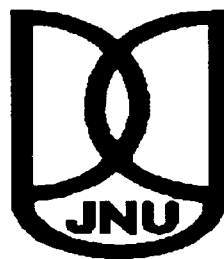


**ROLE AND POSITION OF NORTH AFRICAN COUNTRIES : ISSUES OF
GLOBAL CLIMATE CHANGE,1970-2010**

*Dissertation submitted to Jawaharlal Nehru University
in partial fulfilment of the requirement
for the award of the Degree of*

MASTER OF PHILOSOPHY

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DECLARATION

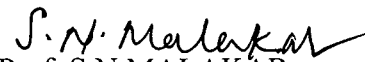

I declare that the dissertation entitled "ROLE AND POSITION OF NORTH AFRICAN COUNTRIES: ISSUES OF GLOBAL CLIMATE CHANGE, 1970-2010" submitted by me for the award of the degree of Master of Philosophy of Jawaharlal Nehru University is my own work. The dissertation has not been submitted for any other degree of this University or any other University.


NEHA SINHA


CERTIFICATE

We recommend that this dissertation be placed before the examiners for evaluation.

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NEHA SINHA

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ABBREVIATIONS

AfDB	African Development Bank
AMCEN	African Ministerial Conference on the Environment
AWGs	Ad-hoc Working Groups
CAIP	Cairo Air Improvement Program
CDM	Clean Development Mechanism
CGOS	Global Climate Observing System
COP	Conference of the Parties
CAHOSCC	Committee of the African Heads of State on Climate Change
CDM	Clean Development Mechanism
EC-CDM	Egyptian Council for Clean Development Mechanism
EEC	The Energy Efficiency Council
GEF	Global Environment Facility
GTCA	German Technical Cooperation Agency
ICARDA	International Center for Agricultural Research in the Dry Area
IPCC	Intergovernmental Panel on Climate Change
LCA	Long-term Cooperative Action
NAPAS	National Adaptation Action Plans
NIC	National Intelligence Council

TCAPP	Technology Cooperation Agreement Pilot Project
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNFCCC	United Nations Framework Convention on Climate Change
VARG	Vulnerability and Adaptation Resource Group

NORTH AFRICA



The focus of my research will be on the following countries:

1. Algeria
2. Egypt
3. Libya
4. Morocco
5. Tunisia



CHAPTER ONE

INTRODUCTION

1.1. UNDERSTANDING OF CLIMATE CHANGE

Climate change is a long term change in the statistical distribution of weather patterns over period of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average, for example, greater or fewer extreme weather events. It refers to any change in climate over time that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods. "Substantial changes in the environment caused by human industrial activities, and their possible climate impact, have become matters of great concern, because variation in climate can seriously affect agricultural productivity and many other aspects of human activity" (Cracknell and Kondratyev 1998). Climate change may be limited to a specific region, or may occur across the whole Earth. Climate change is the variation in global or regional climates over time. It reflects changes in the variability or average state of the atmosphere over time scales ranging from decades to millions of years. These changes can be caused by processes internal to the Earth, external forces like variations in sunlight intensity or, more recently, human activities. In recent usage, especially in the context of environmental policy, the term "climate change" often refers only to changes in modern climate, including the rise in average surface temperature known as global warming. In some cases, the term is also used with a presumption of human causation, as in the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC uses "climate variability" for non-human caused variations (IPCC 2001).

In classical politics, international security and global environmental issues have been the focus of analysis. However in the recent past, issues which affect the entire humanity have come to the fore front and climate change issues are at the top core of political analysis. Climate change issue today is considered to be one of the

gravest threats to the sustainability of the planet's environment, the well-being of its people and the strength of its economies.

UN-sponsored Intergovernmental Negotiating committee for a Framework Convention on Climate Change, global warming negotiations appear to have polarized around two key issues. Countries are divided over how strictly the treaty should control greenhouse gas emissions and how to share the hardship of emission controls in the most fair and equitable manner (Collins 1991; 340). Mainstream scientists agree that the Earth's climate is changing from the build-up of greenhouse gases (GHGs), such as carbon dioxide, that result from such essential human activities as electricity generation, transportation, agriculture, etc. Climate change refers to any change in climate that is in addition to natural climate variability observed over comparable time periods. Usage of the term varies between the IPCC that refers to any change in climate, whether due to natural variability or as a result of human activity and the UN Framework Convention on Climate Change that only refers to natural variability causes (8th meeting of African partnership forum 2007:23-24). Climate change raises serious questions of climate justice and equity, especially in the developing countries.

1.2. GEOGRAPHIC LOCATION OF NORTH AFRICA

North Africa has a total area of about 5 million km², of which more than 90% is desert (Drine 2010). Soil in North Africa is subject to contrasting climate factors like drought and short duration torrential rainfall, and increasingly important anthropogenic factors along the coast, in addition to inadequate cultural practices (Mtimet, 1999). All these factors make the soil relatively fragile. Longer periods of drought accelerate desertification and shift the desert's limit further North, and therefore decrease land areas suitable for agriculture. North Africa is the northernmost region of the African continent, linked by the Sahara to Sub-Saharan Africa. Though my research will cover only five countries of North Africa i.e. Algeria, Egypt, Libya, Morocco and Tunisia but geopolitically, the United Nations' definition of Northern Africa includes seven countries or territories; Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, and Western Sahara. Algeria, Morocco, Tunisia, Mauritania and Libya are

also referred to as the Maghreb while Egypt is a transcontinental country by virtue of the Sinai Peninsula, which is in Asia. The other notable part of North Africa is the territory of the Western Sudan, which includes Senegal, Gambia, Mali, Niger, Burkina Faso, and Chad. These countries are located in intercultural zone, where traditions of Berbers, Touaregs and Arabs are mixed with notable quantity of sub-Saharan cultures. North Africa is divided further into sub-regions: the Maghrib, Arabic meaning “where the sun sets” (the western sub region that includes Morocco/Western Sahara, Algeria, and Tunisia) and the Mashriq meaning “where the sun rises” (the eastern sub region including Libya and Egypt). At other times, Egypt and the Arab Middle Eastern countries are combined into the Mashriq while Libya and Mauritania are linked with the Maghrib.

The distinction between Northern Africa and the rest of Africa is historically and ecologically significant because of the effective barrier created by the Sahara. Throughout history this barrier has culturally separated the North from the rest of Africa and, as the sea-faring civilizations of the Phoenicians, Greeks, Romans and others facilitated communication and migration across the Mediterranean. The cultures of North Africa became much more closely tied to South-western Asia and Europe than Sub-Saharan Africa (Harry and Gailey 1972). The Islamic influence in the area is significant, and North Africa, along with the Middle East, is a major part of the Arab World. North Africa consists of five countries that border the Mediterranean Sea—Egypt, Libya, Tunisia, Algeria and Morocco. The focus of my research will be these five countries. The Sahara desert, the dominant feature of the North African landscape, sweeps across the southern part of the region. The Sahara serves as a geographical boundary between North Africa and sub-Saharan Africa, except in Egypt. It also marks a transition zone from the largely Arab population of North Africa to black Africa of the south.

The population of arid North Africa has multiplied six-fold since the beginning of the century, and the destruction of vegetation in Morocco, Algeria, Egypt, Tunisia and Libya has accelerated in this period, particularly since about 1930 when the population of these countries began to climb steeply. Intense overgrazing, the extension of unsustainable grain farming, and firewood gathering have all contributed to a deterioration of the agricultural environment. With increasingly

eroded lands in the Atlas Mountains to the north, and an encroaching Sahara Desert in the south, food production has stagnated in many areas of North Africa (Eckholm 1975).

1.3. CLIMATE, LAND, WATER AND RESOURCES OF NORTH AFRICA

North Africa has three main geographic features: the Sahara, the Atlas Mountains in the west, and the Nile River and delta in the east. The Atlas Mountains—a complex cluster of ranges, ridges, plateaus, and basins stretch for 1,200 miles along the North African coast from south western Morocco across Algeria to north eastern Tunisia. The tallest peaks are in the High Atlas range in south-central Morocco, which has many snow-capped peaks. South of the Atlas Mountains is the dry and largely barren expanse of the Sahara. In places the desert is cut by irregular watercourses called wadis streams that flow only after rainfalls but are usually dry. The Sahara's major landforms include 'ergs' large seas of sand that sometimes form into huge dunes; the 'hammada' a level rocky plateau without soil or sand; and the 'reg' a level plain of gravel or small stones. The Sahara covers the southern part of Morocco, Algeria, and Tunisia, and majority of Libya. Only two regions of Libya are outside the desert: Tripolitania in the northwest and Cyrenaica in the northeast. Most of Egypt is also desert, except for the Nile River and the irrigated land along its banks. The Nile Valley is a narrow green and fertile thread that runs the length of the country. The Egyptian desert also contains oases, fertile areas around natural water sources. Oases are scattered through other parts of the desert as well. Indicators dealing with the mobilization and use of water presented in the national report show that North Africa is located in a region of the world with the lowest water potential (National reports on the development of water resources, ECA-NA 2005). Coastal North Africa has a Mediterranean climate, with hot summers and mild, damp winters. Along the Atlas chain, the mountains trap moisture-laden clouds blowing south from the Mediterranean Sea. The moisture falls as rain on the mountains' northern slopes. As a result, these slopes and the coastal area between them and the sea are well-watered and fertile, compared with the more arid conditions on the southern side of the mountains. Similar conditions exist in Libya, where cliffs and low mountains separate Tripolitania and Cyrenaica from the desert interior.

Throughout North Africa, the availability of water has always been the chief factor in determining where and how people live. In Egypt, 95 percent of the people live within a short distance of the Nile River or in the delta at its mouth on the Mediterranean Sea. Water from the river is used to irrigate fields of cereal grains, vegetables, cotton, and other crops. In other North African countries, about 90 percent of the people live within 200 miles of the coast, generally in valleys that have streams and rivers. These areas are suitable for agriculture, especially with the aid of irrigation. Citrus fruits, olives, and grapes are major crops. Farther south, drier hills and grasslands bordering the desert have long been the home of pastoralists who raise herds of sheep, goats, cattle, and camels. The only farming in the desert takes place in oases, where the main crops raised are date palms, fruit, and cereal grains. North Africa possesses valuable mineral resources. Libya and Algeria have extensive deposits of petroleum and natural gas. Industrial development of these resources has been underway since the 1950s, and fuel exports are a major source of revenue for these countries. Egypt and Tunisia have oil industries as well, though on a smaller scale. The region also contains small quantities of other minerals, such as copper, zinc, and manganese. Morocco and Tunisia have fairly significant deposits of phosphates, while iron ore is found in Algeria, Libya, and Tunisia.

1.4. THE PEOPLE OF NORTH AFRICA

North Africa's geographical setting has determined its population and its place in world affairs. In some ways, North Africa is closer to Europe and the Middle East than to the rest of Africa. The northernmost point in Morocco lies only eight miles from Europe across the Strait of Gibraltar. The Tunisian coast is just 85 miles from the Italian island of Sicily. North Africa has had extensive contact with Europe over the centuries, and in ancient times it was part of the Roman Empire. Moreover, the Sinai Peninsula, the north-eastern part of Egypt, borders the Middle East. Contacts between the Middle East and North Africa also go back many centuries. The population of North Africa is mainly white, like the peoples of Europe and the Middle East. But racial mixing has occurred over the years between the people of North Africa and the black population of sub-Saharan Africa. North Africa shares the Middle East's dominant ethnic group (Arab), language (Arabic), and religion (Islam).

For this reason North Africa is sometimes considered part of the Middle East, at least culturally. Arabs have long used the term Maghreb, meaning "west," to refer to Libya, Tunisia, Algeria, and Morocco, which they consider the westernmost part of the Arab world.

The most significant feature of North Africa's population is that it is more uniform than the population of any other African region. Although minority populations exist in all five nations, most North Africans are Arabs, Berbers, or a mixture of the two groups. The Berbers were the original inhabitants of North Africa. Between A.D. 600 and A.D. 1000, Muslim Arabs from Arabia swept across the region in a wave of conquest. The two people, physically quite similar, formed a single population in many areas as Berbers merged into Arab society. The Arabs brought with them to North Africa the Arabic language and the Islamic religion. Both the language and the faith, along with many other features of Arab culture, became dominant across North Africa. Some Berber groups, however, have maintained their separate identity (Tondon and Yashpal 1970). These groups generally live in the more isolated or remote mountain and desert areas of Tunisia, Algeria, and Morocco. The people of North Africa are overwhelmingly Muslim. Egypt has a small but significant group of Coptic Christians, followers of an early form of Christianity. Jewish communities have existed in North Africa since ancient times. In recent years, however, they have almost disappeared as North Africa's Jews have emigrated to Israel or Europe. North Africa's population numbered approximately 144 million in 2000. The country with the largest population was Egypt, with more than 68 million inhabitants. Algeria had 31 million people, Morocco 30 million, and Tunisia nearly 10 million. Libya's population numbered only 5 million. Arabic is the official language of all five countries, but many North Africans also speak other languages. French is often used in business in the former French colonies of Morocco, Algeria, and Tunisia. Many Libyans, especially in the cities, understand English and Italian, and many urban Egyptians speak English. Berber is most often heard in Morocco and Algeria, which have large Berber populations.

1.5. CLIMATE CHANGE IN NORTH AFRICA

The potential threat of global climate change is a very serious problem collectively faced by humanity as a result of its own activities (Jepma and Munasinghe 1998). The climate of Africa ranges from tropical to sub-arctic on its highest peaks. Its northern half is primarily desert or arid, while its central and southern areas contain both savannah plains and very dense jungle rainforest regions. In between, there is a convergence where vegetation patterns such as Sahel and steppe dominate. Africa is the hottest continent on earth and holds the record for the highest temperature recorded. North Africa is highly vulnerable to impacts of climate change, even though its greenhouse Gas emissions are relatively small compared to the developed countries. The region has the World's worst water scarcity, reliance on climate-sensitive agriculture, people and economic activity concentrated along the coastal zones and conflict-ridden areas where pressure on resources could escalate violence and political turmoil. Climate change poses serious threats to sustained economic growth and poverty reduction, the quality of life, and political stability in the world. According to the Intergovernmental Panel on Climate Change; North Africa is the most vulnerable continent to climate change and climate variability; and the situation is aggravated by the interaction of multiple stresses occurring at various levels, and is further compounded by low adaptive capacity. North Africa is likely to experience a temperature rise which will be larger than the global mean annual warming. At the same time due to the climate change issue; most parts of the sub-region are expected to experience reduced average annual rainfall and increased aridity and droughts. The combination of reduced rainfall and hotter temperatures is expected to result in a net drying and increased aridity for a greater proportion of the continent (IPCC 2007). It is important to note that not only the Northern part of Africa but all African countries are likely to be drastically affected by climate change. Climate change is expected to have both direct and indirect adverse impacts on human health, which will be aggravated by high population densities. Direct impacts include increased prevalence of vector borne diseases, physiological disorders, skin cancer, eye cataracts, deaths and injuries, respiratory ailments, heat strokes, and heat related illnesses, as well as a weakening of the public health infrastructure. The indirect impacts involve factors such as demographic dislocations and socioeconomic

disruptions. However, comprehensive studies that contain detailed estimations and correlations between climate change and human health are still lacking for Egypt.

Climate model projections available for North Africa indicate a clear increase in temperature over the next 20 years that is expected to continue throughout the 21st century, probably at a rate higher than the estimated global average. Model simulations also suggest a drying trend in the region, particularly along the Mediterranean coast, driven by large decreases expected in summertime precipitation. Since coastal areas historically receive the largest amount of rainfall in North Africa, future decreases will likely have a significant and noticeable impact. Precipitation trends in the interior semiarid and arid regions of North Africa are more difficult to predict due to the very small amount of natural precipitation that characterizes these areas. Climate change will induce some variations in precipitation patterns, but the trend is not clear, as some models predict slight increases and others predict slight decreases in annual precipitation amounts (National Intelligence Council 2009). 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 change in this part of North Africa (Algeria, Morocco and Tunisia), which emits low levels of greenhouse gases; represents 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, enhances the need for adaptive strategies in key sectors in the region for the long term sustainable development of these countries (Agoumi 2003). It is assumed that the following will be the effects of climate change in North Africa.

- By 2020, between 75 and 250 million of people are projected to be exposed to increased water stress due to climate change.

- By 2020, in some countries, yields from rain-fed agriculture could be reduced by up to 50%. Agricultural production, including access to food, is projected to be severely compromised. This would further diversely affect food security and exacerbate malnutrition.
- Towards the end of the 21st century, projected sea-level rise will affect low-lying coastal areas with large populations.
- The cost of adaptation could amount to at least 5-10% of Gross Domestic Product (GDP).
- By 2080, an increase of 5-8% of arid and semi-arid land in areas of North Africa for e.g. Tunisia, Egypt, and Libya is projected under a range of climate scenarios (Agoumi 2003).

The Regional Climate Change Index (RCCI) identifies the Mediterranean as a very responsive region to climate change. Given the ecological and socioeconomic characteristics of the southern Mediterranean countries, the impact of climate change may be more marked than in other regions of the world. Still, most of the predicted impacts in the region are already occurring regardless of climate change for e.g. water stress and desertification. Climate change is expected to exacerbate these trends. Based on global climate projections and given inherent uncertainties, the most significant impacts of climate change in North Africa (Morocco, Algeria, Tunisia, Libya, and Egypt) will likely include water resource stress, agriculture challenges, migration, tourism, energy, urbanization, unemployment, population, Nile valley, the Sahara, etc. Under pressures of climate change, species composition in areas of North Africa may change quite drastically, with potentially profound effects on ecosystem stability and the associated ecosystem goods and services utilized by the human population (McClellan *et.al*; 2005).

1.5.1. ALGERIA

Algeria, the second-largest state in Africa has a Mediterranean coastline of about 998 kilometres. The Tellian and Saharan Atlas mountain ranges cross the country from east to west, dividing it into three zones. Between the northern zone,

Tellian Atlas and the Mediterranean is a narrow, fertile coastal plain (the Tel hill) with a moderate climate year round and rainfall adequate for agriculture. A high plateau region, averaging 914 meters (3,000 ft.) above sea level, with limited rainfall, great rocky plains, and desert, lies between the two mountain ranges. It is generally barren except for scattered clumps of trees and intermittent bush and pastureland. The third and largest zone; south of the Saharan Atlas mountain range, is mostly desert. About 80% of the country is desert, steppes, wasteland, and mountains. Algeria's weather varies considerably from season to season and from one geographical location to another. In the north, the summers are usually hot with little rainfall. Winter rains begin in the north in October. Frost and snow are rare, except on the highest slopes of the Tellian Atlas Mountains.

Since independence, and particularly since 1970, Algeria has adopted quite different strategies to promote socio-economic development - or so it appears on the surface (Nellis 1983). Soil erosion from overgrazing, other poor farming practices, desertification, the dumping of raw sewage, petroleum refining wastes, and other industrial effluents are leading to the pollution of rivers and coastal waters in certain parts of Algeria. The Mediterranean Sea, in particular, is becoming polluted from oil wastes, soil erosion, and fertilizer runoff. There are inadequate supplies of potable water. Algeria's principal environmental problem is encroachment of the desert onto the fertile northern section of the country. Soil erosion from overgrazing adds to the effect. To impede desertification, the government in 1975 began a project to erect a "green wall" of trees and vegetation 1,500 km long and 20 km wide along the northern fringes of the Sahara. The annual cost of this 20-year afforestation project was about \$100 million. Other significant environmental problems include water shortages and pollution. The small amount of water available in Algeria is threatened by regular droughts. The problem is further complicated by lack of sewage control and pollutants from the oil industry as well as other industrial effluents. The Mediterranean Sea has also been contaminated by the oil industry, fertilizer runoff and soil erosion.

