

## DEVELOPING PERSPECTIVES ON CLIMATE CHANGE

Issues and Analysis from Developing Countries and Countries with Economies in Transition

# Vulnerability of North African Countries to Climatic Changes

Adaptation and Implementation Strategies  
for Climate Change

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# Vulnerability of North African Countries to Climatic Changes

## Adaptation and Implementation Strategies for Climate Change

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### Summary

The North African countries are in an arid to semi-arid region with a Saharan climate in the south, an oceanic climate in the west, and a Mediterranean climate in the north. The central part of North Africa, composed of Morocco, Algeria and Tunisia, had 65 million inhabitants in 2000 and is projected to have more than 72 million in 2010. More than two-thirds of the population is predominantly concentrated on the Mediterranean and Atlantic coasts in the north of the region.

In these countries, the life of the population is very much linked to the climate and its fluctuations. The economy is very dependent on water, agriculture, tourism and coastlines. This is particularly striking in Morocco and Tunisia.

Climate data gathered in the region during the 20th century indicate heating, estimated at more than 1°C, with a pronounced trend in the past 30 years. The data also show a marked increase in the frequency of droughts and floods. The region experienced one drought every 10 years at the beginning of the century, to a current state of five or six years of drought per ten years. The general circulation models, even though they are not accurate enough for the region, since there is no mesh model, converge to estimate probable warming in the region in the order of two to four degrees in the 21st century.

Climate change in this part of North Africa (Algeria, Morocco and Tunisia), which emits low levels of greenhouse gases (between 1.5 and 3.5 emission tonnes of CO<sub>2</sub>/inhabitant/year), represent a veritable threat to the region's socio-economic development and to its population. The extreme vulnerability of the region, coupled with the possible impacts climate change represents, stresses the need for adaptive strategies in key sectors in the region for the long term sustainable development of these countries.

The objective of this analysis is to show how three key sectors of the region (water, agriculture and coastline) might fare over the coming decades, and with what consequences to the population, if true adaptive policies are not devised and implemented in region. The analysis is based on the results of the technical studies and research conducted to date in North Africa, particularly those incorporated into the national communications of these countries, presented at the Seventh Conference of the Parties to the United Nations Framework Convention on Climate Change. The pressing need for structural approaches to adapting to events caused by these climate changes is emphasized within the analysis. The case of water, a vital factor for the populations of North Africa, will serve as a basis for this illustration.

This analysis also places emphasis on the inadequacies of the studies and research conducted to date for assessing and evaluating the region's vulnerability, and also suggests future research directions. Suggestions are made for actions to be taken by the countries in the region, both at the technical level and the political level, to enable efficient and lasting adaptation to the deleterious effects of climate change.

### I Introduction

To date, negotiations conducted in the context of the United Nations Framework Convention on Climate Change have largely focused on the aspect of mitigating the effect of greenhouse gases in order to limit the problems that are the source of this global phenomenon. As a result, there have been sustained efforts deployed to ensure the success of the Kyoto Protocol and launch this dynamic of emissions reduction.

Another equally important aspect that has received little focus during these negotiations is *the vulnerability of some regions of the world and their need to adapt to the effects of climate change*. It is true that funds have

been set up to finance these aspects, but their implementation is in the distant future and we are seeing few concrete results with respect to this problem.

Since 1994, three countries in North Africa, (Algeria, Morocco and Tunisia) have taken concerted and strongly synergistic action in the area of climate change, with support from a UNEP-GEF capacity-building project (RAB94G31). These countries, which emit low levels of greenhouse gases, are particularly vulnerable to climate change. The main results of studies and research conducted in this area have been summarized in the initial national communications presented at the Seventh Conference of the Parties to the Convention (COP-7), held in Marrakech in 2001. (1), (2)

The objective of this article is to show—through the results of the technical studies and research conducted to date in North Africa—how three key sectors in the region (water, agriculture and coastline) might fare over the coming decades, and the consequences to the population if true adaptive policies are not devised and implemented in those countries in the near future. Also emphasized is the need for studies and research to better assess this vulnerability and to determine the most appropriate adaptive actions. The case study used as a basis for this analysis is the water sector and its future behaviour in this region in the event of climate change.

