist agriculture, tourism, etc.) within the frame of neo-liberal policies (Southern Tunisia). The present mutations cause changes in the behavior of the oasis populations. The effects of tourism (Egypt, Morocco) emphasize the extent of the current changes in social configurations.

3. OASES SITUATION AND THE NEED OF THE DEVELOPMENTAL STATE

Intervention seems necessary. The State remains a particularly important actor in connection with local planning policies and beyond the overall economic policies. A strong process of singularization of these spaces is underway. By going very far to look for the resources that seem to be lacking locally, the State can develop new territorialities that are no longer based on the exploitation or valorisation of the oasis environment, but on the advantages of a glocalised position that short-circuits the regional national relays and / or makes more use of international entities. Here, the phenomenon of glocalization can be understood as a greater ability of these oases to find the necessary resources in a distanced environment. (DE HAAS, Hein, 2001).

Spaces and societies in the oasis "standardize" to catch up with the rest of the national communities on issues as varied as soil saturation, poverty, democratization, tertiary activities. UNO standards, like sustainable development or territorial marketing are spreading, while the original characteristics of these spaces are fading away. Space organization norms are homogenized to meet the standards built for new users of these spaces, tourists and seekers of aesthetics. Particularly in the Maghreb (Morocco, Tunisia), it restructures civil society and determines the institutional tools for collective mobilization; it directs priorities towards local, participatory and territorial development and constitutes a new decentralized framework of cooperation and partnership.

More or less, the developmental State does not appear to have been particularly concerned with oasis development. Even in national contexts characterized by the presence of large development States (Tunisia, Algeria), we have not discovered holistic "Oases Plans"; the State seems to have generally ignored the strong specificities of these environments. Therefore, the evolution of oases is to be inscribed in a singular development trajectory of articulation to the world and of withdrawal into oneself, somewhere between the two ends of the scale, the local and the global. (MARSHALL, Anais, LAVIE, Emilie, CHALEARD, Jean-Louis, FORT, Monique, LOMBARD, Jerome, 2015).

4. THE FRAGILE STATUS OF OASES IN THE CONTEXT OF GLOBALIZATION

A new approach of the oasis system in all its dimensions should be taken within the framework of a multisectoral sustainable development policy.

1. The transformation of oasian society and space is much deeper than a simple deterioration of small oasis production and its traditional irrigation system. The sudden change in the economic and social life of oases and their integration into a global economy are the real reasons for the mutation of space and society in the oases. Their practices are gradually being forgotten because current production systems tend to align with the modernity imposed by the political decision makers.

2. Oases are facing several environmental problems. There is a need for proper management procedures to address these problems and pave the way for environmentally sustainable and socio-economically viable use of these vital resources. Therefore, the different actors and stakeholders should be environmentally aware. Indeed, the governments should set a framework for collaboration to ensure maximum mutual benefits. (RAMZY, Y. H.).

3. By comparing agricultural developments in the oases of the six countries of MENA, we have identified various factors of transformation, explaining the spatial heterogeneity of oases. Among these factors, the national political and economic context seems to be the most determining factor in the destiny of oases. The general level of economic development, the integration of oases into national and international markets and the development of infrastructure all determine investment conditions. Furthermore, the effectiveness of State intervention determines the risks and profitability of investments and seems to have a clear impact on the tendency to invest. These conditions seem at least slightly better in some countries (Tunisia) than in others (Morocco).

4. Resources management in oases cannot be understood without considering the wider socio-economic and political context in which it operates. The fundamental societal changes that occurred in the last century have profoundly affected local land use and resource management. The effects of the political context, following what was named the Arab Spring, are also to be taken into consideration.

5. These changes linked to the processes of liberalization and globalization are far from uniform. There is a diversity of valuation strategies as well as a significant differentiation of the socio-economic profiles of the farmers. The dynamics observed in the different cases studied illustrate this process of diversification / differentiation of the practices of oasis agriculture and also testify to its resilience and its vitality. (CHALEARD, 2008). (CARPENTIER, Irène, GANA, Alia, 2014).