1.5.2. TUNISIA

Since independence, and particularly since 1970, Algeria and Tunisia have adopted quite different strategies to promote socio-economic development-or so it appears on the surface (Nellis 1983).Loss of agricultural land to erosion, and degradation of range and forest lands because of overgrazing or overcutting of timber for fuel are major concerns. Erosion threatens 76% of the nation's land area. Overcrowding and poor sanitation in urban centers are also major environmental problems. Pollution from industry and farming activities threatens the nation's limited water supply. Erratic global weather patterns caused by climate change have affected the supply of crops and grains in Tunisia (Kassim 2011). Global climate change might cause drastic repercussions in Tunisia. It is currently experiencing extreme summer temperatures, a drop in precipitation and a rise in periods of extreme drought and wetness. Water resources in Tunisia are already overexploited. Climate change will severely threaten the availability of water in the region. Direct effects of climate change, such as soil erosion and a decline in agricultural production has direct impact on important sectors and threatens human habitats and numerous ecosystems. Tunisia has ratified both the United Nations Framework Convention on Climate Change and the Kyoto Protocol. However, the country does not have the expertise and institutional and technical capacities needed to implement the necessary measures, respond effectively to the threats posed by climate change and make use of the opportunities offered by the Kyoto Protocol (UNFCCC 2006-11).

1.5.3. EGYPT

Egypt's climate is semi-desert, characterized by hot dry summers, moderate winters, and very little rainfall. The country has areas with strong wind, especially along the Red Sea and Mediterranean coasts (Agrawala *et.al*; 2004:1). Throughout Egypt, days are commonly warm or hot, and nights are cool. Egypt has only two seasons: a mild winter from November to April and a hot summer from May to October. The only difference between the seasons is variations in daytime temperatures and changes in prevailing winds. Throughout the Delta and the northern Nile Valley, there are occasional winter cold spells accompanied by light frost and even snow. Egypt receives fewer than eighty millimetres of precipitation annually in

most areas. Most rain falls along the coast, but even the wettest area, around Alexandria, receives only about 200 millimetres of precipitation per year. Moving southward, the amount of precipitation decreases suddenly. Cairo receives a little more than one centimetre of precipitation each year. The city, however, reports humidity as high as 77 percent during the summer. But during the rest of the year, humidity is low. Some areas will go years without rain and then experience sudden downpours that result in flash floods. Water drainage toward the Mediterranean Sea from the main plateau supplies sufficient moisture to permit some agriculture in the coastal area, particularly near Al Arish.

The vast majority of the Egyptian population lives along the Nile Delta, located along the thin strip of the Nile Valley. The area also produces nearly 50 per cent of Egypt's annual agricultural product. This area is under serious threat as a large portion of it is now below sea level. Egypt has been ranked as the third most vulnerable country in the world, surpassed only by Bangladesh and Vietnam (Yahia 2008). This is mostly because the whole of Egypt's agriculture depends on the River Nile which is now being threatened by incidences of climate change. Agriculture alone consumes about 53.85 K m³/year out of the available 62.53 K m³ of the renewable resource in Egypt (Sokka 2004). During most of its construction history; natural environments of the Nile delta were capable of sustaining human needs, with minimal impacts to the ecosystem. By the end of the last century population increased and technology advanced to such levels that natural limits were exceeded and Nile delta ecosystems no longer functioned as sustainable resources. Located in a hyper arid environment and surrounded by lifeless desert, expanding populations in the delta have had no viable alternative but to continue to exploit the declining ecosystem, entraining further environmental decline (Stanley and Warne 1998). A phenomenon of Egypt's climate is the hot spring wind that blows across the country. The winds, known to Europeans as the sirocco and to Egyptians as the khamsin, usually arrive in April but occasionally occur in March and May. The winds form in small but vigorous low-pressure areas in the Isthmus of Suez and sweep across the northern coast of Africa. Unobstructed by geographical features, the winds reach high velocities and carry great quantities of sand and dust from the desert. These sandstorms, often accompanied by winds of up to 140 kilometers per hour, can cause temperatures to rise as much as 20° C in two hours. The winds blow intermittently

and may continue for days, cause illness in people and animals, harm crops, and occasionally damage houses and infrastructure.

Egypt's environmental problems stem from its aridity, extremely uneven population distribution, shortage of arable land and pollution. With so scanty a rainfall, the greater part of Egypt consists of barren and inhospitable deserts. Indeed, if the rainfall within her own borders were the sole source from which Egypt could derive water supplies, the whole land would be one vast uninhabitable desert (Ball 1939). Soil fertility has declined because of over-cultivation and agricultural land has been lost to urbanization and desert winds. In addition, the nation's beaches, coral reefs, and wildlife habitats are threatened by oil pollution. Heavy use of pesticides, inadequate sewage disposal, and uncontrolled industrial effluents has created major water pollution problems. The National Committee for Environment, within the Office of the Prime Minister, is the principal agency with environmental responsibilities. It was predicted that a 1-m sea level rise could destroy up to 25% of the Nile delta agricultural land and displace about 8 million people (El-Raey 1990).

1.5.4. MOROCCO

Morocco is in many ways a country apart. It nestles on the north-western tip of Africa, separated from the rest of the continent by the towering Atlas Mountains and by the Sahara itself. Its climate, geography and history are all more closely related to the Mediterranean than to the rest of Africa, and for this reason visitors are often struck by the odd sensation of having not quite reached Africa in Morocco. In the north, its fine beaches, lush highland valleys, and evocative old cities reinforce this impression. Indeed, Morocco and Tunisia are heavily dependent on tourism, which accounts for about 16 % of GDP. Tourism is a strategic sector for development and an important source for employment and foreign exchange. The sector is extremely vulnerable to weather condition as it depends mainly on summer tourists and beach holidays. Hotter summer, sea level rise, and increased water scarcity will cause a drastic decline in the index of tourism comfort (AEFD Report 2009). Many experts confirm that given the expected impacts of climate change, the region may lose its attractiveness as tourist destination. The climate in Morocco is reliably dry, although

small amounts of rain do fall between November and March. Temperature varies considerably by season and locale. While the southern and south eastern desert regions can reach extremely high temperatures during the hot summer months, the higher altitudes of the mountains are cool in summer evenings and freezing in winter. Most travellers find the early summer months to be the most comfortable time to visit, as rain is not a threat and temperatures are warm during the day and pleasantly cool at night. Like all members of an international community that is increasingly aware of the dangers of climate change, Morocco believes that the steps taken so far fall short of what is needed to guarantee peace of mind about the future of our planet. The international community expects a multilateral response that will speed up the reduction of greenhouse gases while building on the gains and experience of the Kyoto Protocol. On the basis of the various scientific conclusions reached by the Intergovernmental Panel on Climate Change (IPCC), Morocco decided that it will support any proposal designed to significantly curb global warming, and believes it is time to reflect on how to achieve that. Given the historical responsibility of the industrialized countries, and to ensure that achieving this objective does not damage developing countries' development prospects, a strong commitment by the industrialized countries would be desirable. Serious concerns have been expressed by representatives of the business world about the future of their economic and financial activities in a globalized world disrupted by climate change (Balafrej 2005).

1.5.5. LIBYA

Libya is a nation in North Africa, bordering the Mediterranean Sea, between Egypt to the east and Tunisia and Algeria to the west. Majority of the country is desert or semi-desert with barren, flat to undulating plains, plateaus, depressions. This northern and eastern part of the Sahara Desert is known as the Libyan Desert. Libya is a significant source of crude oil for the world. Libya's major environmental issues include: desertification; limited natural fresh water resource; the Great Manmade River Project, which is the largest water development scheme in the world, and is being built to bring water from large aquifers under the Sahara to coastal cities. It is susceptible to hot, dry, dust-laden southern wind called the sirocco or "ghibli" which lasts one to four days in spring and fall; and, from dust storms and sandstorms. Climatic conditions and poor soils severely limit agricultural output, and Libya

imports majority of its food. Libya's primary agricultural water source remains the Great Manmade River Project, but significant resources are being invested in desalinization research to meet growing water demands (Hogan and Boukerrou 2011). Within Libya as many as five different climatic zones have been recognized, but the dominant climatic influences are Mediterranean and Saharan. In most of the coastal lowland, the climate is Mediterranean, with warm summers and mild winters. Rainfall is scanty, and the dry climate results in a year-round 98-percent visibility. The weather is cooler in the highlands, and frosts occur at maximum elevations. In the desert interior the climate has very hot summers.

A major environmental concern is the depletion of underground water as a result of overuse in agricultural developments, causing salinity and sea-water penetration into the coastal aquifers. The Great Manmade River Project, currently under development to transport water from large aquifers under the Sahara Desert to coastal cities, is the world's most extensive water supply project. Another significant environmental problem in Libya is water pollution. The combined impact of sewage, oil by products, and industrial waste threatens the nation's coast and the Mediterranean Sea generally..

1.6. AWARENESS ON CLIMATE CHANGE

The technocratic elite and intelligentsia in North Africa are aware of the global debate on climate change, and especially the high level of attention to the issue in Europe. The latest Arab Development Report, for example, devoted significant attention to climate change. It is not clear, however, to what extent elites have internalized the implications of climate change. The prevailing attitude remains opportunistic, seeking ways to profit from climate change mitigation. Moreover, North Africa's educated and professional classes have learned to keep their opinions limited to "technical" or academic discussions. They avoid weighing in on state policy so as not to implicate their governments for lack of foresight in combating the effects of climate change. Those who criticize too loudly will not be tolerated at home; often their only resort is living and writing from exile. Ultimately, elite opinion about climate change may depend largely on the degree to which particular groups are or are not insulated from its effects. Awareness of climate change as a coherent

phenomenon is much more limited among the general populace. Nevertheless, many in the public are beginning to have to cope with the practical effects of climate change, such as water scarcity or higher temperatures, on a day to day basis. Whether they connect increasing hardships to a broader pattern of climate change will depend to a large extent on how the state controlled media frame the issue. In addition, although domestic media in North Africa are strictly controlled by the regimes, there is wide access to satellite television channels such as Al-Jazeera (National Intelligence Council 2009). Such outlets provide a means to circumvent state censorship and propaganda and allow citizens to hear alternative perspectives. Al-Jazeera and other international Arabic-language media could play a significant role in raising awareness of regional climate change and highlighting deficiencies in state responses. Nevertheless, an increase in social awareness of climate change is not likely to produce major change due to the lack of capacity for broad public opinion to decisively influence state policy.

Climate change may significantly compound the consequences of natural disasters and conflicts as well as the global redistribution of resources. It also impacts food production and access to freshwater resources. It may also spread diseases to areas in which they were hitherto unknown. It was also felt that the global hydrological cycle will be enhanced. This is linked to the likelihood of more severe floods and droughts in some areas but less intense floods and droughts in others. There is also a possibility of higher levels of precipitation and more extreme rainfall events. At the same time, warmer areas could face the risk of more severe droughts (Nicholls *et.al*; 1996). The environmental effects of climate change are closely associated with poverty and may seriously harm especially the states that are already fragile. There is concern that human activities may be inadvertently changing the climate of the globe through the enhanced greenhouse effect, by past and continuing emission of carbon dioxide and other gases which will cause the temperature of the earth's surface – popularly termed the 'global warming.' If this occurs, consequent changes may have a significant impact on society (Cracknell and Kondratyev 1998). Due to extreme and unpredictable weather conditions, e.g. drought and floods, as well as sea level rise, climate change may cause mass migrations and extensive immigration in the long term. This would result in increased instability in already volatile border regions and large changes in the ethnic makeup, more unequal

population distributions among states as well as humanitarian crises. Environmental and natural resource issues may also spawn conflicts that could contain military dimensions. If one nation were to contaminate the area of its neighbour, cross-border pollution could create tensions between states. Water rights in border areas could also become a point of contention. This could cause increased migration flows e.g. from North Africa to Europe.

CHAPTER TWO

IMPACT OF GLOBAL CLIMATE CHANGE IN NORTH AFRICA

There are a number of environmental challenges which are faced by the people and countries of North Africa. Like other African countries, North Africans face “rapid population growth, rampant urbanization, and poorly regulated industrialization” (Swearingen and Bencherifa 1996). The most significant challenge to the region’s environment is desertification. Some other major issues in the region are increasing water shortages and the encroachment of the desert. North Africa is particularly vulnerable to climate change because of its overdependence on rain-fed agriculture, compounded by factors such as widespread poverty and weak capacity. The different longer-term impacts which further leads to climate change directly or indirectly in the region are changing rainfall patterns which directly affects agriculture and reduces food security; it worsens water security as well and decreases fish resources in large lakes due to rise in the temperature. The problem of wide spread shifting vector-borne diseases and a rise in sea level results which affects low-lying coastal areas with large population. The North African countries being a part of the third world need to take action in a broader range by taking into consideration the wider international community, multilateral and bilateral development agencies and the government as well. Climate change is said to have a range of decisively negative effects on global health during the next three decades in these region. The manner in which countries respond or fail to respond to these health challenges will have a significant impact on the geopolitical landscape. There have been a lot of reasons for the climate change issues in North Africa. The climate change issue is global, long-term and involves complex interaction between demographic, climatic, environmental, economic, health, political, institutional, social and technological processes. It has significant international and intergenerational implications in the context of equity and sustainable development (Fischer *et.al*; 2005).

2.1. THERE ARE SEVERAL REASONS WHICH HAVE RESULTED IN CLIMATE CHANGE IN NORTH AFRICA. THE REASONS ARE DISCUSSED BELOW:

2.1.1. INTERNATIONAL FACTOR

In recent years, North Africa has become dumping ground for most industrialized country of the world. There are several cases in which it was found that industries waste of European countries most importantly nuclear waste has been dumped in North African countries like Algeria, Tunisia and Libya. This has led to many incurable problems in these countries. It has affected the environment, the people, the agriculture and soil due to the ill effects of radioactive emissions. Climate change is a reality that is already affecting the lives of millions of Africans and will have a profound impact on the programming of public expenditures and public receipts in every African country. If left unchecked it threatens to undo some of the progress made in recent years and will jeopardize countries ability to generate sustained economic growth, create employment, and achieve the Millennium Development Goals (MDGs). So climate change cannot be managed by the Ministries of the Environment alone. African Ministers of Finance and Planning as well as Heads of State need to take note (United Nations Environment Programme 2009: 1).

2.1.2. POLLUTION

Pollution is of several kinds. Pollution in these five countries i.e. Egypt, Libya, Tunisia, Morocco and Algeria which is not only a problem; but it also results in climate change affecting the environment adversely. The important and heavily fished reef zone close to shore in the regions of North Africa is particularly vulnerable to pollution and silting. In these North Africa countries oil has become a major pollution threat to coastal ecosystems, owing to the heavy use of the tanker route along the coast. Slicks are brought in from spills in the open ocean by coastal currents, while operational discharges from ships and refineries add to the load. Wastes which accumulate in water and air not only cause problem for the climate change but it also

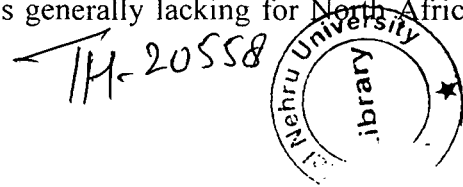
becomes dangerous for the human living. In North Africa operational discharge from ships and industries are also causing problems.

2.1.3. INDUSTRIALIZATION

In North Africa although industrialization remains slow relative to other parts of the world, it takes place without proper environmental impact assessments legislative controls, leading to further pressure on the climate change. In these countries of African rivers, creeks and the sea have become dumping sites for industrial wastes. Industries of major environmental concern in the region include textiles, tanneries, paper and pulp mills, breweries, chemical factories, cement factories, sugar factories, fertilizer factories, and oil refineries. Slaughter houses near the sea are becoming a serious source of marine pollution. In recent decades, the growth of industry has brought an increasing volume of effluents to coastal waters. The use of agricultural chemicals has continued to grow, and sewage treatment continues to be inadequate in many parts of the region (Cracknell and Kondratyev 1998). Some species of marine animals are already endangered as a result of human activities, particularly the dugong or manatee, which is often caught in fishing nets and drowned. Marine turtles continue to decrease in numbers as their eggs are poached and the adults are killed for their meat and decorative shells.

2.1.4. URBANIZATION AND DEFORESTATION

North Africa is undergoing an extraordinary rate of urbanization and as a result of this the cities like Egypt, Morocco, Tunisia, Libya and Algeria have become overcrowded, water supplies have proven insufficient, and systems for drainage, sewerage and refuse disposal inadequate. Domestic sewage is discharged directly into rivers and in some cases the sea. Urbanization also puts pressure on the government of the city and if not handled properly it not only leaves a bad impact on people but also results in climate change indirectly. Deforestation is another area of concern for the region. Information on forest management is generally lacking for North Africa.



In several countries, the available forests do not meet the increasing demand for fuel wood. At the same time, countries of this region of North Africa recognize that indigenous forests are able to provide a variety of valuable products when everything is well managed. Biodiversity is regarded as a potential source of income, especially when wildlife is considered. A better understanding of what is driving deforestation and the economic incentives for landholders to clear forests can help to entice them to conserve forests. Much deforestation takes place to convert forest areas to relatively low return uses. It is also noted that it is not necessary to have financial incentives very high to reduce deforestation significantly. Financial incentive schemes would need to be designed carefully and be accompanied by a package of measures to address poverty and protect the vulnerable (Gracea 2006). Thus protection of trees and forests, in other words protection of environment in the region is important to combat the issue of climate change.

2.1.5. COASTAL DEGRADATION AND EROSION

In the countries of North Africa, human encroachment and activities such as animal husbandry and agriculture are rapidly degrading resulting in deforestation, destruction of mangroves and disappearance of other vegetation; a decline in soil fertility and the death of wildlife. Marine resources are directly threatened by these activities. Mangroves were once common in sheltered bays and estuaries, providing shelter to many important fish species and prawns. They are now threatened by intensive cropping to provide firewood, poles, tannin, medicinal products, paper pulp and timber, and to open up new space for aquaculture and salt production. Coral reefs in these regions have also been damaged by excessive siltation resulting from poor agricultural practices, deforestation along riverbanks and the dredging and dumping associated with harbor development. Many were damaged by fishing with dynamite and poison, especially before these methods were outlawed in part of the region. Tourists collect coral as souvenirs. More recently the bleaching of corals has become a severe problem.

2.1.6. ISSUES IN SOIL AND ENVIRONMENTAL DEGRADATION

Accelerated soil erosion is a severe problem in North Africa with erosion rates exceeding the tolerable level for most regions. These excessive erosion rates have severe economic and environmental implications. An important cause of the severe problem of soil degradation is the prevalence of poor agricultural practices. The expected greenhouse gas emissions scenario developed by the Intergovernmental Panel on Climate Change portends a world in which people and nations will be threatened by massive food and water shortages, devastating natural disasters, and deadly disease outbreaks. An additional problem that furthermore complicates the situation in the region is the relative fragility of soil. Soil in North Africa is subject to contrasting climate factors like drought and short duration torrential rainfall, and increasingly important anthropogenic factors along the coast, in addition to inadequate cultural practices (Mtimet 1999). All these factors make the soil relatively fragile. Longer periods of drought is said to accelerate desertification and shift the desert's limit further north, and therefore decrease land areas suitable for agriculture. Change in water quantity and quality due to climate change are expected to affect food availability and access. This will decrease food security and increase the vulnerability of poor rural farmers.