## II Climate of the region

Due to their geographic location in an arid to semi-arid zone, the development of Algeria, Morocco and Tunisia has been strongly linked to the climate of the region and its variability. This climate is characterized by great contrasts, with very different climate types in relation to the geographic and ecological particularities of the region (5):

- The three countries are located in a territory with a surface area of more than 3.3 million square kilometres, more than two-thirds of which are located in desert zones.
- The region is predominantly semi-arid to arid, subject to a climate resulting from maritime influences to the north, east (Mediterranean Sea), and west (Atlantic Ocean) and Saharan influences to the south.
- A wide diversity of climate types exist which is associated with the longitudinal and latitudinal

size of the region, the existence of mountain ranges exceeding 3,000 metres and the maritime influences in proximity to the coast.

- The region experiences a wide spacial and inter-annual variability in precipitation, with less precipitation in the south, a very limited number of days of rain (fewer than 50 days in a large part of the zone) and frequent episodes of drought, which can last more than three successive years.
- High mean annual temperatures, exceeding 20°C in the south, and milder temperatures along the coastline. This is linked to the high level of solar radiation in the region, and to the frequent advection of hot air masses. These factors lead to extensive evapotranspiration.

Climate data gathered in the region during the 20th century indicate heating, during the century, estimated at more than 1°C, with a pronounced trend in the past 40 years. (1) The data also show a marked increase in the frequency of droughts and floods going from one drought every 10 years at the beginning of the century, to a current five or six droughts every 10 years. The increase in the number of droughts is accentuated by years with very strong rainfall over a short period. Hundreds of millimetres of water can fall on arid regions in a few days with no other precipitation for the rest of the year. Arid soil, erosion, and excessive runoff are characteristic of the region and promote natural disasters related to strong precipitation and flooding (see Box 1). (7)

### Prospects in the event of climatic changes

The general circulation models, even though they are not accurate enough for the region because there is no mesh model focusing on the area, converge to estimate probable warming in the region of two to four degrees in the 21st century, and with more than 1°C of warming between 2000 and 2020, according to studies conducted for Morocco and Algeria. (1), (2)

There is little convergence among assessments of the different models concerning future precipitation. However, these indicate a probable interference with rainfall (spatiotemporal distribution) (5), and a slight downward trend (although this remains to be confirmed).

*Box 1: Flooding in North Africa (7)  
2001 in Algeria / 2002 in Morocco*

The years 2001 and 2002 were catastrophic for the region, with exceptional floods resulting in extensive material and human damage.

**Climate-related disaster in Algeria in November 2001**

Algeria experienced its worst flooding in history November 10–14, 2001. Extreme rainfall occurred whereby Algiers recorded the equivalent of an entire month of rain in several hours and winds reached 120 kilometres per hour. Sixteen provinces were affected, but most of the damage was concentrated in Algiers. This extreme meteorological event claimed 751 victims, including more than 700 in Algiers, and caused damage estimated at US\$300 million. There were 24,000 displaced persons and more than 2,700 homes were severely damaged. Between 40,000 and 50,000 persons lost their homes and nearly 109 roads were damaged. Despite being forecast by Algerian and foreign weather services the magnitude of the human and material damage was categorized as one of the most severe in the past 40 years.

**Climatic disaster in Morocco in November 2002**

During the week of November 20–27, 2002, Morocco experienced some of the worst flooding in its history, with considerable material and human damage. Initial estimates put the damage at:

- 63 dead, 26 missing, dozens wounded;
- 24 houses collapsed; 373 flooded;
- hundreds of hectares of agricultural land damaged; hundreds of heads of livestock swept away; and
- industrial plants sustained severe damage, particularly in Berrechid and Mohammadia. In that city, the most important refinery in the kingdom (SAMIR) caught fire, representing more than US\$300 million in losses.