RECOMMENDATIONS

1. FOR A RENEWED VISION OF OASIS DEVELOPMENT

In terms of sustainability, the oasis has proved its worth to date. The question that remains open today is that of its promotion and preservation, which is dependent on our ability to give it scientific and technological support and to maximize its ancestral achievements. However, in the face of climatic threats, the search for adaptation strategies should be favored. The oasian model demonstrates the human capacity to adapt to the most severe conditions in the environment, and this has also motivated this reflection as a mark of hope for humanity. LAKHDARI, 2014).

The sustainability of oases requires their restoration, protection and preservation. In addition, their invaluable wealth is a real opportunity for their people and the national community. The new vision should bring oases to healthy, prosperous and sustainable ecosystems for present and future generations and must be integrated, territorial, multifunctional and multi-stakeholder. To achieve this renewed vision of the development of oases, strategic axis should include the following:

Figure 14: The renewed vision of oases development:

1	The conservation and improvement of oases ecosystem	5	Intensification and valorization of oasian agricultural production	9	The development of renewable energies
2	Preservation of biodiversity	6	The development of drainage water	10	A better integration of oasis zones with their environment
3	Reducing pollution and nuisances	7	A better marketing strategy for dates	11	A better local environmental governance and decentralized management of natural resources
4	The preservation of agricultural land and the sustainable management of urban space	8	Better land restructuring.		

The recommendations relating to the conservation and improvement of these ecosystems can be detailed as follows:

Figure 15: Detailed renewed vision of oases development.

	AXES	DETAILED ACTIONS TO BE TAKEN
1	Reducing the pressure on the oasis ecosystem	-Rehabilitation, modernization and strengthening of preventive and curative maintenance of irrigation and drainage equipment and networks, strengthening of water-saving programs; -Limiting illicit extensions; -Control of irrigation through rational water use, economical water pricing and water saving.
2	Preserving biodiversity	- A comprehensive inventory of all oasian resources; - Strong enforcement of legislation on transporting and trading palm discharges; - Development of in vitro cultivation of palm;

		-Encouraging the planting of the most threatened varieties of palm trees.
3	Reducing pollution and nuisances.	-Improving sanitation programs and protection against rainwater; -Establishment of an improved system to collect by-products and waste in the oases; -Urgent implementation of planned landfills and the planning of other landfills; -The clearing of the beds of several wadis; -Prohibition of dumping wastewater into the wild and creating wild dumps; -Implementaion of programs to control ndustrial pollution; -Development of organic oasis products.
4	Preserving land and sustainable management of urban space.	-Achievement of functional social housing to discourage illegal construction in oases; -Better co-ordination to control anarchic constructions; -Strong enforcement of legislation.
5	Intensification and valorization of oasian agricultural production.	-Broad dissemination of knowledge acquired in research and know-how in the management of palm and other crops; -Strengthening of phytosanitary protection and prospecting; -Generalization of biological control against major pests; -Increasing scientific research on: irrigation, drainage, diseases, pests, fertilization, better valorization of organic products, etc.); -Valorisation of less quality dates for uses like pastry, vinegar, syrup, jam, etc. -Development of on site agro-industrial activities; -Deepening of the know-how in the field of oasis agriculture in connection with climate change.
6	Management of drainage water	-Presently, there are few opportunities for drainage; only forage crops and forest shrubs can be developed. -This experience can be extended. The objective is to study the technical and economic feasibility of water to enhance its use for other crops.
7	Better marketing strategy for dates	-Ensure that oasis regions derive the maximum added value from the date sector through a better organizing of producers' structures and a search for new markets; -Diversification of the date varieties to be exported and the development of foreign varieties successfully tested; -Coordination with other date exporting countries to safeguard mutual interests.
8	Better land restructuring.	-Strengthening and activating the authorities' interventions and intermediation in the oases by lines of credit for land; -Combating abandonment and under-utilization by: expropriation, penalties, financing campaigns; etc.
9	Development of renewable energies.	-Necessary to reduce the consumption of electric energy, and consequently the costs of production, and to have a clean energy, a stronger integration of oasian zones with their environment and with with other sectors of activity.
10	Better integration of oasis zones with their environment	-Maintaining the protection and development of oases in the priorities of land-use planning, preserving the cultural heritage of the region, diversifying the regional economic base, developing transportation, infrastructure and communication, upgrading of towns and villages, improving the quality of life, integration of the oasian regions and upgrading and enhancement of human resources. -Diversifying economic activities upstream and downstream of the oasis