2.1.7. THE HUMAN FACTOR

Human beings have always been ignorant of their surroundings. The carelessness of people leads to several problems. This is not only a problem in North Africa but all over the world. Urban population growth has been a great problem for North Africa. Because of this the infrastructure gets affected. Climate change issue is of great concern in North Africa. With growth everything gets affected for example tourism in the region has been in a deteriorating condition. The extremely rapid rate of population growth in these countries is a critical factor, and the resulting pressure on social amenities, notably in cities of North Africa, has become very high. The infrastructure is unable to keep pace with the population growth rate; educational facilities are no longer adequate and the resource base to support the required expansion programme meager. This results in great disparity in per capita income in

the countries of the region for a variety of political and environmental reasons (The Washington Quarterly 2007-2008:115–138).

2.1.8. RISE IN SEA LEVEL

Climate change has harmed Egypt's tourism sector through sea level rises and ocean acidification. The Nile Delta is home too much of Egypt's tourism and for cities like Alexandria or Matruh City and the threat of a rising sea level has reduced both their capability to sustain tourism as well as the desire of tourists to visit them. Forty-nine percent of Alexandria's tourism industry will be underwater if sea level rises .5 meters (Agrawala *et al*; 2004). The main economic and social activities in North Africa are concentrated along the coastal zones. Population within 100 km of coast is 68.8% in Algeria, 78.7% in Libya, 65.1% in Morocco, and 84% in Tunisia. Thus, sea level rise could result in major population movements and adversely affect many economic activities like tourism; a major source of employment and income in Morocco and Tunisia. In addition, high levels of carbon dioxide in the atmosphere will result in ocean acidification and destroying of coral reefs (Washington, DC: World Resources Institute 2009). The bleaching of the coral reefs is not just the loss of an important ecosystem but also the elimination of a prime tourist attraction. Disruption to the Egyptian tourism sector could have broader societal implications, as 20% of Egypt's foreign currency earnings are from tourism and according to Egypt's Minister of Tourism, 12.6% of the workforce depends upon the travel industry (Edward 2009). But the dangers climate change poses to Egypt's tourism sector and economy as a whole should not be underestimated.

2.1.9. AGRICULTURE

Agriculture is one of the most important fields to be protected for the survival of mass. Climate change shows an adverse effect on it in North Africa. For example future climate change scenarios predict a decrease in wheat and maize yields in Egypt threatening national grain production, which is already short of meeting local demand. Vulnerability of crops to changes in pest infestation and plant diseases is

another potential impact of climate variability. Planting different wheat and maize cultivars, as well as changing crop choices in the Egyptian agricultural product mix are among possible adaptation strategies to climate variability. It is expected that there will be a change in major crop production in Egypt by the year 2050 due to climate change. North Africa belongs to the hydraulic poor regions located between tempered region of the Northern Hemisphere and the inter-tropical region, characterized by scarcity and spatial and temporal rainfall variability. With regards to climate change projections, the region will be threatened by desertification from the South and sea level rise from the North (Darin 2010:4). Among the five countries Tunisia is suffering the most from water scarcity. Moreover, according to many experts, the situation is very likely to worsen as fresh water availability is decreasing. This will directly affect agricultural sector of the countries.

2.2. IMPACT OF CLIMATE CHANGE ON THE PEOPLE AND THE REGION OF NORTH AFRICA

The National Intelligence Council-sponsored workshop entitled, ‘The Implications of Global Climate Change in North Africa’, held on 20 August, 2009, brought together a panel of experts to consider the probable effects of climate change on North Africa from a social, political, and economic perspective. The workshop focused on Algeria, Egypt, Libya, Morocco, and Tunisia. The panelists concluded that systemic state failures attributable solely to climate change to 2030 are not likely. However, climatic stress coupled with socioeconomic crises and ineffective state responses could generate localized social or governmental collapses and humanitarian crises (National Intelligence Council 2009).

The effects of climate change in North Africa is said to exacerbate the region’s existing challenges of insufficient water and food resources, low economic growth, inadequate urban infrastructure, and weak socio political systems. ‘Moreover, Algeria and Morocco seem to be relatively more vulnerable to drought and floods than Tunisia’ (Darin 2011:8). It was also deduced that Climate change will reduce water availability and quality, creating the potential for severe water shortages in both cities and rural areas. By 2030, three-quarters of Egyptians will have inadequate access to fresh water. Droughts, flooding, salinization, and overall water scarcity can adversely

affect agriculture, threatening food security and forcing farmers off their land. Climatic stress will add to the already substantial migration from rural areas into cities, exacerbating the region's urban challenges. In the workshop it was also noticed that the North African cities will face deteriorating living conditions, high unemployment, and frequent civil unrest (National Intelligence Council 2009). The region is likely to face civil conflicts over scarce resources such as water, arable land, food, or employment, which may be expressed in sectarian, ethnic, or anti-regime tensions. North Africa faces increased risks of interstate conflict with southern neighbours over the next 20 years owing to the impacts of climate change. The attempts made by Sudan or other upstream states to expand their use of the Nile River in response to climatic stress would seriously threaten Egypt and could provoke armed conflict was also discussed in the meeting. North African states may be drawn into conflicts or climatic crises in the vulnerable Sahel region to the south. Conflicts involving nomadic populations could easily see migrants cross state borders. Climate change is likely to increase the already substantial emigration of North Africans to Europe. The region serves as a route for transmigration of Sub-Saharan Africans fleeing severe climatic stress. North Africa's capacity to adapt to climate change is inhibited by underdeveloped and disempowered civil societies and the dominance of repressive but often ineffectual regimes.

A few key decision-makers dominate state policy making and economic activity in North Africa. Vulnerability to climate change also depends greatly on the economic circumstances and infrastructural capacity of nation (Jepma and Munasinghe 1998:37). Their main objective over the next two decades in the region is to bolster regime security and resilience against climate change-induced instability. Longstanding state suppression of civil mobilization and a lack of social capital will significantly constrain the capacity of civil society to address climate change. Ineffective state responses and state suppression of civil society allows Islamist groups to fill the void. Climatic stress may create opportunities for both moderate and extremist Islamist groups to expand their influence in North Africa. Nevertheless, North African states and societies have repeatedly shown the capacity to withstand sustained challenges without overall systemic collapse. Despite widespread institutional deficiencies, North African states have demonstrated the capacity to marshal considerable national resources and tackle large-scale infrastructure projects.

Climate change is one of the few cross-cutting issues having the potential to spur more serious efforts at regional cooperation.

Among the North African states, Libya and Algeria are less economically vulnerable to challenges that arise from climate change because their economies are supported by exporting fossil fuels and are not dependent upon agriculture or tourism. Climate model projections available for North Africa indicate a clear increase in temperature over the next 20 years that is expected to continue throughout the 21st century, probably at a rate higher than the estimated global average. Model simulations also suggest a drying trend in the region, particularly along the Mediterranean coast, driven by large decreases expected in summertime precipitation. Because coastal areas historically receive by far the largest amount of rainfall in North Africa, future decreases will likely have a significant and noticeable impact. Precipitation trends in the interior semiarid and arid regions of North Africa are more difficult to predict due to the very small amount of natural precipitation that characterizes these areas. Climate change will induce some variations in precipitation patterns, but the trend is not clear, as some models predict slight increases and others predict slight decreases in annual precipitation amounts.

2.2.1. IMPACT ON WATER RESOURCES

All countries of North Africa are presently experiencing water stress. Model simulations show a general decrease in rainfall across North Africa, with median decreases in average annual precipitation of 12 percent and 6 percent projected for the Mediterranean and Saharan regions, respectively. This general drying trend for North Africa is punctuated by seasonal variations in projected precipitation that differ by region. Predicted decreases in average annual rainfall, accompanied by projected increases in the population of the region, impede access to water for millions of inhabitants. In addition, with decreasing water levels, other ecological effects such as salinity in coastal areas and deterioration of water quality may increase. Water scarcity is a main constraint to improve agricultural productivity. Irrigation facilities help to improve farmer's resilience to low and erratic rainfall. In North Africa over 90% of agriculture is rain fed and there is no potential for additional development of irrigated agriculture because of water scarcity. 'North African region is among the

most water-scare region in the world and characterized by high spatial and temporal irregularity in water availability. The problem is more acute in view of the increasing urbanization, growing population and the already high rates of water uses. In addition, the high salt content in much of the available water further complicates irrigation efforts. In addition, traditional cultural practices are dominant and access to new technology by the majority of farmers which is quite limited. Therefore, a small reduction in rainfall associated with climate change could cause a sharp decrease in agriculture production and shortage in food supply, particularly for smallholder in rural areas' (Darin 2010:10). Indeed, considering the hydrological regime in the region, the current storage facilities are still insufficient to face the challenge of more frequent and severe drought episodes. Moreover, water efficiency use in the region is low, which is a considerable limit for better management of existing water resources. The region needs to improve its storage capacity in order to cope with climate change adverse effects. However, among the crucial factors which will affect the magnitude of the shortfalls in water storage are identification and availability of sustainable reservoir sites (White 2005).

2.2.2. IMPACT ON AGRICULTURE

Model results are inconsistent regarding future changes in crop yields and agricultural growing seasons in North Africa, and we do not know whether variations in temperature, precipitation, or atmospheric carbon dioxide will be the dominant factor. It was suggested that future increases in atmospheric carbon dioxide concentrations increases maize yields in Morocco, while other modeling studies suggested that future increases in air temperature have a negative effect on growing seasons and crop yields in Egypt. Relatively heat-tolerant species, such as maize, are expected to suffer the smallest losses in yield and growing area, while heat-intolerant crops, such as wheat, are expected to suffer the largest losses. In addition, intensive irrigation practices in the region may result in further salinity, which may lead to desertification. Adaptation strategies, including modifications in sowing dates to match climate changes and development of heat-tolerant crop varieties, is likely to mitigate some of the expected negative effects on North African agriculture. Development of regional and local climate models in the coming years that include

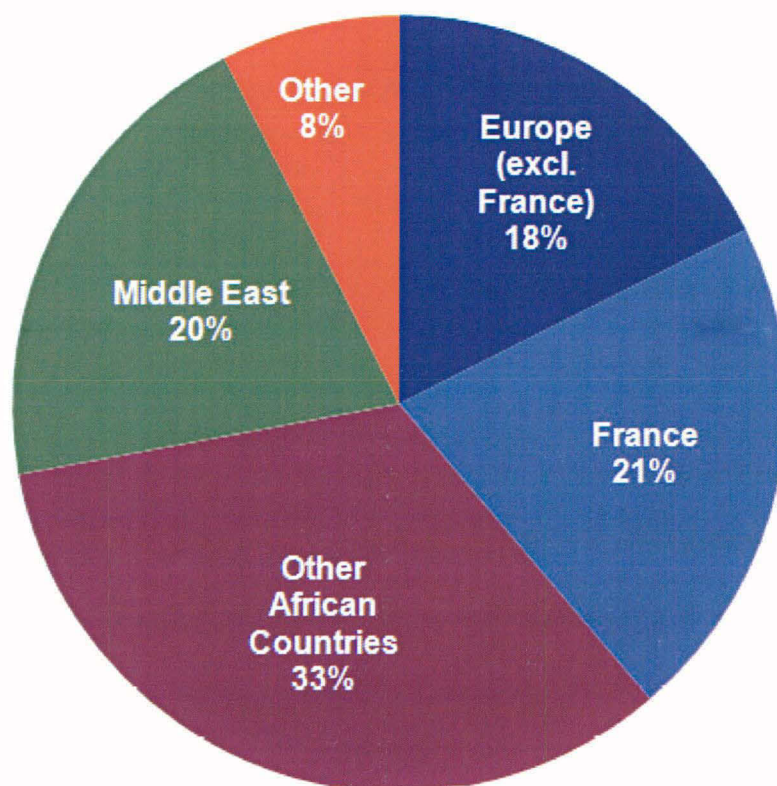
projections of Mediterranean Sea level rise and decreases in the Nile River flow are expected to provide more accurate estimates of future changes in North African agricultural regions. Only a few systematic modelling studies of the effects of climate change on agriculture in North Africa are available, possibly due to the fact that most of the region has an arid and semiarid climate and they receive very low level of rainfall. Temporal and spatial irregularity in precipitation makes it difficult to predict the impacts of climate change agriculture in particular and the economy in general.

However, as one of the world's most water-scarce regions with a high dependency on climate-sensitive agriculture, the economic and social conditions in North Africa are likely to deteriorate in the future. Higher temperature in the region will increase evaporation and cause the loss of surface water. In addition, in the quasi-totality of the aquifers ground water level reached alarming values and water quality is at the lower limit of standard. Changes in extremes including floods and droughts are also projected to affect water quality. Sea level rise is projected to extend areas of salinisation of ground water resulting in a decrease of freshwater availability for human and ecosystem in coastal areas (IPCC 2007).

2.2.3. IMPACT ON MIGRATION

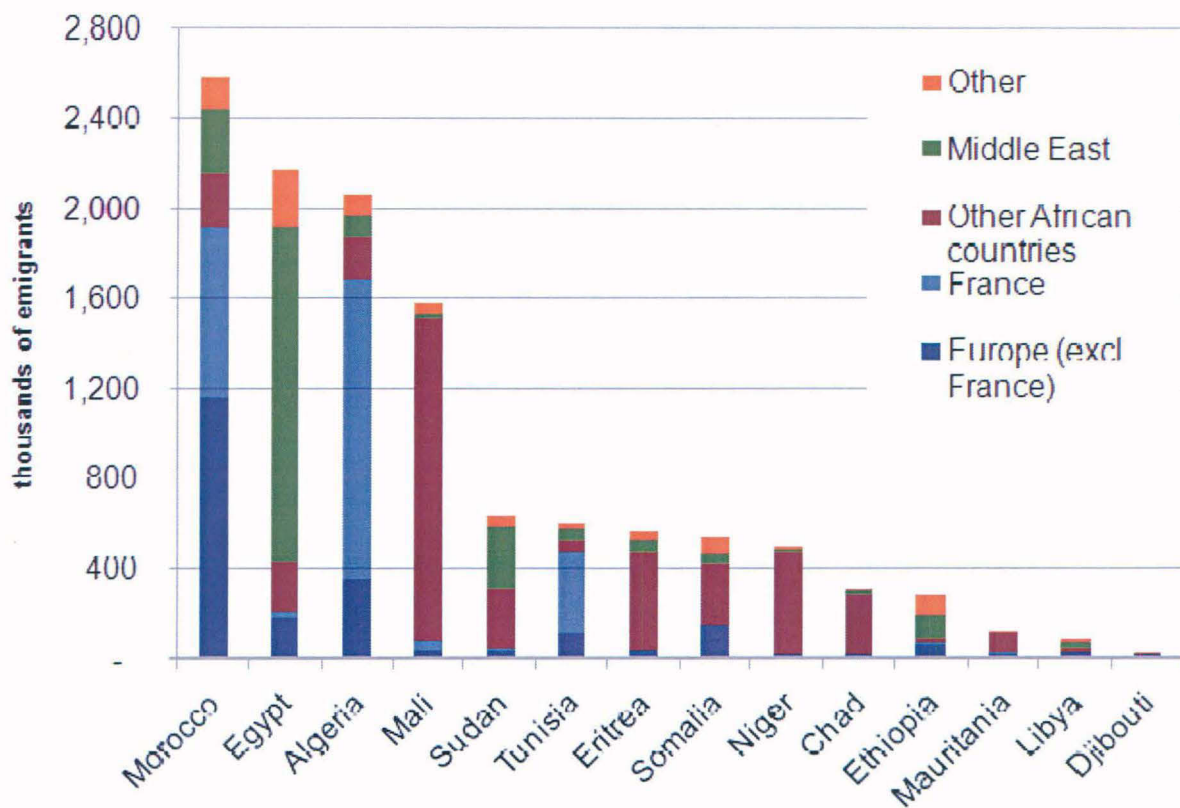
In recent years, North Africa has experienced vast migration pressures from both migrants that settle in the region from the North African countries as a transit area to reach Europe. Because of the climate change issues there are lots of group wanting to shift into that region where it is suitable for them to lead a comfortable life. Thus, experts have not cited climate change as a driving force for migration in the region; nevertheless, a warmer climate and changing precipitation patterns, which is likely to reduce viable cropland and reduce access to water, will increase urbanization and make accommodating the needs of a growing population more difficult. Besides food and water necessities, climate change-related migration may also imply greater demands on infrastructure along the coasts as well as ethnic, racial, or religious clashes. The following image shows the statistic of people migrated to other countries from North Africa because of climate change:

Destination of Emigrants out of North Africa, the Sahel and the Horn



Source: Global Migrant Origin Database 2007

Destination of Emigrants out of North Africa, the Sahel, and the Horn



Source: Global Migrant Origin Database 2007

2.2.4. NATURAL DISASTER

Though North Africa is not the centre for natural disaster but its effect which results into problem and issues of climate change cannot be ignored. Floods are one of the major reasons of concern. Because of the lack of historical data from tide gauges in the region, the wide range of future estimates in sea level, and the paucity of regional climate model projections for the Mediterranean Sea, a definitive estimate of sea level rise along the coastline of North Africa in the next 20 years is not possible. However, the intensity and frequency of floods along the Mediterranean coast are expected to increase by the middle of the 21st century. Compared to other regions, the impacts of sea level rise in North Africa are expected to be stronger in terms of social, economic, and ecological factors. Highly populated and agriculturally important coastal cities are the most vulnerable.

2.2.5. IMPACT ON TOURISM

Tourism is an important source of income for most countries of North Africa. Of concern, however, are the large quantities of water this sector demands and the little attention that governments of this region have given to water provision in the past. Thus, increased water scarcity, sea level rise, and increasing temperatures have a negative impact on this sector and consequently the economy of most North African countries. 'Climate change in the region is more than an issue of environment it is indeed a matter of development; 'unsustainable development is the underlying cause of climate change and development pathways will determine the degree to which social systems are vulnerable to climate change' (Huq *et al*; 2006:4).

2.2.6. IMPACT ON ENERGY

The economies of Algeria, Libya and to a lesser extent Egypt are dependent on the hydrocarbon industry. Because of the revenues they receive from exporting fossil fuels mostly to Europe they are to some degree more resilient to the deleterious impacts of climate change. Any shift in the interest of other regions in importing natural gas and oil from North Africa, conversely, may make these North

African countries considerably more vulnerable. However, there is no indication now that Europe and other importing regions will stop importing from North Africa in the next few decades (National intelligence Council 2009).Based on a comprehensive global comparative study of resilience to climate change using the Vulnerability-Resilience Indicators Model; a wide range of adaptive capacity is represented in this group of countries from Libya to Morocco. Under a high growth scenario of the future, all countries have gained adaptive capacity, especially Libya. However, under a delayed-growth scenario, all of these North African countries lose adaptive capacity.

2.2.7. IMPACT ON NILE VALLEY

Almost all of Egypt's population and agriculture is concentrated in a narrow strip along the banks of the Nile and in the Nile Delta. Any serious disruption of the Nile's flow, whether due to climate change or human activity, represents a threat to Egypt. Upstream water diversion schemes by Sudan and Ethiopia have been a recurring source of regional tension, a dynamic that climatic stress is likely to intensify. Shifts in the monsoon exert a greater influence on the fate of the Nile than climate change in North Africa. Climate change within the region will nevertheless exacerbate a number of threats to the lower Nile and Nile Delta. Although sea-level rise is not likely to threaten most of North Africa's coast to 2030, much of the Nile Delta is already at or even below sea level. Even marginal sea-level rise combined with storm surges could create disastrous flooding in the delta. Egypt's second largest urban centre, Alexandria, is at high risk for catastrophic flooding that could cause billions of dollars in damage and threaten millions of inhabitants. One of the principal reasons for construction of the Aswan High Dam, completed in 1970, was to control seasonal flooding along the Nile. As a result of doing so, however, the dam reduced the replenishment of fertile silt, leading to erosion of the Nile Delta. Reduced flows also allowed encroachment of saltwater into the delta, contaminating the groundwater.