This wet, rainy year followed several dry or partially dry years, and the last wet year, 1996, was also a disastrous year for the country.

### III Socio-economic context

The population of the region is large and continues to experience significant growth. The combined population of Algeria, Morocco, and Tunisia went from less than 60 million in 1994 to nearly 65 million in the year 2000, and should reach more than 72 million in 2010.

This population growth was accompanied by rapid and sometimes anarchic urbanization, with the appearance of large cities whose infrastructures were barely adequate to the needs of the population base, particularly in areas affecting the hygiene and quality of life of the citizens: drinking water, sewerage, urban waste and air quality.

The rural exodus has been extensive in recent decades coinciding with climatic changes in those years. Predominantly a rural population in the 1970s (more than 60 per cent of the population was rural), the population of the region is now concentrated in urban areas (more than 60 per cent of the population is now urban).

The socio-economic development of the countries in the region took place in the past century based on different economic choices and production sectors. In Algeria, the industrial sector is the largest (more than 57 per cent of the GDP in 1994). In Morocco, the largest is the agricultural and fishing sector (more than 43 per cent of the GDP in 1994) and in Tunisia, the largest is the service industry (more than 50 per cent of the GDP in 1994). (8)

Despite these different economic trajectories, the vulnerability of the people in the region to the climate and its vagaries is now practically at the same level, with the exception of a few nuances. In these countries, the people are linked to the climate and its fluctuations, while the economy is very dependent on water, agriculture, tourism, and coastlines. This is particularly striking for Morocco and Tunisia.

Climate change in this part of North Africa which emits low levels of greenhouse gases (between 1.5 and 3.5 emission tonnes of CO<sub>2</sub>/inhabitant/year), repre-

sents a veritable threat to its socio-economic development and the life of its people. (8)

The extreme vulnerability of the region, coupled with the possible impacts climate change represents, stresses the need for adaptive strategies in key sectors in the region for the long term sustainable development of these countries.

## IV Fragile natural resources

There are great natural resources in the region, but they are very fragile and vulnerable. Some of the key statistics regarding water, soil, urban areas and coastal zones are outlined below.

### Water resources

- There are 53 billion cubic metres of water that can be mobilized in the three countries: primarily surface water with a mobilization rate of approximately 60 per cent.
- Water is primarily used for agriculture (80 per cent), drinking water (13 per cent), and industry (seven per cent).
- The three countries are considered water-stressed (less than 1,000 m<sup>3</sup>/inhabitant/year), with Algeria and Tunisia being closer to a shortage (less than 500 m<sup>3</sup>/inhabitant/year);
- There are rapid and sometimes violent flows of water with significant sediment transport of 500 to 2,000 metric tonnes/km<sup>2</sup>/year.
- Water quality is sometimes at the lower limit of the standards.
- The water table is decreasing strongly in recent years, with salinization of some coastal groundwater.

### Soil, vegetation, and agriculture

- Fertile, well-watered zones are found in the north, sometimes with small forests.
- Steppe-type vegetation is common with primarily alfa grass in the arid regions in the centre and south.
- Oases are planted with date palms in the south.
- There exists a strong potential for land dedicated to agriculture (cultivable land, forests, alfa grass coverage, range land), particularly in Algeria and Morocco.

- Agriculture is primarily rain-based, and is subject to climatic hazards.
- There is strong soil erosion with extensive soil degradation. Decreasing rain-based agricultural yields with grain yields reduced by up to 50 per cent in periods of drought.
- There is increased water needs for irrigation and decreased agricultural production due to lack of water in recent years.
- Desertification is accelerated particularly in the south of the region
- Limited forestland is undergoing ill-advised development with depletion of forest reserves as a consequence.

### Urban environment

- There is a marked expansion of insalubrious dwellings around the large cities.
- Sewerage infrastructure is lacking in large cities, particularly in Algeria and Morocco
- Air quality is critical in cities at certain times of year, particularly in Algiers, Casablanca and Tunis.