		activities (agri-food industries, handicrafts, local resources, sustainable tourism, etc.
11	Better local environmental governance and decentralized management of natural resources.	<ul style="list-style-type: none"> -Increased powers and roles of local actors (administrations, locally elected representatives, NGOs and GDA , etc. -Strengthening the capacity and mobilization of local actors in the field of sustainable oasis development. -A better coordination between actors. -Establishment of appropriate regional institutions for oases development and coordination of interventions. -Generating funding sources for oasis development actions. -Establishment of local oasis observatories.

2. ROLES OF ACTORS IN OASES CONSERVATION AND DEVELOPMENT

The roles of actors in oasis conservation and development could be as follows:

Figure 16: Role of actors

	ACTORS	MISSIONS
1	State and Public authorities	Conductors of development interventions
2	Scientific/Academic research	To identify in time any problem threatening the oasis ecosystem and to quickly find solutions
3	Local authorities	Essential players in the coordination of all stakeholders and participation through financial contributions
4	Media and communication strategy	Raising awareness of oases preservation at all levels, to support initiatives, information and a good governance
5	Private responsible citizens	Responsible economic agents, users of natural resources and polluters have a decisive role in the preservation of the oasian ecosystem
6	Farmers	Adopting good water-saving practices, improving the value of natural resources, preserving agricultural land and biodiversity, limiting illegal extensions and participating in limiting any environmental nuisance
7	Workers, women and youth	Different roles to play in everyday life of the oases
8	Private operators	Participating in activities relating to oasis agriculture, industry, dates, sustainable tourism in the oasis system
9	GDA	Ensuring transparent administrative and financial management, limiting illegal extensions and constructions, helping farmers and initiating projects
10	NGOs	A vital link between oases and other actors, necessary to alert, popularize, sensitize and mediate issues

3. STRATEGIC RECOMMENDATIONS

3.1. Global guidelines

The design of the strategy is based on both the theoretical concepts related in particular to territorial and local development and on the lessons learned from the different experiences carried out in North African countries studied. This strategy is mainly characterized by four determinants:

Figure 17: The 4 determinants of the strategy

<p>(I) The concept of construction of the territory, overlapping local development and governance, by developing a common strategic vision for oasis development based on a broad consultation of all citizens and partners and actors concerned.</p>	<p>(II) A strong representativeness, involving effective participation of local populations and grass-roots organizations in local development projects through institutions aiming at the capacity building of territorial actors.</p>
<p>(III) The concept of sustainable development, shifting from an approach focusing exclusively on short-term economic and social development concerns to a vision centered on concrete conciliation between development dynamics and environmental imperatives.</p>	<p>(IV) A holistic vision, imbricating the complex relations with other spaces and other communities and rethinking the management of oases in a context of integrated local socio-economic and socio-cultural development.</p>

3.2. Intervention approach

Agricultural development in the oasian regions must be structured around three levels of intervention: small, medium and large. There is an urgent need to promote the small oasis family farm, which is the guarantor of the ecological and social balance of the oases as well as the average family farming. This type of farming must be a transitional stage between the subsistence farm and the large farm. Moreover, it is also necessary to promote large scale farming which is based on agriculture and of an intensive type and which would be capable of achieving import substitution and reducing the country's food dependence.

The approach to be promoted for the implementation of the sustainable oasis management strategy is based on the principles of territoriality, integration and participation of all stakeholders and the accountability of local farmers' organizations. The objectives of the strategy will only be achieved with the introduction of technical and pedagogical tools, the mobilization of human and financial resources for an adapted communication strategy, the capitalization of good practices and the realization of possible readjustments. This intervention approach will take into account the integration of elements of good governance, the participation of all stakeholders in decision-making, the development of decentralization and the involvement of civil society in the development process.