The River Nile provides an invaluable source of livelihoods to over 300 million people. As the populations grew and civilisation evolved, the demand for more water resources took a toll in the region. The climate change effects have further compounded water management in the basin. Water and food security in the region is under threat, so that there is a need for robust transboundary water management in a

region that has only finite water resource' (Ndayizeye 2009:19) On the other hand, the water impounded in Lake Nasser provide Egypt with a means to compensate if climate change causes variations in Nile flow. A threat to water quality and increasing urban demand for potable water is likely to pose a greater hydrologic challenge for Egypt than outright water scarcity. Water quality in Egypt is already poor, subject to pollution and high salinity, and causes a high incidence of waterborne illnesses and infections. Climatic stress on agriculture is likely to cause a greater use of fertilizers, contaminating drinking water. In the Nile Delta, salinization of groundwater resulting from over extraction will significantly reduce available potable water. By 2030, three-quarters of Egyptians will have inadequate access to fresh water.

2.2.8. IMPACT ON COASTAL MAGHREB

The Mediterranean and Atlantic coasts of the Maghreb have a wet-dry climate that on the one hand brings periodic and often sustained droughts and on the other hand causes occasional extreme precipitation that leads to flooding. Climate change will likely exacerbate both of these extremes Drought is a normal, recurrent phenomenon, which occurs in virtually all climate zones, although its characteristics vary significantly from one zone to another (Hulme 1995). Droughts in the region are already increasing in frequency and severity; this trend will likely continue through 2030. Droughts have caused serious damage to agriculture in Morocco and Tunisia and could put tens of millions of North Africans at risk for water stress. Population, agriculture, and economic activity in the Maghreb are disproportionately concentrated in areas at risk for flooding. More frequent and severe floods will damage both urban and rural infrastructure, agriculture, and housing, as well as threatening water quality. In addition to low-lying coastal plains, the valleys of the Atlas Mountains in Morocco and Algeria and the margins of the periodic salt lakes such as Chott el Djerid in Tunisia are subject to flash floods due to extreme rainfall. A related threat from extreme rainfall is mudslides, particularly in Algeria where the Atlas Mountains rise steeply above the densely populated coastal plain. In 2001, extreme rainfall triggered mudslides in Algiers that killed over 500 people and generated significant urban unrest. In addition to periodic extreme weather events droughts and floods, the coastal Maghreb is projected to suffer an overall 12 percent decrease in annual precipitation

to 2030. Given the existing high level of demand for water resources in the area, such a decrease will create major socioeconomic stress. Both urban and rural water distribution infrastructure in the coastal Maghreb is fairly extensive but inefficient and antiquated. Higher temperatures will increase evaporation, already a major cause of water wastage due to the widespread reliance on inefficient surface irrigation systems. Aside from major disruptions to rain-fed agriculture, reductions in runoff, reservoir levels, and river flows could lead to sustained urban water shortages. Water scarcity will likely become a major driver of socio-political unrest and migration. In addition to rainfall, the other major water source is groundwater drawn from aquifers (National Intelligence Council 2009).

The Maghreb's coastal aquifers face severe strain due to increasing rural and urban water demand. Climate change-induced reductions in precipitation will both increase reliance on groundwater and reduce renewal from runoff. In addition, coastal saline intrusion contaminates coastal aquifers, saline contamination of drinking water is already a problem in Tunisia. The Maghreb states increasingly need to tap into the inland aquifers under the Sahara. Libya has taken the lead in doing so with its "Great Manmade River" (GMMR) project, and consequently will not face the same water stress its neighbours will suffer to 2030. The GMMR is tied to a prehistoric non-renewable water source that will ensure adequate water supply in Libya for at least the next half century. The supply life of the GMMR may be extended if other aquifers provide an additional water source or are found to be replenishable; however, there are no known Saharan aquifers of similar scale.

2.2.9. IMPACT ON SAHARA

The socioeconomic impacts on North African states from climatic changes in the Sahara are likely to be minimal due to the lack of agriculture and low population. Many areas of the Sahara already experience decades without rainfall; climate change will only worsen conditions incrementally. The most significant regional impact may be the drawdown of Saharan aquifers that provide water to neighbouring areas such as the Mediterranean coast and the Sahel. Drying and warming trends as well as depletion of aquifers may also accelerate desertification in the semiarid strip along the

interior margins of the Atlas Mountains, an area disproportionately inhabited by Berber minorities. Countries in sub-Saharan Africa are likely to suffer the most devastating impacts of climate change because of their geographical location, low incomes, low technological and institutional capacity to adapt to rapid changes in the environment, as well as their greater reliance on climate-sensitive renewable natural resources sectors such as water and agriculture (Eboh 2009). In addition, even marginal climatic shifts could put acute water stress on the isolated Saharan oases, which host densely concentrated populations living under very marginal conditions. Climatic stress on desert scrub vegetation will threaten the marginal grazing that underpins the nomadic, pastoral lifestyle of desert-dwelling groups. The oases are also milestones on the trans-Saharan migration routes, and Sub-Saharan African migrants, who are often halted at the oases for considerable periods of time, are likely to suffer the worst privations.

2.2.10. CIVIL RESPONSES TO CLIMATE CHANGE

To a large extent the response of groups within North African civil society to climate change is driven by how the state response. Most civil responses to climate change are likely to manifest at the individual or local level for instance, farmers changing planting schedules or irrigation methods and urbanites conducting more business at night to avoid the heat. The state is likely to inhibit social mobilization for larger-scale responses. If the state is able to respond effectively, civil society is likely to remain quiescent. The track record of states in the region, however, suggests that their responses to climate change induced challenges may in many cases be deficient or seriously disruptive of civil society. State responses may involve large-scale disruption of social structures or local communities, such as by forcing relocation out of threatened areas or out of the way of public works projects. Since states in North Africa are largely organized for the benefit of narrow elites, the state's response is likely to focus on mitigation measures that benefit those groups. State responses and resource allocation decisions that manifestly disadvantage or disrupt some segments of society while benefiting others are likely to provoke civil dissatisfaction that may manifest in political unrest, radicalization, or social mobilization (National Intelligence Council 2009). An acute state failure to address climate change that results in

intolerable conditions for significant segments of the population may constitute a socio-political tipping point, in essence a breaking of the social compact between North African states and civil society. At that point, civil actors may determine that fundamental systemic change is necessary. The results of such a situation will depend on the specific reactions by state elites and by the public; reform, repression, or revolution are all possibilities. A combination of climatic stress and inadequate state responses over the next two decades could prove the catalyst for a major socio-political shift in North Africa. On the other hand, North Africans tend to hold a religiously based view that “what will be, will be.” Owing to this fatalistic mindset, North Africans are unlikely to blame the state for climate related stresses, making it more difficult to attain the aforementioned tipping point.

2.2.11. IMPACT ON ISLAM

Climate change-induced challenges over the next 20 years is considered to provide a major opportunity for Islamist groups to step up as both effective civil responders and political challengers to North Africa’s state elite. Islamist groups have emerged as the only viable opposition force because they have resisted state cooptation and because the state has blocked other avenues for social mobilization. In addition, they have established a track record of effective humanitarian responses to mudslides, earthquakes, and other natural disasters, often providing immediate medical, shelter, and food aid that are normally the responsibilities of the state. In many cases Islamist groups may fill the void left by inadequate state responses or the weakness of other types of potential civil responders. Moderate Islamist groups could play a constructive role, providing highly visible humanitarian assistance that empowers autonomous civil actors and contrasts with ineffectual state responses, thus pressuring state actors to respond more effectively. Moderate Islamists could use the climate change mitigation issue to bolster their argument that existing North African governments are illegitimate and exploitative, creating momentum for political reform (National Intelligence Council 2009). On the other hand, Islamic extremists across the region may exploit climate change’s destabilizing impacts and ineffective state responses to promote the spread of militancy and anti-regime violence. Indeed, Islamist militants could point to climate-induced catastrophes as evidence of God’s

wrath against “apostate regimes” whose un-Islamic behaviour has plunged the region into desperate circumstances. Moreover, Islamic extremist groups could take advantage of dire socioeconomic conditions to recruit more followers, particularly among disaffected youth in the shanty towns of Morocco and Algeria. The concentration of unattached, unemployed young men in overstressed North African cities as well as disaffected, marginalized rural communities under acute climatic stress provides ideal recruiting grounds for extremists (National Intelligence Council 2009).

2.3. INTERNAL MIGRATION

Climatic stress will add to the already substantial movement of population from rural areas into cities, exacerbating the region’s serious urban challenges. For the most part, such migration is unlikely to differ in kind from existing rural-to-urban migration patterns. It generates higher unemployment, further strain on urban resources, further expansion of shanty towns, and increased social friction. The decisive question becomes is that whether increased migration reaches an urban tipping point after which the region’s cities begin to suffer critical failures of infrastructure, services, economy, and society. In turn, that may depend on the manner and degree to which the state intervenes to sustain urban systems. In Morocco, for example, cyclical fluctuations in agricultural production have produced a corresponding cyclical migration back and forth between rural and urban areas. To the extent that climatic impacts exhibit a similar fluctuation in intensity, they may produce similar transient migration. Climate change in this part of North Africa which emits low levels of greenhouse gases represents a veritable threat to its socio-economic development and the life of its people (Agoumi 2003). In addition, differential climatic impacts in particular areas may drive rural populations to migrate into new rural areas with more abundant resources and less climatic stress. Because such areas are bound to already be inhabited, such movements are almost certain to cause resource conflicts and extend the collateral effects of climate change even into less directly affected areas. In addition, the combination of water scarcity and stress on marginal agriculture could drive more Berber-speakers into Arab-speaking coastal communities, creating a potential for ethnic conflict.

2.4. STATE'S RESPONSE

All five North African states have similar political systems. Regardless of the differing trappings of monarchy, revolutionary heritage, or republicanism, all are governed in an authoritarian fashion by autocratic elites. All five states of North Africa are highly centralized, with final authority concentrated within a small elite group. The state maintains a predominant position relative to civil society and the public, using coercion and consensus to achieve social acceptance of the existing system. Although the level of repression varies between states, with Tunisia and Libya the most extreme, and has varied cyclically over time, authoritarian regimes are well entrenched in every state in the region. Each of the five North African states was headed by a leader who promotes a cult of personality to serve as the legitimizing instrument for his rule, the most extreme examples was of Zine El Abidine Ben Ali of Tunisia and Muammar Qadhafi of Libya. The essential authoritarian character of North Africa's political systems is not likely to change over the next 20 years, even if other circumstances in the region shift significantly. Climate change seems unlikely to be a catalyst for political reform. The region's authoritarian regimes have weathered the international and domestic challenges and dynamism of the past half century and are likely to persist through 2030, although perhaps in a weakened and unstable form.

2.5. ELITE ATTITUDE TOWARDS CLIMATE CHANGE

Ruling elites in North Africa do not see climate change as an immediate threat to their authority. They therefore feel free to take an opportunistic attitude toward climate change, supporting climate change mitigation policies that have collateral economic or political benefits to their particular interests. By the same token, elites are aware that concern over the environment and climate change plays well internationally, particularly in Europe, making green initiatives and climate change mitigation politically advantageous. In addition, elites are conscious of the potential for climate change-induced civil unrest and socioeconomic instability and have an incentive to take measures to diffuse them. They are highly unlikely to countenance measures that involve broad social mobilization or social disruption, both of which are potential threats to their political security. Generational turnover in

leadership over the next 20 years is unlikely to decisively alter underlying elite attitudes and objectives. For example, younger leaders such as King Mohammed VI in Morocco and Muammar Qadhafi's son, Saif al-Islam, in Libya have shown interest in environmental and climate issues. Their policies, however, have exhibited the same political calculus and are rooted in the same authoritarian system as their antecedents (National Intelligence Council 2009).

2.6. CLIMATE CHANGE MITIGATION AND DEVELOPMENT PLANNING

Most climate change mitigation in North Africa is to be undertaken as a result of discrete decisions in response to specific climatic impacts rather than as a result of holistic mitigation planning. Mitigation measures will vary down to individual areas and communities within states, as well as differing according to the specific perspectives of the elite decision-makers who champion them. Nevertheless, because of the region's perennial resource scarcity, North African states are accustomed to conducting significant amounts of development planning. Development planning, infrastructure design criteria, and economic policies over the next two decades will be forced to take the impacts of climate change into account. Climate variability refers to inter-annual variability of individual climatic parameters around longer term mean values. It is inherent in dry land areas (Verhagen *et.al*; 2004). The future viability of North African development plans depend on whether climate change produces incremental changes in conditions or a radical discontinuity. In addition, North African development models from the colonial period to the present have emphasized water-intensive economic activities such as inefficiently irrigated agriculture, tourism, phosphate processing, and light manufactures. Plans for future development build on this legacy, with particular emphasis on European tourism. Hotels, resorts, and golf courses create very high hydrologic demands; climate change may not be reconcilable with this development model. For countries such as Morocco, Tunisia, and Egypt, where tourism is a key component of the economy, pressures to alter development patterns that reduce water usage, limit building expansion on arable land, or suspend highway construction, will be very difficult. Libya's nascent tourism industry has far fewer vested interests in existing patterns, and Libya is developing "green" tourism in Cyrenaica. Water resource management will be the most important aspect of climate

change mitigation in North Africa. North African states are accustomed to sustained water resource constraints and have institutional experience planning for and managing water resources. One likely response is more investment in desalinization plants as the increased costs of scarce water makes them more economically viable. Libya is already investing significantly in desalinization research and other states are likely to follow suit.

All North African states will need to significantly upgrade urban water infrastructure. The Maghreb states are likely to increase construction of reservoirs, dams, and other water management infrastructure in the Atlas watershed. Additional states are likely to follow Libya's example and invest in major infrastructure projects to tap into Saharan aquifers. In Egypt, water management infrastructure projects on the Nile are likely to be expanded. Mega-projects such as the New Valley Project will need to be carefully assessed in terms of gains in arable land versus strain on water resources. Although North African farmers have proven adept at adapting individually, many of the problems agriculture will face will require major state-level intervention and investment. To mitigate harsher and more variable growing conditions, states will need to update rural infrastructure, particularly irrigation systems; encourage and subsidize crop substitution away from rice and wheat toward more temperature and water stress-resistant crops such as maize; and adopt more efficient land use patterns. Overall, maintaining the agricultural sector will take a larger share of state budgets. As climate change induced disruptions increase volatility in production and prices, states will need to increase market intervention to stabilize and subsidize prices and supplies or face widespread social unrest. Increasing dependence on food imports will eat into state revenues.

One of the most complex aspects of climate change mitigation will be addressing the expected growth and climatic stress on North Africa's cities. North African states have been ineffective in managing urbanization. Since state policies will focus on the needs of the privileged and of foreign visitors, the wide disparity in levels of infrastructure, services, and standards of living between districts in the region's cities will likely worsen. As state resources become increasingly tight, the shanty towns may receive only the bare minimum of development attention. Because North Africa is not a major direct contributor to global greenhouse gas emissions, it

faces less international pressure than other regions to mitigate the causes of climate change. Libya and Algeria, however, are major suppliers of fossil fuels to Europe, so their indirect contribution to European emissions is considerable. Oil and gas production are essential to economic development in Libya and Algeria, and these countries have no interest in limiting exports in order to curb emissions. Indeed, they will do as much as possible to sustain rather than diminish consumer dependence on hydrocarbons. European policy will ultimately determine how the contribution of North African oil and gas to global emissions is addressed.

2.7. SOCIAL CONTROL

The implications of climate change in North Africa notably migration, stress on both rural and urban areas, unemployment, and increased resource competition are likely to generate volatile socio-political conditions that will pose significant threats to the existing political structure. The responses of North African states to these threats may be more decisive for the fate of the region than their direct responses to climate change impacts. North African states have robust capacity to maintain social control in the face of domestic challenges and destabilization. They have a track record of effectively suppressing dissent and unrest or remaining resilient where unrest has persisted, such as the civil conflict in Algeria. States in the region may seek to suppress or distort information on climate change-related challenges. They seek to control access to any information that could provide a basis for opposition to the state, even information as seemingly innocuous as census data. The proliferation of new media and alternative information sources, however, will make it difficult to maintain such censorship. North African regimes are also adept at deflecting blame, and policy failures may be attributed to sub-ministerial-level bureaucratic scapegoats or foreigners (National Intelligence Council 2009). In addition, all states except Libya have exploited so-called “democratic elections” as a way to demonstrate to their own people and outside observers that they are responsive to rising expectations and accountable to the public. State-civil society relations in the region are cyclical and specific dynamics will vary between states. Overall, however, increased climatic pressure to 2030 is unlikely to facilitate moves toward greater openness, reform of political institutions, or democratization. What is worrying

people at the moment of Egypt, Libya, Tunisia, Algeria and Morocco is the possibility of a substantial global warming as a result of changes in the greenhouse effect induced by human activities (Creacknell and Kondratyev 1998). Climate change-induced increases in unemployment, derailment of economic progress, and increased public disaffection will make it less “safe” for elites to allow the public more voice. North African states may instead respond to this challenge with widespread repression, human rights violations, and suppression of civil society, NGOs, independent media, and other dissenting voices. Security forces are more likely to be used to suppress civil reactions to climatic crises rather than to provide humanitarian support. More states are likely to adopt Tunisia’s practice of systematically isolating, opposing, and ultimately eliminating any opposition. In the process, they are likely to damage overall adaptive capacity by inhibiting constructive contributions by civil actors.

North Africa in many respects comprises two distinct regions: the Maghreb (Morocco, Algeria, Tunisia, Libya, as well as Mauritania and Western Sahara) on the one hand, and Egypt on the other. Whereas the Maghreb looks to Europe, Egypt is oriented more toward the Middle East and the Arabian Peninsula. Turkey is the development model for Egypt, not Western Europe. The dialects, dress, and lifestyles are different in the Maghreb people eat couscous, in Egypt they eat bread. Egypt’s hydrology and agricultural practices are markedly different from those of the Maghreb. As a result, the two sub-regions will face differing types of climatic mechanisms. In sum, there is much that divides Northwest from Northeast Africa and relatively little that unites the two sub regions.

2.8. REGIONAL ENERGY ISSUES

Libya, Algeria, and to a lesser extent Egypt are major energy suppliers to Europe and are likely to remain so to 2030. Although Europe is likely to reduce its dependence on oil in an effort to curtail greenhouse gas emissions, demand for natural gas is likely to increase as an alternative. All three North African energy producers have substantial natural gas reserves, particularly Algeria. Europe has a strong interest

in expanding gas ties with North Africa to diversify its gas supply away from dependence on Russia. Europe's energy relationship with North Africa will become more hardwired as additional gas pipelines to Spain and Italy come online over the next two decades. Because of their high natural gas and oil revenues, Libya and Algeria's economies (and to a lesser extent that of Egypt's), are likely to be less impacted by climate change in the short term. Morocco's dependence on agricultural production has slowed down its economic growth a trend which may be exacerbated by climate change by the middle of the 21st century, unless significant policy changes are made (Snoussi 2008). For example, in 2005, Morocco's government spent more than twice the amount it had planned on food subsidies. By contrast, Tunisia has a more diversified economy. Hence, despite higher energy costs, Tunisia's economy has grown in recent years. As with other aspects of Trans Mediterranean relations, North African states have competed more than cooperated with each other in pipeline construction. In addition to natural gas, North Africa has the potential to become an exporter of solar or wind-generated electricity to Europe. Construction of solar arrays in cloud-free North Africa connected to Europe via high tension power lines could become a second energy link between the two regions. Besides the direct energy benefits, Europe could situate solar energy projects in non-gas-producing states in order to dilute the threat of energy monopoly. Both gas and solar energy development in North Africa would have the collateral effect of providing employment and revenues in the region that might diminish the incentive for emigration to Europe and increase adaptive capacity. On the other hand, these industries are not labour intensive and the state would appropriate most of the revenues.