### Coastal zones

- The region fronts both the Atlantic and Mediterranean for thousands of kilometres.
- There is extensive, under-exploited fishing resources, particularly offshore.
- Two-thirds of the population lives along the coastline in municipalities whose waste is often dumped into the sea with no prior treatment.
- Industrial activities are concentrated along the coasts and various waste products are dumped into coastal waters without any treatment.
- Important tourist activity, particularly along the Mediterranean coast, is degrading the quality of the coastal waters, with noticeable consequences for water-based activities and marine life.

This degradation of natural resources in the region is now reaching its limits. Due to climate changes, *the risks of natural resource degradation are increasing, and there is an immediate need for adaptive policies.*

## V Vulnerability and need for adaptation

The initial qualitative vulnerability studies conducted in the three countries in the areas of coastline, agriculture and water, have highlighted the need for developing more refined studies capable of accurately measuring the region's vulnerability. (1)

In the case of Tunisia, current coastline studies have been undertaken, along with the future impacts of climate change. (2) In Tunisia, the coastline is the hub of the country with. Sixty per cent of the population living there, 70 per cent of all economic activity taking place in the region, and 90 per cent of its tourist attractions occurring there. The studies have revealed the following risks:

- altered coastal dynamics, with effects due to expected elevation of the sea level, expected increase in temperature, interference with the precipitation cycles, and the resultant impact on recharging of coastal waters;
- erosion of some coastlines;
- loss of land to sea water, particularly on some islands (KerKenna Islands) and swamps (Maritime swamps and Sebkhas);
- intrusion of sea water onto land and salification of coastal ground water;
- changes in agricultural and aquatic production along the coastline; and
- socio-economic endangerment of these coastal zones, linked to the greater frequency of flooding and land erosion. Seaside tourism and its infrastructures would be greatly threatened.

However, such studies would require more research in order to be more accurate in their forecasts for Tunisia. Similar studies are currently being conducted in Morocco and Algeria. (10)

Studies on the future of vital agriculture in the region have shown the following risks, which are linked to climate change:

- greater erosion, leading to widespread soil degradation;
- deficient yields from rain-based agriculture of up to 50 per cent during the 2000–2020 period;
- reduced crop growth period;

- risk of non-dormancy of some arboreal species;
- reduced agricultural activity in coastal zones due to anticipated salinization of ground water;
- reduced agricultural production linked to higher water demand in this sector, combined with an anticipated decrease.

These studies resulted in recommendations to adapt this sector to climatic changes, by incorporating better use of water for agriculture (new techniques), adoption of drought-resistant varieties of crops, better selection of planting dates, and supplemental irrigation in zones that lend themselves to that practice. (1), (2)

With respect to the water sector, the analysis conducted in North Africa revealed the following risks:

- probable decrease in water flow;
- change in seasonal water recharging, with impact on the effectiveness of certain hydraulic and agricultural systems;
- increased evapotranspiration and, consequently, water salinity;
- drop in water tables and increased salinity of coastal ground water; and
- warmer, less aerated surface water, with less flow and therefore less able to dilute and biodegrade certain pollutants.

The anticipated decrease in runoff due to climate change in the region has been the subject of an attempt at quantifying the vulnerability of water resources in the region. This attempt was based on research conducted (3) on one of the most strategic watersheds in Morocco, the Ouergha Watershed, which supplies the largest dam in the kingdom, the Al Wahda Dam.

A hydrologic model simulating runoff to the mouth of the watershed, taking into account precipitation and air temperature, was developed, calibrated and validated for the watershed. In the second phase of the research, this tool was used to assess the future of the runoff in the event of climatic changes, by incorporating new temperatures anticipated by the general circulation models. (9) Different air temperature and precipitation scenarios were tested, from 1–4°C of warming and 0–10 per cent decrease in precipitation (see Box 2).