The participatory planning process will lead to the identification of actions and measures to restore ecosystems and restore their ecological and environmental functions as part of the pillars of oasis development and preservation of their heritage value. On the socio-economic level, the aim is to support the emergence of interest groups, around actions to develop production systems and management of natural

resources and around the promotion of agricultural and extractive income-generating activities by providing them with the necessary support (training, financial support, community supervision, etc.).

- The first guiding principle aims at establishing local and shared environmental governance in the oases, with a view to their preservation and their development by strengthening of research and development; institutional and administrative planning, knowledge and development of more sustainable technical routes, based on the potential of oases in terms of agro-ecology.
- The second principle deals with the rehabilitation and preservation of the ecological and environmental functions of oasis ecosystems. It focuses on the management of water resources.
- The third relates to the protection of the environment of agricultural areas and the financing of which is economically justified. The fourth axis is concerned with the management and preservation of agricultural and urban areas in oases, as well as with the improvement of the living environment of the oasis populations. The fifth priority axis focuses on risk management and ways and means of adapting oases to the effects of climate change.

3.3. Strategic axis of intervention (SAI)

These can be detailed as follows.

Table 18: Detailed SAI:

<p>SAI1: Improvement of oasis governance and involvement of all stakeholders in the implementation of the strategy</p>	<p>Several specific objectives are to be achieved: Strengthening the political, institutional and legal framework specific to oases. Support for governments orientations; Adoption of a regulatory framework to institutionalize the practice of a participatory and integrated approach to the development and management of oasis ecosystems; Encompassing in a "code of oases" all the texts in various economic, social, cultural and other fields; Adoption of a platform for communication giving more visibility, understanding and support to governmental actions, establishment of a regional, decentralized, transversal institution for the development of oases and the coordination of interventions; Agricultural investment and the structuring of the production chain, commercialization and valorization of date palm products, support scientific research and development research. This perspective implies a redefinition of the roles of the various actors.</p>
<p>SAI2: Protection, integrated management and economy of use of water resources</p>	<p>Three specific objectives: 1. Conservation, collaborative and integrated management of water resources at regional level, requiring updating knowledge mobilization, exploitation and development of tools; 2. Integrated water resources management on the basis of the new knowledge acquired and the risks involved (conventional and non-conventional); 3. Economy, valorization and adaptation to water scarcity.</p>
<p>SAI3: Rehabilitation and</p>	<p>Preserving the sustainability of the exceptional biological richness of oases requires:</p>

<p>conservation of the plant and animal biodiversity of the oasis ecosystem</p>	<ol style="list-style-type: none"> 1. Strengthening of the varietal biodiversity of the date palm; 2. Preservation and improvement of seeds of herbaceous crops; 3. Restoration and preservation of the genetic heritage of fruit varieties in oases; 4. Conservation of the biodiversity of the oasis spontaneous flora and fauna; 5- Protection of several other animal and plant species in the oasis environment.
<p>SAI4: Protection of the environment of the agricultural and urban areas of the oases and improvement of the living environment of the oasis populations</p>	<p>Four specific objectives are to be achieved:</p> <ol style="list-style-type: none"> 1. Shifting the planting date, switching crops and crop varieties, as well as expanding the area of production and / or increasing irrigation coverage; 2. Protection of the oasis environment against pollution through the collection of wastewater from oases and their treatment before their rejection in the natural environment; 3. The generalization of landfills and solid waste collection stations and the establishment of wastewater collection networks in urban agglomerations; 4. Protection of oases against flooding and silting.