2.9. CROSS BORDER MIGRATION

The threat that climate change to 2030 will drive major increases in cross-border migration is one of the principal preoccupations for Europe and the North African states. North Africa is both a source of migrants and a transit region for external migrants. Both of these dynamics are likely to be significantly expanded by climatic stress in Africa, and both are directed primarily at Europe. Although migration probably will have less direct adverse impact on North African states than other climatic challenges, it is likely to be the principal manifestation of climate

change-induced spill over into Europe. ‘The direct and indirect effects of climate change could further undermine peace and stability in North Africa. Climate change impacts and their interaction with other vulnerabilities and environmental exposures will likely lead to significant population migrations internally as well as across borders with severe humanitarian impacts further undermining peace and stability. Scarce water resources are another contributor to an increased risk of conflict’ (8th meeting of African partnership forum 2007:9). To date, the vast majority of cross-border migration from and through North Africa has been economically or politically driven, rather than environmental. This pattern will be altered as climate change affects North Africa more significantly, but the degree to which it will drive increased migration remains unclear. As climate change impacts are felt more strongly in the Sahel and Sub-Saharan Africa, however, they will become leading drivers behind the larger African migration pattern northward toward Europe. Climate change is likely to render North Africa a less attractive final destination for migrants even as it increases transmigration into Europe. High levels of climatic stress and rampant unemployment in the North African states not only are intrinsic deterrents to immigration but leads to a situation in which states in the region should take more strenuous steps to curb migration. For the same reasons, sustained climate change induced challenges are not likely to result in substantial horizontal migration between the North African states. Although localized crises might propel transitory intra-regional migration flows, North Africans will most likely continue to migrate out of the region rather than within it.

2.10. OVERALL FOREIGN POLICY IMPLICATION

Foreign policy interests in North Africa are first and foremost a function of how such interests can protect and promote the power and privileges of the narrowly based ruling elite. As such, foreign policy considerations are pursued in a very instrumental fashion regardless of their impact on broader societal concerns. The preeminent climate change related foreign policy objective for North African regimes over the next two decades will be to develop relationships and access to resources that bolster regime security against climate change-induced instability. Concentration of carbon dioxide and other green house gases are rising and there is a growing concern

about the effect this may have on the global climate and on communities around the world. The lack of an adequate ancient analogue for future climates means that we ultimately must use and trust climate models, evaluated against modern observations and geologic records (Kump 2002). North African states are therefore likely to adopt more open foreign policies that seek greater engagement with the United States and Europe. Despite similar overall foreign policy goals pertaining to climate change mitigation assistance, the North African states are not likely to act as a concerted regional bloc. Each government will pursue its own foreign policy reflecting its specific interests and orientation, often in competition with its neighbours. As in other areas, the foreign policies of Egypt and of the Maghreb have differing orientations. Egypt's most important relationships are with the United States and the Middle East, while the foreign policy of the Maghreb is Euro-centric. These distinctions will most likely persist over the next two decades.

CHAPTER THREE

ROLE AND POSITION OF NORTH AFRICAN COUNTRIES

The origin of climate change issue can be traced back a few decades. However, the main concern for the issue was felt and witnessed more after 1970's when a number of organizations started taking up this issue as the most important threat to the world system. It was realized that the natural disasters, humanitarian emergencies, and other crises that climate change causes or intensifies; present serious challenges not only to directly affected countries, but to the entire international community. The gravity of the climate change problem is underlined by the great degree of international attention paid to the subject (Munasinghe and Jepma 1998:1). The UNO Summit in Stockholm (1972), the Vienna Convention (1985), Brattland Commission (1987), Earth Summit (1992), Kyoto Protocol Summit (1997), Summit on Sustainable Development Johannesburg (2002), Copenhagen Summit (2009), Cancun Summit (2011), etc. are some of the important summits where the negotiations on global climate change and involvement of Africa (north, south, central, east and west) has come to the forefront. Most importantly the role of African Union, the Maghreb Union and the United Nations cannot be ignored in this region. There has been a demand by North African countries in concern to the climate change issues. For example, key demands of the African Group based on the Common Position of the Committee of the African Heads of State on Climate Change (CAHOSCC).

3.1. SUMMITS ON CLIMATE CHANGE

3.1.1. STOCKHOLM SUMMIT

In 1972, environment was included in the agenda of the UNO summit in Stockholm. The United Nations Environment Program (UNEP) was established in this summit. UNEP works as a global leader in environment protection. It mentioned that the developing countries have lesser responsibility as compared to the developed countries in terms of climate change issues and environmental protection. It attracted the attention of countries all over the globe. North African countries like Egypt, Morocco, Libya, Tunisia and Algeria were also among other countries which paid attention to the issues of global climate change. The countries became aware of the

problem which could lead to several problems all over the region. In 1975, 16 Mediterranean countries and the European Community adopted the Mediterranean Action Plan (MAP), the first ever Regional Seas Programme under UNEP's umbrella. In 1976 these Parties adopted the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention). In 1995, the Contracting Parties were 22 which include North African countries like Algeria, Egypt, Libya, Morocco and Tunisia (Mediterranean Action Plan 2009). In 1981, it was recognized that the North African countries like Algeria, Tunisia, Libya and Egypt identified large-scale erosion, oil pollution, damaged coral reefs, ruined mangrove swamps, pollution from fertilizers and threats to precious marine animals as the major environmental problems in the region. The list of threats to the environment has changed little since then. All these further resulted in the change of climate which brought several kinds of issues as to how to protect the country and the continent in fact the whole of the world from this issue. In 1985, the Vienna Convention was organized and in 1987 the Montreal Protocol took place. Under the protocol, it was agreed to cut down CFC emissions by 50% by 1999. 24 industrially advanced countries agreed to the protocol's aim. The North African countries like Libya and Tunisia took note of it and planned to work according to its manifestation.

3.1.2. BRATTLAND COMMISSION, 1987

In 1987, the UN Assembly created World Commission also known as Brattland Commission which presented its report and advocated sustainable development. Sustainable development is defined as a development which fulfils the current needs and also the needs of future generations without any compromise. Hence, the conclusion was to protect the environment and tackle the climate change issues. Again, the North African countries became aware of the environmental problem occurring all over the globe and also in that region. Steps were taken to fight against the issue of climate change all over the globe.

3.1.3. BASEL CONVENTION, 1989

The Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal was the most comprehensive global environmental agreement on hazardous and other wastes. It aimed to protect human health and the environment against the adverse effects of the generation, management, trans-boundary movement and disposal of hazardous and other wastes. The Basel Convention was adopted in 1989 and entered into force on May 5, 1992 (Mediterranean Action Plan, 2009). All the five countries of North Africa played an important role in this summit.

3.1.4. EARTH SUMMIT, 1992

In 1992, the Earth summit was held as a reaction to the rise of climate change issues. A task team report on the implications of climate change for the developing nations concluded that the region's low-lying coastal areas and marine ecosystems, water resources, terrestrial ecosystems and human settlements and coastal infrastructure are at risk as a consequence of climate change impact. It was noticed that the effects of climate change will be felt everywhere, perhaps most obviously in altered patterns of rainfall, coastal weathering, atmospheric pressure and evaporation. The spatial and temporal distribution of storms and cyclones will change their paths and frequency, and could well increase in intensity. Besides the direct toll on human lives, it was felt that there can be impacts on coastal habitats such as coral reefs, lagoons, and mangroves. The reefs in North Africa were vulnerable to wave action and sea-level rise as well as sedimentation. Their destruction led to a decline in natural coastal defences and further led to an encouragement in coastal erosion. The quality and quantity of water available from rainfall, rivers and ground water is affected by changes in the distribution and amount of rainfall, evapo-transpiration, surface runoff, river discharge, recharge, and aquifer volumes. Drier and hotter conditions place an inordinate pressure on water resources. An ecosystem effect includes latitudinal and altitudinal shifts in plant and animal species as well as, loss of biodiversity due to water scarcity and arid soil conditions. While agriculture benefited somewhat from a global increase in carbon dioxide in North Africa, moisture deficits

lowered the crop yields and additional irrigation was needed. Fisheries were affected by changes to the breeding and migratory habits of most fish, hence, year to year variability of stocks increased leading to a planning and management problems. Socio-economic activities, and infrastructure such as port facilities, waste disposal, roads, are already under stress. Climate change would create additional stress in the region, hence reducing economic performance and growth.

3.1.5. KYOTO PROTOCOL SUMMIT, 1997

The Kyoto Protocol is a short name for the “United Nations Framework Convention on Climate Change”. The Protocol is an international agreement that sets targets for industrial countries to cut their GHGs by 2012. The gases include carbon dioxide, methane, hydro fluorocarbons, perfluorocarbons and sulphur hexafluoride. The Common Position of the African Group stated that Copenhagen should produce a 2-track outcome. One track should stipulate the future commitments by developed countries party to the Kyoto Protocol, excluding the US (Bali Action Plan 2007). This track should be amended to specify the commitments beyond 2012 of the developed countries that are bound by the Kyoto Protocol. The second track should provide a legal instrument for the outcome of the negotiations under the Convention which includes all Parties to the UNFCCC including the United States. A workshop in 1997 listed that North African countries like Algeria, Libya, Egypt, Morocco and Tunisia is suffering from domestic sewage, solid domestic waste, habitat degradation, agrochemical pollution and industrial waste pollution. The region remains characterized by vulnerable economies, large populations with a high rate of population growth, and areas subject to environmental stress. Hence the climate change issue had become important for all the developing nations of the world. 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 meagre results seen, even with the probable implementation of the Kyoto Protocol (Agoumi 2003:9). In the Bali conference of 1997, few North African countries including Libya and Tunisia took a common stand to conserve environment, necessity of international cooperation combat climate

change issues, education and public participation to overcome the issue of climate change, etc.

‘Egypt was among the first Arab countries to join the cooperative global efforts to confront climate change. Since the Rio de Janeiro Earth Summit in 1992, it has ratified the United Nations Framework Convention on Climate Change (UNFCCC) in 1994 and signed the Kyoto Protocol in 1999. Its First National Communication to the United Nations Framework Convention on Climate Change was published in 1999. The report pays attention to the risks faced by the country due to climate change and sea-level rise, mainly in relation to agriculture, water resources, human health, and the coastal zone. It also includes economic loss estimates for sea level rise in several coastal cities’ (Agrawala *et.al*; 2004:17). Egypt signed Kyoto Protocol on 15 March 1999 and ratified it on 12 January 2005. The Convention entered into force on 16 February 2005. Egypt stands at a crossroads. It can either take a leadership role in confronting climate change or see its land blossom into a powerful centre at the heart of the renewable energy sector or it can fail to implement the necessary policies and thus transform Egypt’s unique geographical resources into a deadly trap spreading massive dislocations of people, economic disaster, and starvation. The latest signs from Egypt’s government are encouraging and if successful could help marshal the rest of the international community to take similar action.

International climate change negotiators in Marrakech, Morocco, reached agreement on a complex set of decisions spelling out rules for implementing the Kyoto Protocol. The decisions by the Seventh Session of the Conference of the Parties to the UN Framework Convention on Climate Change, known as COP-7, provide detailed "legal" text elaborating the principles of the Bonn Agreement, reached at COP 6.5 in Bonn, Germany (Conference of the Parties-7 2001).

Major areas covered in the Marrakech Accords included:

- Operating rules for international emissions trading and the Protocol's two other flexibility mechanisms (the Clean Development Mechanism and Joint Implementation) and rules defining a party's eligibility to participate in the mechanisms.

- A compliance regime that sets consequences for failing to meet an emissions target but defers until a later Conference the question of whether the consequences are legally binding.
- Accounting procedures that provide for fungibility - meaning that emissions units under all three mechanisms can be transferred several times as equal units.
- Creation of a new type of emissions unit for sinks credits that cannot be banked for future commitment periods.

3.1.6. SUMMIT ON SUSTAINABLE DEVELOPMENT, JOHANNESBURG 2002

It was the second earth summit to discuss about the sustainable development. The main concern of North African countries and other underdeveloped country was that the average global temperature has increased by 0.6 C in the 20th century. Most scientists believe that emissions of 'greenhouse gases' (GHG) like CO₂ (carbon dioxide) and methane, which trap sunlight in the earth's atmosphere, have contributed to this increase. They also believe that a further increase in the emission of these gases will lead to an increase in the average temperature by the end of the 21st century. This will lead to dramatic climate change. Since neither the problem nor its consequences are local; international cooperation, especially between industrial countries that produce most of the CO₂, is required to reduce emission of these gases. In the Montreal Declaration 2005 the United Nation on climate change had a talk on targeted protocol resolution North Africa showed its participation and concern for the climate change issue.

The IPCC reports that in regions where mean drying is expected, such as North Africa in the 21st century, there will be a proportionally larger decrease in the number of rainy days expected to occur. 'In the 21st century, the frequency and intensity of frontal and convective thunderstorms in the regions north and west of the Atlas Mountains are expected to increase, the frequency and intensity of droughts in the southern and eastern portions of the country are expected to increase, and the length

of the rainy season is expected to decrease' (Nicholls 2006). This result suggests that although there will be less net rainfall in the region in the future, rain will be more intense on days that it does fall; indicating a compensation between intensity and frequency of precipitation that may lead to enhanced flooding (IPCC 2007). In its First National Communication to the United Nations Framework Convention on Climate Change, Morocco outlined several likely changes in extreme events, based on climate scenarios developed according to IPCC guidelines.

3.1.7. COPENHAGEN SUMMIT, 2009

A Political commitment was reached in Copenhagen between five countries: US, China, India, Brazil and South Africa. The rest of the conference simply "took note of it", most with resignation, many with anger. The conference ended without any significant result as the result came only in the form of BASIC declaration which was brought by the U.S. and other BASIC countries. The main agreement brought here was that the average temperature of earth in comparison to pre industrial age shouldn't arise from 2 degree centigrade. This summit was unaccepted by the G-77 and most of the African countries. North Africa unlikely played a substantive role in the Copenhagen climate change negotiations. The region is not a significant global source of greenhouse gas emissions and has more to gain from engagement with Europe on the climate issue than from a global agreement. In general, North African states are likely to go along with the overall position adopted by the G-77. In addition, Libya and Algeria can be expected to push for compensation for prospective losses in hydrocarbon revenues under a more stringent emissions regime. Mostafa Tolba, an Egyptian who is the former chairman of the United Nations Environment Program (UNEP), offered statements to the press criticizing the performance of the Egyptian government in dealing with climate change at the Copenhagen Summit. The biggest failure was on the issue that most of the African and the underdeveloped countries wanted a legally binding agreement like that of the Kyoto protocol. These nations were mainly concerned with the problem of rise in the gas emission of carbon dioxide which has become a threat to global environment further resulting in climate change issue. 'Chinese premier Wen Jiabao said it was a result that came from hard work on all sides, was accepted by all, didn't come easy and should be treasured' (The

Financial Times 2009). He said China is willing to build on Copenhagen but warns that future negotiations will be tough because the right to development is key to the climate talks. South Africa's environment Minister Sonjica stated that the result of the negotiations was unacceptable but South Africa decided to stay to influence the process from within and thus not do another walkout as had been discussed between African leaders (The Financial Times 2009). Many countries with regards to the reduction in carbon emission have voluntarily taken up the decision to cut carbon emission to 20% to 25% till 2025. But Africa which also includes the North African countries wanted a legal agreement unlike India. Most of the African and other poor countries wanted this legal bound agreement because they felt that the outcome of the problem of climate change would be felt by these countries the most. North Africa's stand on this summit was that it felt ignored because it was not given importance in comparison to other countries like India, Brazil, China, etc. North Africa like other African countries was not made a part of decision making process as well. They have realized that the acceptance of 2% rise in the temperature which has been accepted has been injustice to them. This should have been instead 1.5 percent centigrate. In this manner India has disappointed the African countries.

In 2010, the BASIC summit was held to discuss about the issues of climate change. The summit held in January and April has taken into account the problem that is affecting the environment. The Copenhagen Accord of December 2009 did not incorporate agriculture into the UNFCCC regime (UNFCCC 2009). Developed countries were aware that including agriculture in the UNFCCC regime will impose on them additional financial and technology transfer commitments especially that developing countries insist on overcoming the two issues before any measurable and verifiable commitment. Although, at present, there are variety of financial resources to fund such climate change mitigation and adaptation activities, "there is a considerable gap between identified needs and current pledges" (Keane, et al. 2009:17).

Tunisia took part in summit on climate change which was held in Copenhagen. It started focussing on ways of reducing greenhouse gas emission through an international agreement, as well as preventing global warming. Tunisia had adhered to major international efforts which aimed at reducing pressure on natural resources and limiting gas emission. President Ben Ali that time in his address to

Euro-African summit in Lisbon, 2007 also advocated the need to sustain international cooperation and assist developing countries like Tunisia, Libya, Algeria for example from north Africa to cope with climate change and reduce the development gap between the countries. Tunisia also hosted several events and conferences on climate change such as “international solidarity conference for strategies to tackle climate change.” Several decisions from this conference have been adopted in regional and international meetings. Tunisia is also preparing prospective studies in order to preserve natural resources and economic activities, including those related to strategies adopted in the agricultural sector and ecosystems to cope with climate change. Tunisia began the implementation of projects to reduce gas emissions, under the Clean Development Mechanism (CDM). So far, 28 projects have been set up in the sectors of energy, waste management, industrial methods, transportation, agriculture and forestry, apart from future projects funded by international cooperation

The Tunisian ministries have a comprehensive report at their disposal which identifies the regional impacts of climate change. Key decision-makers from risk-prone countries can refer to these findings and forecasts in order to adopt appropriate measures. The adaptation strategy and action plan for the agricultural sector were coordinated and agreed with all relevant sectors and institutions. It became apparent that the climate problems cannot be resolved by the agricultural sector alone but requires a coordinated inter-sectoral approach. The shared understanding of the problem makes it easier to undertake the adaptation work which is now required. The National Adaptation Strategy contains detailed proposals and criteria for the authorities on adaptation to climate change and the specific measures which must now be implemented. As the next step, the findings should be extended to the health, coastal protection and tourism sectors as well. The work on the adaptation strategy also generated considerable interest among the Tunisian public. A number of newspapers, radio and TV stations followed the project work and reported on the conferences that took place. This did much to raise general awareness of climate change and triggered a lively public debate about its impacts in Tunisia. Tunisia calls on developed countries to be more committed to reduce greenhouse gas emissions from all sectors because of the historical, present and direct responsibility to climate change. The post 2012 period should include quantitative targets with emphasis that

adopted measures and policies to achieve these targets should not adversely affect sustainable development in developing countries. Tunisia also believes that actions to the benefits of developing countries should rise to the level of international commitments agreed upon and the challenges posed by climate change, and support currently available mechanisms, especially the clean development mechanism, as well as funding mechanisms and Funds that emerged from the Kyoto Protocol but not yet into force.