**Box 2: Scenarios used for the simulations (9)**

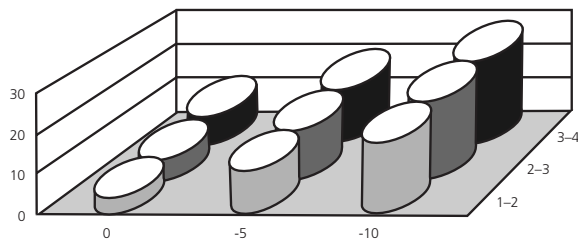
DT = anticipated temperature differential (°C)

DP = anticipated precipitation differential (%)

Scenario 1:	DT = 1 to 2°C	&	DP = 0%
Scenario 2:	DT = 2 to 3°C	&	DP = 0%
Scenario 3:	DT = 3 to 4°C	&	DP = 0%
Scenario 4:	DT = 1 to 2°C	&	DP = -5%
Scenario 5:	DT = 2 to 3°C	&	DP = -5%
Scenario 6:	DT = 3 to 4°C	&	DP = -5%
Scenario 7:	DT = 1 to 2°C	&	DP = -10%
Scenario 8:	DT = 2 to 3°C	&	DP = -10%
Scenario 9:	DT = 3 to 4°C	&	DP = -10%

For all scenarios tested with this model, the decrease in annual runoff that could result from the climatic changes and, therefore, supply to the dam, was estimated at between four and 25 per cent.

For the next 20 years (2000–2020), where the anticipated temperature increase has been estimated at 1°C (1), assuming the precipitation levels to be constant, the change in runoff would be on the order of 10 per cent. (3)



**Percentage of annual water deficit in the Al Wahda Dam (Oz) as a function of warming in °C (Ox) and the percentage of anticipated precipitation deficit (Oy)**

For similar watersheds in the north of the country, if a 10 per cent annual decrease in runoff is assumed, it would represent the loss of one large dam per year. This shows the impact that such a loss of runoff would have on Morocco (4). These estimates are close to those that were done for Spain and for the Nile.

However, these results should be regarded with great caution:

- our knowledge of the relationship between evapotranspiration and air temperature in this region is very limited;
- calibration of the model developed for this watershed was not satisfactory, given the spatiotemporal heterogeneity of the research databases;
- the basic scenarios used to estimate future behaviour in the event of climatic changes are not very accurate (lack of an accurate general circulation model for the region); and
- the particularity (humidity) of this watershed makes it not very representative of all water resources in the region. An extrapolation could be done on the results for the northern part, but not for the southern part of this zone.

Diverse studies and research in order to more accurately assess the vulnerability of the water resources in the region is needed. However, this initial approach has confirmed the high vulnerability of this vital sector and the need for immediate structural adaptive policies.

The little knowledge that is known about the vulnerability of water resources in the region should not result in failure by water resource managers to take action in meeting this challenge. Accurate results are not necessary since the actions that are needed to limit the damage are already known (5):

- mobilization of conventional water that has not yet been mobilized (this affects Morocco and Algeria, since Tunisia has mobilized practically everything);
- development of non-conventional water sources (waste water, desalination, artificial recharging);
- pollution control of water resource systems and purification of waste water before dumping (in this area, Morocco is far behind);
- use of water-saving techniques, particularly for agriculture, and choice of crops that consume less water;
- application of withdrawer-pay and polluter-pay principles; and
- awareness and education of citizens about the value of water in the region.

Above and beyond these actions, what seems important for these countries to realize successful adapta-

*Box 3 (11)*

*Adaptive measures taken by the governments of the three North African countries in the area of water, in situations of acute drought*

**Morocco**

- formation of an inter-ministerial committee to combat the effects of the drought (chaired by the prime minister);
- increased the pace of mobilization of surface and groundwater resources;
- desalinated the sea water (start-up of the first units at Laâyoune and Boujdour);
- combated leaks in drinking water supply networks;
- increased the frequent restriction of water supply for irrigation;
- encouraged water savings in agriculture (subsidy for drip irrigation systems);
- increased public awareness by undertaking campaigns on saving water;
- accelerated implementation of a program for widespread access to drinking water in rural environments (PAGER); and
- conducted pilot experiments on reusing waste water for agriculture (Ouarzazate, Ben Sergao, etc.).