<p>SAI5: Management, preservation of agricultural land, combating desertification and sustainable management of the oasis urban space</p>	<p>Three specific objectives:</p> <ol style="list-style-type: none"> 1-Fighting the degradation of oasis soils and improving their fertility; Mitigation of the phenomenon of widespread decline in soil fertility, Fighting to reduce the fragmentation of farms and abandonment of oasis lands. Protection of agricultural land against urbanization and sustainable management of the oasis urban area; 2- Development of a plan to safeguard oases; 3- Introduction / strengthening of local and participatory territorial management procedures.
<p>SAI6: Rehabilitating productivity and maintaining a viable and ecological operating system:</p>	<ol style="list-style-type: none"> 1. Consolidation and intensification of oasis agricultural production, by promoting agroecology, reconciling traditional practices with the scientific achievements, and with locally available resources, and aiming to reduce costs by reducing external dependencies. Strengthening agroforestry, Reforming the system of aid and support to the oasis agriculture; Irrigation water supply and distribution systems in order to ensure a constant supply of irrigation water by implementing an innovative approach known as "oasis extension"; 2. Organization and consolidation of traditional oasis products, by efficiently encouraging agricultural investment and structuring of the production chain; Marketing and valorization of date palm products, in partnership with the various stakeholders; Encouraging compliance with the quality standards demanded by the most remunerative markets, given the real trends of competition with other countries; 3. The development of the "date chain" should be redesigned to provide a lever for the promotion of other goods and services provided by the oasis community ; it is not only goods and services that are promoted but the whole territory; 4. Strengthening of development and commercialization of agrobiological certified products. Supporting alternative production methods (organic farming, biodynamics, designation of origin, etc.) Selecting products and creating certified pathways (aromatic plant and sales and promotion of the oasis label); 5. Research on the oasis focusing on current problems to fill the knowledge gaps persisting around different themes.

<p>SAI7: Creation and consolidation of income-generating activities and promotion of social solidarity economy</p>	<ol style="list-style-type: none"> 1. The strategy promotes a policy of maintaining a competitive and employment-generating oasis system, by diversifying the economy and promoting solidarity employment. Additional jobs that can be developed and real opportunities exist. Actors are advised to look for other channels to diversify the local economy basis and create employment. Tourism, agri-food and agricultural services can be promising niches; 2. To develop social and solidarity economy through a collective and participatory system, any economic project should have social utility, ethical implementation, participative governance and development dynamics aspects, based on a territorial anchoring and a citizen mobilization; 3. Encourage experimental initiatives of institutions by pooling the means of social innovation; 4. Develop appropriate financial tools, including a social innovation fund, which provides zero-repayable advances, as well as grants to finance feasibility studies, prototypes, support local development initiatives; 5. Remittances from oasis migrants should not only be encouraged, but the State should devise the most effective means of directing these funds for specific purposes.
<p>SAI8: Rehabilitation and consolidation of the heritage, landscape, socio-cultural and tourist values of the oases</p>	<p>This axis is particularly aimed at historical oases. The future of these oases should be considered for the numerous functions they play as environmental, cultural and landscape heritage. Several options are possible for rehabilitating and preserving them: recognition of their specificity, delimiting their protected area, eventually based on international recognition (UNESCO).</p> <ol style="list-style-type: none"> 1. Restoration and preservation of the historical and cultural heritage of the oases The ethnographic and historical aspects of the past of the oases are rich. Museums and cultural spaces are a means to keep their memories alive; 2. Promotion of an appropriate alternative oasis tourism (agro-eco-tourism), based on sustainable development, both ecosystem-friendly, and locally income generating; 3. Promoting socio-cultural activities and events such as festivals, oasis marathon, traditional cavalry, etc.; 4. Promoting the classification of traditional oases and farming; 5. Rehabilitating and valorizing artisanal know-how through the upgrading of local products, involvement of renowned designers, partnerships of institutes of arts and crafts, technical and artistic training of students in collaboration with design professionals of the design and artisans.
<p>SAI9: Risk management and adaptation of oases to climate change</p>	<p>Three specific objectives are identified:</p> <ol style="list-style-type: none"> 1. Adaptation to climate change by: Capacity-building for better planning, coordination and implementation of local plans and actions related to Climate Change (CC), Promotion of innovative actions and strategic projects / interventions that serve as a model for sustainable livelihoods; 2. Valorization of renewable energies; 3. Considering environmental emergencies and better management of environmental disasters, Establishment of a system of risk alerts (fires, pollution, flood, locust, etc.).

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