Finally, Tunisia wants the developed countries to give their support for technology transfer, capacity-building and financing to undertake a deeper and more comprehensive assessment of the potential impacts of climate change to the developing countries for their betterment. In short, the international community is increasingly being urged to give a concrete meaning to international solidarity, particularly through implementing adequate measures, mechanisms and adaptation programmes to tackle climate change, but also through financing the Sustainable Development Programme with a view to bringing the world as close as possible to the targets defined by the UN Millennium Project (2005) and the decision of the Gleneagles G8 Summit (2005). Tunisia also hosted from September 14 to 15, 2010, a regional workshop for North Africa under the theme: "Meeting the Challenges of Climate Change, Strategies of Small Farmers to Achieve Food Security and Growth in Africa." The workshop was a part of preparations for the 2010 African Forum of the detailed forum for development of African agricultural. To take a more pro-active approach to the preparation of solution to combat climate change problems UNFCCC Conference of Parties was held in Bali December 2007, with respect of the leading proposals for global emissions control, by evaluating these through the lens of equitable access to carbon finance. To work with the international community and other stakeholders to facilitate progress in reducing deforestation in North Africa and lastly to continue to improve the environment for investment to encourage private sector investment in carbon finance (8th Meeting of the Africa Partnership Forum 2007).

3.1.8. AFRICAN DEVELOPMENT FORUM, 2010

The 7th African Development Forum was held from 12-15 October 2010 in Addis Ababa, Ethiopia, under the theme, "Acting on Climate Change for Sustainable Development in Africa." The main objective of the Forum was to raise awareness of climate change and also promote effective mainstreaming of climate change concerns into development policies, strategies, programmes and practices all over Africa. Progress continues to be made in the implementation of the NEPAD sub regional environmental action plans adopted by the environment ministers of the five sub regions (Central, East, North, Southern and West Africa). The past year has seen progress in the implementation of the Climdev Africa programme by the African Union Commission, in collaboration with the ECA and AfDB. The aim of the programme is to improve analytical capacity and knowledge management in areas related to climate change.

3.1.9. AFRICAN UNION SUMMIT, 2010

The 14th African Union Summit, which was convened in Addis Ababa, Ethiopia, 2010 focussed on Comprehensive Africa Agriculture Development Programme (CAADP) – land and water management. The result was that African and Arab Ministers met Egypt, to agree on a Joint Action Plan (JAP) that would guide their collaboration in agriculture and food security. The 2010 Joint Annual Meetings of the African Union (AU) Conference of Ministers of Economy and Finance, and the UN Economic Commission for Africa (UNECA) Conference of Ministers of Finance, Planning and Development, took place on 29-30 March 2010, Malawi. Countries of North Africa were also a part of this meeting. The Experts meeting considered a report titled "Climate Change and Development in Africa," which includes policy recommendations on: integrating climate change needs into national decision making, so as to reduce its negative effects on resources, livelihoods and the wider economy; strengthening Africa's coordination and negotiation structures and mechanisms in light of the lessons learned at Copenhagen. In statements marking World Day to Combat Desertification, celebrated annually on 17 June, UN Secretary-General Ban Ki-moon and UN Convention to Combat Desertification (UNCCD) Executive

Secretary Luc Gnacadja have called attention to the interlink ages between soil, biodiversity and climate change. It was said here that dry lands are areas of enormous biological diversity and productivity. Thirty per cent of the crops that are cultivated and consumed in every corner of the world originate in dry lands. Countries of North Africa have large areas of dry land and thus this land should not be considered as waste rather it should prove as a source of production for the whole region

3.1.10. CANCUN SUMMIT, 2010

This summit was held in Cancun (Mexico) which was celebrated as a success, unlike the COP-15 at Copenhagen in 2009, for it had managed to cobble together an Agreement, even if it was weak and limited. The North African countries were ignored in this summit. Even in the discussion of climate change issues the Northern region was not given special importance. There were several countries which took their own stand in dealing with the problem and making the environment and the world a better place to live in.

3.1.11. THE BASIC PLUS MEETING, 2010

The 'BASIC plus' meeting in New Delhi, included representatives from Argentina, Algeria and the Maldives who currently occupy an important place in climate change negotiations. This was the first international meeting on climate change negotiations since the COP-16 was held in Cancun (Mexico) last December i.e. 2010. Accordingly, the New Delhi BASIC meeting was aimed, first of all, at preparing rules and modalities for implementing the Cancun Agreement. Secondly, this was also an attempt at finalizing joint strategies for the forthcoming April meeting in Bangkok of the two Ad-hoc Working Groups (AWGs) of the United Nations Framework Convention for Climate Change (UNFCCC) respectively on Long-term Cooperative Action (LCA) and Kyoto Protocol. And finally, this meeting was also important to kick-start a momentum for the COP-17 to be held in Durban in December 2011(Singh 2011). Discussions, amongst others, revolved around how to approach the Kyoto Protocol in its Second Commitment Period and action in emission reduction beyond the current phase that ends in 2012. For this, the BASIC ministers'

Joint Statement underlined “the need to maintain balance between the obligations of the developed countries vis-à-vis those of developing countries.” Their deliberations also highlighted the challenges within BASIC formulations. The BASIC experts were assigned in New Delhi the task of preparing 'a synthesis document' to be considered in their next meeting. At the same time, they emphasized the criticality of evolving consensus amongst developed countries for launching the post-2012 Second Commitment Period under the Kyoto Protocol to achieve ambitious emission reduction.

3.1.12. 15th SUMMIT OF G-15, 2010

This summit was hosted by Iran on 17th may, 2010, in Tehran. Algeria and Egypt are its members. The global economic and financial crises, its adverse impact on developing countries, climate change, etc., were the focus of discussion at the summit. The summit proved to be beneficial to North African countries like Algeria and Egypt as several measures were discussed to fight with the issue of climate change.

3.1.13. INDO-AFRICA FORUM SUMMIT, 2010

The second Indo-Africa forum summit was held in Addis Ababa from May 20 -25, 2011. It was the first such meeting between the Head of state and government of India and 14 countries of Africa chosen by the African Union. Libya and Egypt's heads of state did not attend. In this summit emphasis was neither given to climate change nor was the North African countries a part of this summit (Gondkar 2011:24).

3.2. ROLE OF AFRICAN UNION AND UNITED NATION

The OAU was adopted as result of several factors but no where it considered the climatic change issue as an important factor for the development of the African continent. North African region were also ignored. But with the formation of the African union the problems of climate change came to be listed on the top of the

priority list. The African Union is also raising climate change adaptation as a key priority and seeks more support for adaptation and better integration of climate in development programs (8th Meeting of the Africa partnership forum 2007). At its January 2007 meeting, the African Union called for the integration of climate change adaptation strategies into African national and sub-regional development policies, programs and activities. It also demanded that developed countries undertake deeper cuts in GHG emissions and implemented the “polluter pays” and “differentiated responsibilities” principles as provided for in the UNFCCC. On financing, it called for the urgent streamlining of the Global Environment Facility (GEF) funding mechanisms to ease African countries’ access to GEF financial resources; and the exploration of other financial resources and mechanisms to support Africa’s adaptation programs. Apart from African union this issue has been taken up in several Indo-African summits, by NEPAD as well.

To reinforce cooperation on climate change issues with Algeria (2010), the United Nations Industrial Development Organization (UNIDO) has decided to launch a USD 25.7 million project this year in the country on persistent organic pollutants (POPs). This will be carried out in accordance with the best environmental practices as defined by the Stockholm Convention. Re-forestation policy aiming to mitigate the effect of climate changes according to the UNFCCC and urban forestry aiming to contrast and mitigate the effect of urban emissions and pollution are some of the United Nations conventions. In keeping with the spirit of World Environment Day, staff from UN agencies operating in Tunisia, as well as staff of the United Nations Information Centre (UNIC) in Tunis, gathered at the Africa Hotel in Tunis on 10 June 2009 for a briefing about climate change and how to deal with its effects. Management of water resources was also an important issue.

Leaders of African Union countries gathered in Libya's capital, Tripoli, in 2009 to discuss regional armed conflicts and climate change. The African Union said in a statement that the summit would provide Africa's leaders with an opportunity to review the ongoing efforts to address the challenges of peace and security on the continent. The leaders of African countries are also to develop a united position on climate change, and to decide on the size of a compensation claim against industrialized nations. According to the UN Environment Program, between 75 million and 250 million people in Africa may face water shortages by 2020, and the

continent will need up to \$50 billion every year to cope with the effects of climate change. African leaders also suggested that developed countries should cut greenhouse gas emissions by at least 40% by 2020, and that richer nations should provide \$67 billion a year to help the least well-off countries cope with climate change and rising temperatures (UNEP 2002). In spite of the G8 commitment and strong support by key African institutions including the Africa Union, UNECA and regional economic communities (RECs), funding of the program, besides pledges by the UK and the Netherlands, has yet to be realized. It focused on integrating climate change with raising awareness of policies that reflect this change. The lack of strategic leadership by central governments is reflected in weak sectoral planning and policies. Raising the awareness of development planners and others and augmenting their ability to respond efficiently by means of appropriate training and support will facilitate integration of National Adaptation Action Plans (NAPAs) into national development strategies.

Among the most important responses made through the United Nations system was the establishment of the intergovernmental panel on climate change in 1988, based on an initiative led by the World Meteorological organisation (Munasinghe and Jepma 1998:1). The Africa Union together with UNECA (United Nations Economic Commission for Africa) and GCOS launched “ClimDev Africa” (The Climate Information for Development Needs: An Action Plan for Africa) a plan of action on climate information aimed at mainstreaming climate information into decision-making for African development. The 10-year, 3-phase programme addresses four principal gaps in integrating climate into development policy: i) the gap in raising awareness for broad ownership, support and communication to adapting to climate variability and change; ii) the gap in climate risk management for strategic planning and disaster risk reduction; (iii) climate-based services support to governments, the private sector and civil society; and (iv) observations, data management and infrastructure to provide essential data to cover the first three gaps. On financing the transition to cleaner energy, the World Bank and AfDB are jointly developing a framework to accelerate the adoption of cleaner, more efficient energy production and use. The recent adoption of an ‘Action Plan for Africa on Climate Information for Development Needs (or ClimDev Africa) is the culmination of a multi-year effort by the GCOS-UNECA-Africa Union partnership to address gaps in

mainstreaming adaptation into policy. The action plan has been approved, but so far only seed money has been pledged. Tools for climate risk management are being developed and this has stimulated coordinated efforts between the World Bank, the AfDB and other partners; but progress has been slower than expected (8th Meeting of the Africa Partnership Forum 2007:8)

Egypt has participated in and made several actions in dealing with climate change:

1 - Ratification on the United Nations Framework Convention on Climate Change, the issuance of Law 4/1994 for the Protection of the Environment, and the participation in various international workshops and conferences related to climate change to avoid having any international obligations on developing countries, including Egypt.

2 - Ratification of Kyoto's Protocol, and the establishment of the Egyptian Designated National Authority for Clean Development Mechanism; consisting of the Egyptian Bureau and the Egyptian Council for Clean Development Mechanism (EC-CDM).

3 - Issuance of Initial National Communication (INC), in 1999 to make an inventory for Greenhouse Gases and the foundation on a National Action Plan for Climate Change.

Egypt established the NREA in 1986 and signed the UNFCCC, developed an inter-ministerial committee of climate change, and signed and ratified the Kyoto Protocol. Egypt also hosted the first major climate conference in the Middle East. The conference was convened by the Climate Institute as well as the Egyptian government and the United Nations Environment Programme in 1989. Several Egyptian ministers not only attended but also participated in the sessions. Mrs. Suzanne Mubarak, the wife of Egyptian president Hosni Mubarak, served as the honorary chairman and addressed the conference. The conference resulted in the publication of the Cairo Compact, a set of recommendations and reports on climate change, which

helped set the stage for the UNFCCC by illustrating the possibility of different governmental leaders agreeing on the importance of addressing climate change (Gregory *et. al.*; 2007).

The initial vulnerability studies conducted by the countries in the region, in 2000–2001, which were presented in their national communications, were also not very developed. That was 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 (Agoumi 2003:8).

‘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’ (Agoumi 2003:9).

Governments, multi/bilateral organizations, corporate, NGOs and academics in the "International Solidarity Conference on Climate Change Strategies for African and Mediterranean Regions", was held in Tunis, Tunisia, on November 18- 20, 2007, upon the initiative of the Government of Tunisia. The initiative of the Government of Tunisia to organize the Conference, with the support of the Governments of Netherlands, France and Italy, the World

Sustainable Development Forum, the United Nations Development Programme (UNDP), the World Bank, the African Development Bank, the Islamic Development Bank, the Sahara and Sahel Observatory, the Mediterranean Action Plan, the German Technical Cooperation Agency (GTCA), the World Health Organization, the International Centre for Agricultural Research in the Dry Areas (ICARDA), the Arab Maghreb Union and numerous African sub-regions and countries of the Region. The main focus of the meeting was on climate change issues where the following points were taken into account. They are as follows:

- Climate Change represents one of the most preoccupying problems of the Planet, given its effects on natural resources, on the health, food security, well-being and development of the whole international community, and that the mechanisms and means of action can be perceived only at the continental or regional level;
- The North African and South Mediterranean countries, though they emit little greenhouse gases, are particularly vulnerable to Climate Change, and, therefore, need to establish adaptation mechanisms, and to develop attenuation and clean development techniques;
- The establishment and implementation of Climate Change adaptation programs constitute an urgent necessity, particularly for African countries whose socio-economic development depends on the preservation of their natural resources;
- Climate Change adaptation should be integrated within the sustainable development policies (social, ecological and economic), strategies and plans of developing countries, taking into consideration their legitimate priority 2 needs, with a view to achieving sustainable economic growth and eradicating poverty;
- Synergies between Climate Change adaptation and efforts to combat other environmental problems, such as desertification, sand encroachment and

biodiversity degradation, should be optimized in order to take advantage of the gains accomplished through these actions;

- That helping the most vulnerable countries to anticipate and adapt to Climate Change risks contributes to achieving development objectives, including those agreed upon at the international level, such as the objectives unanimously adopted at the Millennium Summit and those spelled out in United Nations Conventions (Climate change-UNFCCC, Combating Desertification-UNCCD and Biodiversity-UNCBD).

An Action Plan was prepared to be submitted to the International Conference on 'International Solidarity for a Strategy on Climate Change in Africa and in the Mediterranean Region'. This Action Plan resulted of a wish to enhance international solidarity to enable the countries of the region to put into effect their national climate change adaptation plans and strategies. That is why it only goes into issues that are seen as having priority that can be dealt with through international solidarity and cooperation. After it was reviewed and adopted by the Tunis Conference, the Action Plan was presented to the Conference of Parties to the Convention on Climate Change (COP-13) in Bali (International Solidity Conference on Climate Change Strategies for African and Mediterranean Regions Tunis, Tunisia, November 18-20:2007). Based on observations, experiments, and model analyses made by the National Institute for Agricultural Research in Morocco, several potential changes to agricultural growing seasons in Morocco were outlined in Morocco's First National Communication to the United Nations Framework Convention on Climate Change (UNFCC 2001). The work of the intergovernmental panel on climate change (IPCC) has helped to draw the attention of policy makers and the general public alike to the unprecedented challenge posed by global climate change. The IPCC was created in 1988 by the World Meteorological Organisation and the United Nations Environment Programme to access scientific information on climate change, to evaluate the environmental and socioeconomic effects of climate change and to determine response strategies (Bolin and Watson 1998).

3.3. ROLE OF THE WORLD BANK

Scientific consensus warns that climate change threatens to derail development, while businesses usual development threatens to destabilize the climate. The World Bank Group has awakened to the challenge of disarming these interlocking risks (World Bank 2008). The Ministry of Agriculture, Rural Development and Fisheries and the World Bank, in collaboration with the National Institute for Agricultural Research, the Food and Agriculture Organization of the United Nations (FAO) and the National Meteorology Authority together undertook an original exploratory study to quantify the impact of climate change on Moroccan agriculture by the end of the 21st century. The objective of World Bank is to determine the economic and political options for adapting Moroccan agriculture vis-à-vis climate change so that Morocco is not caught unawares by possible crisis situations. This study is operationally organized in 5 phases: 1) future climate projections at the level of Morocco; 2) impact on agricultural yields; 3) impact on water resources; 4) economic impact and 5) public policy options for adapting to climate change.

The impact of climate change on agricultural yields constitutes the second phase of the "World Bank - Kingdom of Morocco: Adaptation to climate change in the agriculture sector". It is build on climate change scenario data developed by Wilby (2008) and provides one of the bases upon which "Impacts on Farming Systems" and "Economic impact assessments" were based, leading eventually to "Policy adaptation options". The results presented in this report were purely descriptive in the sense that they did not endeavour to propose solutions, at this stage of the study, for adapting to climate change. The present document on it was an interim report on climate change impacts on crop yields in Morocco and it is part of a larger study led by the World Bank and the Government of Morocco on climate change and agriculture. The yield component was coordinated by FAO with INRA and DMN as the main national partners. The comprehensive final report is under preparation by the World Bank (FAO 2009).

A study conducted by FAO together with the World Bank, the Morocco Ministry of Agriculture and Maritime Fisheries and several other national institutions, assessed the impact of climate change on Moroccan agriculture toward the end of the 21st

century. The detailed study covers fifty crops, major agro ecological zones, and several climate change scenarios. The first results of the study on the projected future agricultural production focus on:

- Agricultural adaptation capacity
- Uncertainties related to methodology
- Future availability of crop varieties with higher water use efficiencies.

The approach adopted for the assessment of impact of climate change on crop yields is based on the experience of FAO in establishing and operating real time crop yield forecasting systems in a number of countries worldwide in a food security context. The study is the second phase of the project led by World Bank and the Morocco on the adaptation to climate change in the agriculture sector (FAO 2008).

Since the 1992 Earth Summit, Morocco has been actively involved on a regular basis in international efforts to protect the Earth's climate. It ratified the United Nations Framework Convention on Climate Change in 1995 and the Kyoto Protocol in 2002, and hosted the seventh Conference of the Parties in Marrakech. Since ratifying the Convention, Morocco made institutional arrangements to deal with climate change. It prepared its first national communication and submitted it at the seventh Conference of the Parties. The results of the greenhouse-gas inventory show that Morocco's contribution to worldwide greenhouse-gas emissions is very small, but this has not stopped Morocco from taking practical steps to mitigate greenhouse-gas emissions through energy-saving projects, projects to control energy use and the promotion of renewable energy sources. However, its first national communication showed that Morocco is very vulnerable to climate change and needs a strong adaptation policy. Its vulnerability was highlighted in two key sectors of the domestic economy - water resources and agriculture. The climate-change scenarios for Morocco produced using the methodology of the Intergovernmental Panel on Climate Change and presented in the communication are particularly harsh. If no global action is taken, the annual average temperature in Morocco will rise by between 0.6 and 1.1° C by 2020, and annual rainfall will drop on average by 4 per cent as compared with the figures for 2000. The potential impact of climate change on water resources in 2020 was an average countrywide reduction of 10-15 per cent and on agriculture a fall

in cereal output of 50 per cent in a dry year and 10 per cent in a normal year. A dozen adaptation projects were identified in the first national communication. Some are now being implemented, while others are in search of funding. Under the terms of the Convention, Morocco is required to report regularly and continuously to the international community on action taken to comply with its obligations under United Nations Framework Convention on Climate Change. Accordingly, Morocco began preparing its second national communication in April 2005. This communication is considered to help strengthening Morocco's technical and institutional capacity to tackle climate-related concerns in national and sectoral development priorities. It therefore follows on from the steps already taken to produce and refine studies on vulnerability and adaptation and to assess the potential for mitigating greenhouse-gas emissions (Cracknell and Kondratyev 1998).