**Tunisia**

- undertook the restructuring of farmers' bank debt;
- imported and subsidized drilling products;
- controlled the opening of forest land for grazing;
- gave priority to drinking water;
- restricted certain number of summer crops; and
- carried out a public awareness campaign.

**Algeria**

- limited water allocation, based on the following priorities: drinking water, agriculture and industry;
- accelerated the construction of dams;
- started supplemental drilling programs and rehabilitate abandoned wells;
- drew up appropriate distribution plans (increased deep drilling in areas surrounding the cities of Algiers, Oran and Constantine);
- regulated the consumption of water in cities at service stations, bath houses, and public showers;
- rehabilitated the water distribution network;
- used non-conventional water sources: recycle water by industry, and use waste water;
- protected water resources through pollution and sanitary protection areas (vulnerability map); and
- regulated water withdrawal from groundwater sources.

tion is the implementation of water policies focusing on the scarcity of the resource, and on its progressive future decrease due to climatic changes.

Today, adaptive practices are already in use (see Box 3), because episodes of drought, flooding, and abnormal air temperature increases are evidence of climatic changes already taking place in the region. To deal with them, situational actions are being conducted. *These actions must now be incorporated into an all-encompassing national policy to adapt the water sector to these new circumstances.*

## VI Adaptive actions and strategies to be implemented

To deal with the negative impact of climate change in the region, various types of action are required. These actions should be conducted simultaneously and aim to:

- Undertake accurate monitoring and, therefore, gain better qualitative and quantitative knowledge of climate changes in the region.
- Forecast medium and long-term behaviour of climate in the region relative to anticipated climate change.
- Develop better, more complete, and, insofar as possible, quantitative assessment of the vulnerability of the region to climatic changes, and adaptive actions required as a consequence. Additionally, creation of an observatory to monitor changes in vulnerability in the various affected sectors.
- Integrate into the socio-economic and policy decision-making processes in these countries, of the high vulnerability of the region to climatic changes and the need for ongoing adaptation strategies and actions.

### Climatic observation network

All data that have been used to assess the current behaviour of the climate in the region have come from weather stations managed directly or indirectly by the meteorologic services of these countries. This is the network that will also make it possible, in future, to understand the climate in the region and, especially, to quantify it. It is in the interest of these countries, as well as to the international community, to possess a high-performing local network.

Today, this network exists in three underdeveloped countries, and is not very spread out over the territory. It requires reinforcement and rehabilitation, both from a quantitative perspective (number of stations) and with respect to the techniques and technologies used.

### Future climate forecasting in the region

With respect to potential future climatic changes, it is important to note that the assessments of warming and changes in precipitation made in the initial vulnerability studies in these countries, which were incorporated into their initial national communications, are not very accurate. They are the result of assessments made using empiric models.

Knowledge of the possible behaviour of the climate in the region, in the event of climatic changes—the basis for any assessment of the vulnerability of the region—requires that the region possess a general circulation model, with a mesh model focusing on North Africa.

This is a basic tool that would seem essential in order to help the countries in the region to achieve, develop, and adapt to the local climatic context. It should be noted that, of the meteorologic services in these countries, the national Moroccan weather service has the computer and technical capabilities to carry out this task, with the support of specialized international agencies.

### Evaluation and monitoring of the region's vulnerability to climatic changes

The initial vulnerability studies conducted by the countries in the region, in 2000–2001, which were presented in their national communications, are not very developed. This is particularly the case for vulnerability adaptation studies on water and agriculture in Tunisia, and on coastlines, which were not dealt with in the initial national communications by Morocco and Algeria.

Therefore, it is essential that additional studies be conducted to refine the initiated studies, and to begin new ones. In that regard, it should be noted that:

- Within the framework of the UNEP-GEF Project TUN, in 2002, Tunisia began new water and soil vulnerability studies.
- In 2003, Morocco began a project with UNEP on the rise in the sea level along the Moroccan coastline and its relationship to climate change.