Morocco was one of the first countries to show faith in the Kyoto Protocol. The Marrakech Accords, reached in a difficult political context, paved the way for the entry into force of the Protocol. History will recall in particular the decisions that contributed to the rapid introduction of the clean development mechanism (CDM), a prime example of a North-South partnership for sustainable development. For the benefit of its own sustainable development and in order to contribute to industrialized countries' mitigation efforts under this mechanism, Morocco had met all the requisite conditions and had a portfolio of CDM projects that led to significant reductions in greenhouse gases. It also cooperates closely with various developed countries to enable the objectives of the multilateral convention to be attained by means of stronger bilateral relationships (Balafrej 2005).

3.4. CLIMATE CHANGE MITIGATION ASSISTANCE

Facing severe political, economic, and social dislocations, North African countries will work assiduously to win sweeping aid packages from Western donors. Foreign assistance will play a critical role in North Africa's climate change mitigation efforts over the next two decades, compensating for inadequate domestic capacity. On the other hand, without sufficient oversight, foreign aid is likely to fall prey to the same problems that dilute domestic state capacity in the region. In addition to

financial aid and investment, North African states will seek Western technical expertise and technology transfers. While the Maghreb states will look primarily to Europe as a source of climate change mitigation aid, Egypt will look first to the United States. Unlike Sub-Saharan Africa, North African states are less engaged with China on development issues. Barring a major shift in North African elite attitudes, states in the region are likely to approach climate change mitigation aid from an opportunistic perspective. North African states will try to extract as much as they can from international donors. They may not seek the types of foreign assistance directly applicable to their most pressing climatic challenges. Instead, they are likely to push for security and economic development oriented assistance that benefits state and elite interests rather than necessarily mitigating climatic impacts. For example, hydrocarbon-rich states such as Algeria and Libya will seek compensation for expected losses in income as oil and gas consumers come under increasing pressure to reduce their carbon footprint. They may seek financial assistance and technological expertise to develop alternative sources of energy such as solar and wind power.

In addition, North African regimes will seek increased military and security assistance to enhance regime security under the guise of combating climate change induced regional and domestic instability. As climate change becomes more of a driver of cross-border migration, North African states will hold out the need to stem migration flows as a justification for significant increases in climate-related foreign aid. They may also demand increased access to European markets as another incentive for North Africans to stay home rather than seek economic opportunity in Europe. Because of the direct threat it poses to Europe, the migration issue could become the strongest bargaining chip for North African states. Depending on the magnitude of climate change-induced migration flows, they might resort to outright blackmail, threatening to unleash unimpeded flows of migrants unless granted massive amounts of foreign aid. In a more general sense, they may play the “climate change card,” citing the threat of climate change-induced regional crisis to garner Western aid, as they have done with the “terrorism card” (National Intelligence Council 2009).

3.5. THE UNITED STATES AND NORTH AFRICA

Relations between the United States and North Africa have varied widely over time and between states in the region. The strongest US relationships are with Morocco and especially Egypt. Relations with Tunisia and Algeria are also solid and improving, bolstered by cooperation against international terrorism. Although relations with Libya remain tenuous, the formerly implacable hostility has eased since Libya abandoned its WMD programs and adopted a more conciliatory policy in 2003. Although the evolution of US relations with the North African states over the next 20 years is difficult to predict, the challenge of climate change will likely encourage increased engagement. To the extent that US relations with all five North African states continue to improve, the United States could act as a facilitator for greater regional cooperation. For the Maghreb states, relations with the United States will most likely continue to be secondary to their relations with Europe. States in the region may attempt to leverage competition for regional influence between the United States and Europe, particularly France. Conversely, Egypt is a close ally of the United States with weaker ties to Europe. The US stake in Egypt is much greater than in any other country in the region; climate change-induced crises in Egypt would impact US interests far more than climate change in the Maghreb (National Intelligence Council 2009). Ultimately, the differing relationships may encourage a division of labour whereby Europe concentrates on support to the Maghreb and the United States on support to Egypt.

3.6. US CLIMATE CHANGE MITIGATION ASSISTANCE

The most important contribution the United States can make to North African climate change mitigation probably is the provision of technical expertise. Promoting more informed, efficient, and effective decision-making on infrastructure, resource allocation, and development planning will act as a force multiplier for both financial aid and domestic regional capacity. In addition to direct climate change mitigation assistance, overall increases in development assistance and investment will boost regional adaptive capacity (National Intelligence Council 2009). In the longer term, promoting North African economic development is a more effective means of

providing the resources needed to address climate change than simply continuing foreign aid. Bolstering the region's economies will spur infrastructure development and job creation, directly addressing climate change-induced unemployment and other deleterious impacts. At the same time, the United States could incentivize more sustainable development patterns suited to the constraints climate change will impose on the region. The United States can provide development advice and assistance in a wide range of critical areas, ranging from health to agriculture. In most respects, US assistance will most likely parallel that from Europe a mix of foreign aid packages, investment, and technical assistance. There are a number of areas, however, in which the United States has comparative advantages relative to Europe in the kinds of assistance it can provide. The region's most critical needs in terms of climate change mitigation assistance are in water resource management. The inefficiency of existing water management infrastructure is a major contributor to the region's vulnerability to climate change. The United States, far more so than Europe, has long experience dealing with water resource issues that could be shared with North African countries. The American Southwest is hydrologically comparable to North Africa and could provide an instructive model for water resource management and irrigation policies in both the Maghreb and Egypt (National Intelligence Council 2009:35-36). In addition, unlike Europe, the United States can offer North Africa genetically modified crops that could dramatically improve agricultural adaptive capacity. The downside is that European restrictions on such crops would close European markets to North African exports. On the other hand, introduction of genetically modified crops could significantly mitigate domestic food security issues in the region.

Although efforts to raise awareness of climate change, engage with civil society, and promote political and social reforms also could produce beneficial results, the effectiveness of such efforts will be determined by how sensitive they are to the socio-political realities of the region. North African states are adept at circumventing Western political pressures involving human rights abuses, democracy promotion, and other liberalizing measures in civil society. They are hostile to intrusions into their internal affairs, particularly the delicate issue of state-society relations. The United States should not expect North African states to subordinate regime security and elite self interest to climate change mitigation. There could be a backlash from states in the region that could damage mitigation efforts and relations with the United States as a whole. For example, public relations campaigns to raise

climate change awareness could easily be perceived as critical of local regimes for their inaction and ineffective responses and of elites for contributing to unsustainable development. Similarly, empowering NGOs and civil actors and promoting other forms of social mobilization could be viewed as threatening by North African regimes even if directed at mitigating climatic challenges.

3.7. AFRICAN MINISTERIAL CONFERENCE ON THE ENVIRONMENT

African Ministerial Conference on the Environment (AMCEN) at its twelfth session, held in Johannesburg, South Africa, in June 2008, initiated a comprehensive process for the work of AMCEN on climate change in Africa, which involves Africa's preparations for developing a common negotiating position on a comprehensive international climate change regime beyond 2012, and a comprehensive framework of African climate change programmes. The meeting was attended by representatives of the following countries: Algeria, Angola, Egypt, Libyan Arab Jamahiriya, Malawi, Mauritius, Mozambique, South Africa, Swaziland, Tunisia, United Republic of Tanzania, Zambia, and Zimbabwe. In this presentation, the AMCEN Secretary outlined the mandate stemming from decision on climate change adopted by AMCEN at its twelfth session for a common negotiating position on a comprehensive international climate change regime beyond 2012 and for a comprehensive framework of African climate change programmes and associated regional programmes to tackle climate change. He provided the background and progress of three sub regional desk studies and described the indicative conceptual outline of the comprehensive framework with its emphasis on adaptation, mitigation and supporting and enabling measures. He examined the programmatic and policy groups for both North and Southern Africa and the expected products from the current meeting, including, for each region, a draft framework of sub regional climate change programmes; draft key political messages to inform the global debate and negotiating process; and a statement on combating climate change in Africa, particularly in North and Southern Africa, including the associated challenges and opportunities. By the end of the process it was to be hoped that African countries would have a common vision to combat climate change. In conclusion, he said that concerted effort was required from all to ensure a common and informed African voice as a solid foundation for work related to climate change on the continent. The Clean Development Mechanism was

unsuccessful in Africa, except for in Algeria, Egypt, Morocco and Tunisia, given the difficulties in gaining access to funding.

In the meeting several challenges were brought to the forefront which grabs the North African region viz., population growth, declining rainfall, water shortages, falling agricultural production, land degradation and seawater incursion into coastal aquifers. The mandate and history of the report, the conceptual framework, methodology used and situation analysis, before outlining the achievements of the study, lessons learned and experiences, challenges and gaps and the tentative conclusions were described. Emphasis was also laid on capacity-building and the lack of planning, management and monitoring as major challenges.

The ministerial segment of the thirteenth session of the African Ministerial Conference on the Environment (AMCEN) was held at the International Conference Centre in Bamako from 23 to 25 June 2010. Meetings of the experts preceded the ministerial segment. The theme for the 13th session of AMCEN was “Enhancing the interrelationships between climate change, biodiversity and desertification for sustainable development”. Libya, Egypt, Tunisia, Algeria were keen participants apart from other nations in the meeting. The main objective of the session was to provide a platform for environment Ministers to deliberate on substantive issues of importance to Africa that must be tackled in the context of desertification, continuing negotiations on climate change and biodiversity. It was described that the emergence of wind and solar power to replace traditional energy generation in North Africa and the potential of export to Europe of solar-generated power (African Ministerial Conference on the Environment 2010). Concern for the adoption of cleaner technologies in the region related to reducing the use of oil and in water treatment was shown. Land degradation outlined both challenges and opportunities in the region. Listing the supporting institutions involved it was discussed that there were key shortages of research, training, resources, knowledge and marketing to tackle mitigation issues. In conclusion, he stressed the role that non-governmental organizations could play and the need for greater emphasis on linking adaptation strategies closely with development.

Mr. Peter Acquah, Secretary of AMCEN also highlighted the key challenges for the sub-region with regard to climate change, including its social and economic vulnerability to extreme climate events, dependence on climate-sensitive sectors, susceptibility to food insecurity and disease outbreaks, and sensitivity of its national economies to climate variability. Turning to preliminary conclusions, he underscored the need to enhance the scope of adaptation programmes in the sub-region and to ensure that sub-regional and national programmes embraced mitigation activities that contributed to global greenhouse-gas emissions reduction together with poverty alleviation. Stress was also given on the initiatives related to supportive measures to be scaled up, with particular focus on strengthening sub-regional networks for sharing information and knowledge, identifying innovative financing mechanisms and developing and providing access to appropriate technologies (African Ministerial Conference on the Environment, 2010)

Since 1990, WHO has published a series of reports on climate change and has participated in review processes such as the Intergovernmental Panel on Climate Change. It has also focussed on the North African countries like Libya, Tunisia, Algeria, etc. These activities have outlined four key characteristics of the health risks generated by a warming and a more variable climate in North Africa. First, these hazards are diverse, global and probably irreversible over human time scales. They range from increased risks of extreme weather, such as fatal heat waves, floods and storms, to less dramatic but potentially more serious effects on infectious disease dynamics, shifts to long-term drought conditions in many regions, melting of glaciers that supply freshwater to large population centres, and sea level increases leading to salination of sources of agriculture and drinking water. Second, the health impacts of climate change are potentially huge. Many of the most important global killers are highly sensitive to climatic conditions. Malaria, diarrhoea and protein-energy malnutrition together cause more than 3 million deaths each year (*The World Health Report 2004*). Third, these risks are inequitable, in that the greenhouse gases that cause climate change originate mainly from developed countries, but the health risks are concentrated in the poorest nations, which have contributed least to the problem (Patz *et al.*; 2005). Finally, the projected impacts on health are avoidable, through a combination of public health interventions in the short term, support for adaptation

measures in health-related sectors such as agriculture and water management, and a long-term strategy to reduce human impacts on climate.

CHAPTER FOUR

CHALLENGES AND SUCCESSIVE MEASURES TAKEN BY NORTH AFRICAN COUNTRIES

There are several challenges as well as successive measures taken by the North African countries to fight the global climate change issues. It is believed that even in the absence of global climate change, North African countries like Tunisia, Egypt, Algeria, Morocco and Libya will face significant socio-political challenges over the next two decades. ‘When we see the population basket to create a composite vulnerability index of physical exposure and population density, we find that coastal Morocco, Algeria, and Tunisia are more vulnerable while the interior, just south of the coast, of all three countries are less vulnerable. Egypt along the Nile appears much more vulnerable to climate change’ (Smith *et.al*; 2010). The region will have to contend with pressures created by a burgeoning youth population, tenuous economic growth, persistent unemployment, and urbanization and related stresses including inadequate housing and infrastructure. The effects of climate change in North Africa will likely exacerbate these existing political, economic, and social challenges, potentially worsening them to the point of plunging the region into crisis. Some of the challenges faced are discussed below:

4.1.1. HYDROLOGIC CHALLENGES

A study of the large scale atmospheric processes responsible for weather and climate changes requires a consideration of the interaction of the atmosphere not only with the land but also with the ocean, which is a gigantic heat reservoir (Cracknell and Kondratyev 1998:21). North Africa is one of the world’s most arid regions, and the lack of water represents one of the most important challenges facing North African states and societies. Water availability is the primary determinant of settlement patterns in the region, a fact illustrated most dramatically by Egypt’s Nile Valley. Water stress and scarcity are major problems across the region due to major population growth and economic development as well as to arid conditions. As a result, significant segments of the population in North Africa depend on a limited number of tenuous water sources that are in danger of depletion even

under current climatic conditions. The most extreme examples are the oasis settlements of the Sahara, where densely concentrated populations depend on a single source of groundwater. Such conditions render North Africa particularly vulnerable to climate change-induced hydrologic challenges (National Intelligence Council 2009:10-11). The hydrologic impacts expected as a result of climate change to 2030 will differ across the region. North Africa comprises at least three distinct hydrologic systems. Egypt is almost entirely dependent on water from the Nile, which in turn is fed by drainage from the highlands of East Africa. The Mediterranean coasts of the Maghreb depend on direct rainfall, groundwater, and drainage from the Atlas Mountains. Without appreciable rainfall, the Sahara depends entirely on subterranean aquifers.

4.1.2. AGRICULTURAL CHALLENGES

Despite the region's aridity, North Africa hosts substantial agricultural activity in the Nile Valley and coastal plains and highlands of the Maghreb. Although agriculture is no longer the dominant economic sector in any North African country, it remains important in all but not Libya. Egypt accounts for roughly half the region's agricultural production, and Morocco and Algeria are also major agricultural producers. Soil moisture is a climatic variability that has a significant impact on ecosystem and agriculture (Ephramus *et al*; 1990). A disproportionately large segment of the labor force is engaged in agriculture, both directly and in the processing or trading of agricultural products, particularly in Tunisia and Morocco. Over the next two decades, climate change-induced stress on the agricultural sector will threaten the livelihoods and subsistence of millions across the region. The primary climatic challenges facing North African agriculture to 2030 are likely to be the aforementioned impacts on the region's already constrained water resources. Droughts, flooding, salinization and overall water scarcity will adversely affect agriculture. In general the productivity of forests depends on temperature, precipitation and nutrient availability; all of which is affected by climate change (Munasinghe and Jepma 1998:40-41). Other climate change-related effects may have a more mixed impact. Whereas increase in temperature and reduced growing areas and growing seasons will adversely affect agricultural productivity, carbon dioxide

fertilization may sharply increase productivity in some cases. Climatic impacts on agriculture will depend on highly localized conditions, the tolerances of specific crops, and the effectiveness of agricultural adaptation measures.

Egypt and the Maghreb have differing agricultural systems based on their differing hydrology. Egyptian agriculture is entirely dependent on Nile irrigation, while the Maghreb hosts a mix of rain-fed and groundwater-irrigated agriculture. In both cases, water availability is the decisive factor. In Egypt the scarcity of arable land is also a critical factor, and climate change-induced urban expansion and soil salinization will further reduce land available for cultivation. In addition to basic resource constraints, North African agriculture is characterized by significant inefficiencies in crop selection, irrigation practices, land management, and food distribution. Even where climate change does not substantially reduce productivity, more frequent agricultural disruptions and more variable conditions will substantially increase volatility in agricultural production. Population growth and more frequent droughts have already forced increased importation of food due to its weak agricultural sector. Libya already imports three-quarters of its food. The region's cities already face perennial food scarcity and high food prices. All of the North African countries except Libya have price subsidies for basic foodstuffs, and price increases have been met by food riots. The need for price subsidies, more food imports, and investment in agricultural adaptation will increasingly constrain state budgets in the region.

Climatic stress may necessitate the substitution of hardier, less water-intensive crops such as maize, for current staples such as wheat and rice as well as greater reliance on fertilizers and intensive irrigation, further straining water resources. Changes in land use and resource allocation are caused by the interaction between a wide range of agro-climatic and socio-economic factors that influence regional and farm-household options for crop choice, input use, labour allocation and marketing (Ouedraogo *et.al*; 2004:83). Although North Africa has high crop yields, agriculture remains highly inefficient with substantial potential for gains from mechanization, better irrigation, and other modern farming techniques. Such adaptive measures also will make agriculture less labor-intensive, further increasing the already substantial flow of population into North Africa's cities. Agriculture will be less able to act as an employment safety valve for underemployed or seasonally

employed unskilled workers. Stress on rural communities may lead to civil unrest or encourage radicalization.

4.1.3. DEMOGRAPHIC CHALLENGES

Dramatic population growth over the last half century has seriously strained North Africa's limited resources and inadequate socioeconomic structures. Over the next two decades the effects of overpopulation and climate change will pose a mutually reinforcing threat to the region's water and food resources, economies, urban infrastructure, and socio-political systems. Harsher climatic conditions are likely to further concentrate population in the limited areas suitable for large-scale habitation. Population growth has produced a demographic "youth bulge." Nearly 60 percent of North Africa's population is under the age of 25 (National Intelligence Council 2009:13). Fertility rates are declining in North Africa as family planning has improved. However, over the next two decades the region will have to contend with a large group of people passing through their most economically productive years without adequate employment opportunities.

Urbanization- Rapid urbanization has long been the source of significant disruptions in North Africa, and climate change will exacerbate these challenges. Although the current level of urbanization varies widely across the region, cities across North Africa are experiencing a major influx of population from rural areas. Morocco, Algeria, Egypt, and to a lesser degree Tunisia, already suffer from overpopulation in their major cities. Algeria, for example, has some of the world's highest per unit occupancy rates and faces a severe housing shortfall. The region's largest city, Cairo, is one of the world's most densely populated urban areas, with nearly seven million inhabitants in the city and a further ten million in the surrounding metropolitan area. Such concentrations of population will create major problems for Egypt and other North African states in managing water needs and other climatic stress. Worse, climatic pressure is likely to significantly increase rural-to-urban migration, further swelling excessive urban populations. The relationship between, on one hand, drought and climate variability in general and, on the other hand, environmental degradation, is a complex one and mediated by factors such as population dynamics, land use practices and urbanisation (Dietz *et.al*; 2004:211). Cities in North Africa face over-

urbanization and under-urbanism. They have too many rural migrants who are not integrated into urban society or economic structures. Climate change will place additional stress on already inadequate urban infrastructure, exacerbating water, food, and housing shortages, poor sanitation and water quality, and inadequate employment opportunities. Urban heat waves will not only threaten public health but will have an adverse effect on economic activity as people stay off the streets.