- Along with UNEP-GEF, the three countries have begun developing a new regional project on the topic of “Integrated Watershed Management in North Africa in Light of Climatic Changes.”

These projects will clarify the vulnerability of the region and better define the necessary adaptive actions. Logically, a major portion of these countries’ second national communications should be devoted to this problem, which is vital for the region.

For the assessment of the vulnerability of the region to climatic changes and its evolution to realism and accuracy, two actions are necessary:

- The start-up of research projects at universities and engineering schools in North Africa on vulnerability/adaptation. Without a basic knowledge of the behaviour of natural and human systems in the region in light of climatic changes, the studies can be nothing but general and approximate. The development of excellence centres for studies and research in the field is mandatory in these countries.
- Setting up an observatory in the region to monitor the vulnerability of natural and human systems, in light of the changes taking place in the climate and the adaptive actions conducted to deal with them, is urgently needed. This is an indicator that will allow adaptive strategies to be adjusted at any time, based on the actual evolution of this vulnerability and the success of the various adaptive endeavours tested in the field.

### Choosing policies that incorporate the vulnerability of the region and its need to adapt to climatic changes

In addition to the studies, strategies and tools that need to be developed and obtained for these countries to adapt to the probable effects of climatic changes, it is now essential that there be political awareness of the socio-economic challenges linked to this phenomenon.

There needs to be integration into the political and economic choices made by these countries, so that there is an understanding of the structural reality of climatic change in its broad dimensions and with its medium- and long-term repercussions. There is a need to make a clear and direct connection between this phenomenon and other socio-economic factors that are more integrated on a policy level including: accelerated rural exodus, strong urbanization, pover-

ty, food safety, health, agriculture, tourism, energy, water scarcity, etc.

It is important to point out that the governments of these countries have taken important steps in recent years. In recent speeches by high officials, the term “climatic change” is appearing more and more often. A political awareness seems to be developing. Morocco’s organization of the Seventh Conference of the Parties (COP-7) in North Africa, in October of 2001, bears witness to this. That conference was also a very good catalyst, since it enabled the region to make a strong move in the right direction.

This political will now remains to be translated into concrete action, i.e.:

- Create lasting structures at a high state level to manifest this vision. Climatic change units, national climate change (CC) committees, and specialized scientific committees have been created in these countries in recent years and have supported the progress that has been made. These institutions must be placed on a more political footing, so that the synergy of these problems and those cited above can be brought to light (CC/water, CC/agriculture, CC/energy, CC/tourism, etc.)
- Initiate large-scale programs to make the populations aware and educated about the repercussions of climate change and the technical methods available to improve adaptation to its deleterious effects.
- Undertake projects targeting a transfer of technology to these countries, to enable adaptation of their actions to the new climatic context in the region. Financial mechanisms need to be created to promote this transfer of technology.

### VII More interest in vulnerability – adaptation on the negotiating level

During the negotiations that have been conducted to date relative to the United Nations Framework Convention on Climate Change, interest primarily focused on methods to reduce emissions and the meager results seen, even with the probable implementation of the Kyoto Protocol.

On the topic of vulnerability and adaptation, the results that have been achieved remain very limited

and, so far, involve only the least developed countries (LDCs). It is true that adaptation funds have been created, but implementation of these financial mechanisms is largely in abeyance.

The three North African countries that are the subject of this analysis are not LDCs and are, as demonstrated above, extremely vulnerable. Vulnerability is a reality, with important and significant needs for enabling true adaptation. The international community is duty-bound to help the region achieve this objective, according to the terms of the convention.

With respect to the conferences of parties to the climate convention (COP), during COP-7 and then COP-8, these countries held side events to demonstrate their situation. They also sought to promote greater interest at the negotiating level. It is clear that they will continue to do so, in cooperation with similar countries, in hopes that concrete action in this area and for this type of country (non-Annex I and non-LDC) will see the light of day.

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