4.1.4. ECONOMIC CHALLENGES

After varying degrees of socialist economic policies in the last century, in recent decades most North African states have undergone economic liberalization. The trend is toward increased privatization of state-run enterprises, diversification from agriculture or petrochemicals into light industry and tourism, and greater foreign trade and investment, particularly with Europe. Economic reforms have often been slow due to large, corrupt, and inefficient government bureaucracies and entrenched economic interests. Economic development has also failed to address major structural economic problems such as unemployment, pervasive poverty, a lack of skilled labor, and over-dependence on externally determined rents from hydrocarbons, phosphates, tourism, and emigrant remittances. 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 was the largest (more than 57 per cent of the GDP in 1994). In Morocco, the largest was the agricultural and fishing sector (more than 43 per cent of the GDP in 1994) and in Tunisia, the largest was the service industry (more than 50 per cent of the GDP in 1994). Despite these different economic trajectories, the vulnerability of the people in the region to the climate and its vagaries was 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 (Agoumi 2003:3). Nevertheless, the region will likely continue its trajectory toward greater economic liberalization to 2030. With the partial exception of Tunisia, living standards among the general public across North Africa have not kept pace with economic growth. The centralization of ownership and revenues has concentrated economic benefits among the narrow

political and economic elite. Gross income inequality is a major source of public disaffection in North African societies. The distinction between rich and poor is probably most stark in Morocco and Egypt; while Tunisia is more economically equitable if politically repressive. Poverty remains a major problem across North Africa, reducing state and social capacity and forcing states to subsidize basic necessities. Egypt spends roughly 7 percent of GDP on subsidies, a significant drain on the economy. Climate change will only further impoverish the region through reduced agricultural productivity, over-urbanization, reduced employment opportunities, and higher food and water prices.

It was felt that climate change-induced challenges will prove costly to North Africa's economic systems. Although the agricultural sector will suffer the most direct effects; the massive government expenditures required to head off or cope with climatic challenges will impact economies across the board. State investment and subsidies that still underpin much of the region's economic activity could be jeopardized. In addition, climate change mitigation will divert resources from programs to address poverty, unemployment, and poor living conditions, such as Morocco's National Initiative for Human Development (INDH). Collateral effects such as over-urbanization and socio-political unrest will further undermine economic performance.

Unemployment- North Africa's economic development patterns have failed to generate adequate urban employment for either skilled or unskilled labor. Economic growth has focused on non-labor-intensive sectors such as tourism or oil and gas. As a result, even oil-rich states such as Libya have massive unemployment. Unemployment is most severe among the region's disproportionately large young population. In Algeria, for example, youth unemployment is estimated to be as high as 43 percent i.e. the region's highest. Unemployment statistics do not tell the full story, however, because they do not account for the region's rampant underemployment. Many of the "employed" only work the equivalent of one or two hours per day, and many of the region's growing number of university graduates are forced to take low-paid jobs far below their skill level. Conversely, many of the displaced rural labourers moving into the region's cities lack the educational and technical skills necessary to succeed in a modern urban environment. In condition of intensive industrial and technological progress, human activities depend more on weather and climate, in particular for

agriculture, energy production and transport. It is a fact that human activities on the environment and climate are increasing in North Africa (Cracknell and Kondratyev 1998:487). The combination of urban economies incapable of creating adequate employment opportunities and a mass displacement of population from rural areas into cities as a result of climatic stress could create an employment crisis across the region. In Egypt, the return of up to half a million overseas workers as the Arab Gulf states slowly nationalize their own labour forces will compound the problem. Cities like Cairo, Casablanca, Alexandria, Algiers, and Oran are already overflowing with thousands of angry and unemployed young men who congregate in ghetto-like environments passing their days leaning on walls with little to no hope of escaping their fate.

Energy- In dark contrast to the economies of Egypt, Tunisia, and Morocco which are a diversified mix of services, light industry, and agriculture; the economies of Libya and Algeria are dependent on oil and natural gas exports. Because climate change will not directly impact hydrocarbon extraction, unlike agriculture or tourism, these countries may prove more economically resilient to challenges that arise over the next 20 years. On the other hand, they face a grave threat from a likely reduction in hydrocarbon demand from Europe, which currently consumes the vast majority of North African hydrocarbon exports. There are numerous stresses affecting North African countries, including climate change. Some stresses could be further accelerated by climate change. In countries like Algeria, Tunisia, Libya and Morocco; renewable energy, particularly solar and wind power, is the most significant source of energy produced in the subregion. Climate change is likely to have a mixed impact on other aspects of the region's energy sector. More unreliable and infrequent rainfall will reduce the potential for hydroelectric power in the Atlas Mountains. On the other hand, the potential for wind and solar energy may increase. The expansion of tourism is an important aspect of economic growth and diversification in the region, particularly in Tunisia, Morocco, and Egypt. An ambitious plan to expand tourism over the next two decades is intended to provide a major source of revenue in the region, contributing significantly to spending on social development. Morocco, for example, has plans to develop six large new coastal resorts and boost tourism to 20 percent of GDP, surpassing agriculture. In addition, Morocco is becoming a popular

location for Europeans to purchase holiday homes. Libya also plans to dramatically increase tourism, and Muammar al-Qadhafi's son Saif al-Islam has sponsored a "green" tourism project in Cyrenaica (NIC 2009). Climate change poses a particularly acute threat to the tourism sector, since tourists will quickly elect to go elsewhere in the face of harsher conditions such as water scarcity and increased temperatures. In addition, tourist-oriented development is highly resource-intensive. For example, tourists consume far more water than local inhabitants and are far less likely to accept austerity measures. As climatic stress becomes more severe, the disproportionate resource allocation to foreign tourists is likely to cause increasing tension with local populations. It is already becoming an issue in Morocco's tourist centers such as Marrakesh and Fes Medina.

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

4.2. CLIMATE RELATED DISASTER IN ALGERIA IN NOVEMBER 2001

Algeria experienced its worst flooding in history in 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 lives, 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. Approximately 40,000-50,000 people 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 (Agoumi 2003:3).

4.3. 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 wet year, 1996, was also a disastrous year for the country (Agoumi 2003:3).

4.4. EGYPT – the following are some of the institutional initiatives taken by Egypt to combat the issue.

“Egypt has been an active participant when it comes to the matter of climate change and facing its vulnerabilities, improvement of living conditions, and the foundation of Sustainable Development's basis on Planet Earth” (Ball 1939).

In today's world Egypt is following the trend of developing countries in climate change negotiations through international meetings and conferences. From the point of view of the leading position of Egypt regionally, it plays a vital role in the UN groups, G77 and China, the African group and OAPEC. The Egyptian views could be summarized as follows:

- 1- Total refusal of any negotiations could lead to any commitment on developing countries, including Egypt, regarding reduction in GHGs according with the convention and the protocol
- 2- The impacts of current and expected climate change occurred as a result of industrial activities on developed countries since industrial revolution till date.
- 3- There's an obligation on the developed countries towards the developing economies to ensure GHGs reduction, technology transfer, adaptation of funds, research and observation systems (2008-2012).
- 4- Egypt refuses the Russian Federation proposal regarding voluntary commitment on developing countries, which is supported by most of developed countries. The proposal aims to provide incentives for those developing countries that are ready to accept going through voluntary commitments to reduce their GHG emissions which could lead to obligations later on, where the mentioned incentives are already addressed for developing countries.
- 5- Reliable climate change scenarios are needed to assess impacts. Climate scenarios have become more closely linked to the changes in concentration of carbon dioxide and other GHGs (Carter *et.al*; 1994). Egypt welcomes the continuation of negotiations with developed countries for future commitments post 2012 to agree on acceptable and scheduled GHG reduction.
- 6- Egypt stresses on the importance of continuing the dialogue between developed and developing countries to improve the Convention and Protocol in all international forums. In such as climate change conferences, because this is the only way to avoid the potential risks of climate change.
- 7- Egypt believes that the developed countries should fulfill their obligations towards developing countries; particularly the most exposure to the risks of climate change is a fundamental pillar in the success of the negotiations on the future financial commitments for developed countries. Also, there is a need to focus on the topics deal with the vulnerability of climate change along with the topics of mitigation and reduction of greenhouse gas emissions.
- 8- Egypt believes that the discussion on climate change issues must remain within the

framework of meetings and negotiations and the climate change conference, which is organized work under the United Nations Convention on climatic changes and the Kyoto Protocol, and that it must not be politicized the issue so as not to be directed to trends against the interests of developing countries.

9- Egypt believes that the issue of technology transfer is important, there is a need to form a strong institutional structure capable of activating the transfer of technology to developing countries fund projects and support technology transfer on preferential terms, as well as capacity-building and technical support to these countries in order to ensure continuity and efficiency of this mechanism.

4.5. NATIONAL COMMITTEE ON CLIMATE CHANGE

Egypt established this committee in 1997 to represent a large number of non-governmental and governmental stakeholders. The head of this committee is responsible for coordination, establishment and communication of national policy on climate change. The other initiative is related to Capacity Building Project where the aim is to institutionalize climate change issues on a national level. The project focuses on assessing technology needs for adapting measures in relation to coastal zones, agriculture and water resources (Agrawala *et.al*; 2004:19). The Energy Efficiency Council (EEC) is a project where public and private agencies are associated with the energy sector to guide the energy efficiency practice in Egypt. A key focus of the EEC is developing interagency cooperation to promote efficient use of energy resources. The council has looked into the development of a National Energy Efficiency Strategy assisted through USAID's Egyptian Environmental Policy Program. Certain steps were taken in Egypt like the UNDP supported fuel cell bus demonstration projects in Cairo, to reduce GHG emissions and other pollutants. Natural gas motor project has been introduced in Egypt which is of a Canadian technology developed to reduce the emissions of GHG by converting two-stroke engines used in motorcycles to compressed natural gas (CNG). Another project implemented by the UNDP with GEF funding was designed to achieve reduction in GHG emissions. This was to be achieved through the adoption of policies that promote demand-side management and energy conservation activities, and the creation of an enabling environment for energy efficiency.

Within the framework of promoting market-based instruments for GHG emissions reduction through CDM, the World Bank, with Swiss funding, assisted Egypt in exploring opportunities and benefits through the adoption of this mechanism. The study aims at identifying institutional national prerequisites for CDM, preparing a pipeline of projects for implementation under the CDM, and studying the international market for GHG emissions reductions for Egypt's CDM projects. The scope of this study concentrated on the potential sectors for CDM projects in Egypt, including energy, industry, transportation, waste management and agriculture. The study started in late October 2000.

4.6. ADAPTIVE MEASURES TAKEN BY THE GOVERNMENTS OF THE FOLLOWING NORTH AFRICAN COUNTRIES IN THE AREA OF WATER, IN SITUATION OF ACUTE DROUGHT

4.6.1. Morocco

- Formation of an inter-ministerial committee to combat the effects of the drought;
- increased the pace of mobilization of surface and groundwater resources;
- desalinated the sea water
- 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.
- conducted pilot experiments on reusing waste water for agriculture (Agoumi 2003)

4.6.2. Tunisia

In April 2005, within the framework of Tunisian-German cooperation, GTZ was commissioned to manage the requisite analyses to enable more precise conclusions to be drawn about the impacts of climate change in Tunisia. The focal points were the agricultural sector, ecosystem vulnerability and water resources development. Under the auspices of the Ministry of Agriculture and Water Resources, various Tunisian ministries and authorities worked with GTZ during the two-year analytical process. Numerous non-governmental organisations were also involved in producing the adaptation strategy. During the first phase, the climatic impacts of global warming were analysed with support from an international research team. In a second phase, the impacts identified were studied with reference to Tunisia's society and economy. The aim was to develop a national adaptation strategy for the agricultural sector, culminating in an action plan (Stephan 2007).

In order to mitigate the impacts of global warming in Tunisia, the adaptation strategy provides for the following measures:

- Appointment of an interministerial National Climate Council to improve the coordination of measures for adaptation to climate change.
- Promotion of interdisciplinary climate research and development of appropriate training programmes
- Broader-based collection of climate and water resource data to improve the quality of forecasting
- Better enforcement of existing water and agricultural ordinances
- Introduction of insurance services for climate-related damage in agriculture, with a particular focus on small farmers
- Assistance with the restructuring of farms that are affected by climate change
- Development of a climate label for agricultural products which are particularly resilient to the impacts of climate change

OTHER STEPS TAKEN BY TUNISIA ARE:

- 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 (Agoumi 2003).

4.6.3. STEPS TAKEN BY 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.
- regulated water withdrawal from groundwater sources (Agoumi 2003).

Along with the 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 climate changes”. These projects will clarify the vulnerability of the region and better define the necessary adaptive actions

4.6.4. MEASURES TAKEN BY LIBYA:

In the African Ministerial Conference on the Environment (AMCEN) at its twelfth session (held in Johannesburg, South Africa, in June 2008) several measures were expected to be followed to deal with the problem of climate change in North Africa. It was noted that North African countries should recognize that research, development, demonstration, diffusion and transfer of existing adaptation technologies, including knowledge and skills, should be supported by new funding. African countries should recognize that cooperation at the regional, national and local levels is key to the effective implementation of adaptation technologies, in particular: The diffusion and adjustment of proven existing technologies across and within countries, to enable their use in different contexts in response to local vulnerabilities. The enhancement of national and local capacities, including public sector and civil society institutional capacity, knowledge and know-how for sustainable adaptation to climate change. Countries should develop technologies that can provide synergy with mitigation efforts, especially those involving land-use practices such as agriculture and forestry, which offer adaptation and mitigation benefits while also contributing to food security and strengthened livelihoods. Empower the most vulnerable communities (for example, traditional technologies based on indigenous cultural identities, knowledge and experience); and allow access to information on the potential impacts of climate change, reduce vulnerability and strengthen resilience to extreme weather events, building on disaster risk reduction management practices (African Ministerial Conference on the Environment 2010).

It was also noted that there is a need to develop, research and demonstrate new adaptation technologies, based on needs identified through national planning processes and technology needs assessments. African adaptation and mitigation actions should be supported by a network of networks to meet the challenges of adaptation capacity. This can be achieved by updating and developing new curricula for teaching, learning and research on climate change adaptation in African universities. This would strengthen the capacity of African universities to analyse and

assess the risks associated with global and climate change. There is also a need to strengthen partnerships and collaboration between African universities and to stimulate science-technology-policy dialogue between all stakeholders. The region must ensure greater integration of gender considerations when developing and implementing adaptation and mitigation strategies.

This project of UNFCCC focuses its advisory activities on climate change adaptation, emissions reduction and synergies. It supports decision-makers and management and technical professionals at national, regional and local level in implementing the UNFCCC. This takes the form of:

- technical and methodological support in implementing the Framework Convention on Climate Change,
- advice on the key areas of adapting to climate change and reducing greenhouse gases and on how to incorporate combating desertification, biodiversity and climate change mitigation into development planning,
- support for negotiation processes for national climate change adaptation strategies and for their implementation,
- support in public relations work, training schemes and discussion forums,
- funding for training and participation in international conferences.

4.7. RESULTS ACHIEVED SO FAR BY UNFCCC ON TUNISIA

Ministries, government and non-government organisations in the high-risk sectors of agriculture, water resources management, health and tourism are aware of the effects of climate change and communicate them to the public. Climate change adaptation measures in the agriculture, water resources management, and health sectors have been established on a political level as one of Tunisia's priorities. Partner institutions have achieved a significant growth in competence, allowing them to tap the potential in the CDM, and to draft and implement adaptation strategies. Tunisia is increasingly viewed as an attractive and competent partner on the international CDM market. Investment projects for the key adaptation measures have been drafted. An early warning system for floods and heat waves has been set up. Measures to reduce greenhouse gases have begun to take effect. They include introducing renewable energies, saving energy, improving waste management and using biogas.

4.8. RESULTS ACHIEVED BY MOROCCO

Like all members of an international community who are increasingly aware of the dangers of climate change, Morocco believes that the steps taken so far fall short of what is needed to guarantee peace of mind about the future of our planet. The discussions at this seminar should shed some light on the future of the process we are now involved in. The international community expects a multilateral response that will speed up the reduction of greenhouse gases while building on the gains and experience of the Kyoto Protocol. On the basis of the various scientific conclusions reached by the Intergovernmental Panel on Climate Change (IPCC), Morocco supported all proposal designed to significantly curb global warming, and believes it is time to reflect on how to achieve them. Given the historical responsibility of the industrialized countries, and to ensure that achieving this objective does not damage developing countries' development prospects, a strong commitment by the industrialized countries would be desirable. And the sooner the better, starting in Montreal. Serious concerns have been expressed by representatives of the business world about the future of their economic and financial activities in a globalized world disrupted by climate change. To succeed, we need to make business our ally. For this reason, it would be a great help to have economics ministers more closely involved in the next stages of the process. We should also make the process less complicated and less onerous. The initiative taken at the tenth Conference of the Parties to improve the way the Convention works should be pursued so that we have a more flexible, less arduous system that takes more account of the concerns and expectations of developing countries (Balafrej 2005).

The mission of ACCMA was to increase the knowledge and awareness about climate change and improve capacity to assess climate change vulnerability in different sectors in Morocco in order to develop research, to improve stakeholder's adaptive capacities to climate change and to improve interaction capacities in the decision making process. It was assumed that climate change will impose additional threats on the coastal areas of the North Moroccan provinces of Berkane and Nador. Already now supply and demand of water has approached critical limits. The parallel expansion of touristic and agricultural infrastructure will additionally threatened by future anticipated rise in the sea-level. ACCMA has come to strengthen local

capacities to get involved in adequate environmental decision making. In particular the goals are:

- People know how their environment is going to change and how to adapt,
- Research have established social, economic, and environmental safe limits and these are respected by decision makers in their pursuit of sustainable development,
- Governments, research institutions, and civil society organisations are engaged in learning networks from other regions to exchange experience concerning climate change and adaptation measures,
- Institutions (key stakeholders in Morocco) are actively engaged in collaborative integrated strategic coastal planning - including climate change mitigation and adaptation - supported by an adequate legal and institutional framework for implementation and enforcement (ACCMA,2008).

As the availability of water diminishes, the demand for water grows higher and, with higher demand, the need to rely on costly water treatment and extraction methods increases. Wastewater treatment and re-use has become prevalent in Tunisia, Egypt and Morocco; the use of desalinated water has become prevalent in Egypt and Libya (Paeth *et.al*; 2009). In addition, North Africa is increasingly investing in water infrastructure, accounting for more than 20 percent of public sector investment in Morocco and Tunisia, and 12 percent in Algeria (IPCC, 2007). In 2002, Ragab and Prudhomme s(IPCC 2007) reported that:

- By 2010, Algeria estimates it will need another 5.5 km³ of water annually: 50 percent for

irrigation and 50 percent for domestic and industrial uses. It plans to build 50 more dams and

10 diverting canals and will tap non-renewable fossil water beneath the Sahara.

- In 2000, Tunisia expected to use 90 percent of its surface water in the north and all of its groundwater. Part of the country's agenda is to build new large dams and develop a network of pipes and canals for water transportation between river basins.

As a result of these efforts, Tunisia will be able to transport more than half of the water captured behind dams in the Northern regions.

- Morocco plans to double the proportion of its river flow that is controlled by dams and extract more groundwater. It will construct 60 large dams, 100 km-long sink boreholes and construct 280 km of water-transportation structures.
- Libya intends to tap more underground water and transport it to the coastal aquifers, which have been excessively depleted due to over extraction. Libya's annual water withdrawal is larger than the volume of its renewable resources.

According to Egypt's Initial National Communication on Climate Change to the United Nations Framework Convention on Climate Change (UNFCCC), Egypt also is undergoing massive projects to divert some of the Nile waters to Northern Sinai and to the Toshka depression in the extreme southern part of the country (IPCC 2007). In addition, 70 percent of cultivated areas rely on low efficiency surface irrigation systems, which result in high water losses, a decline in land productivity, saturation of the ground with water, and salinity problems (IPCC 2007). As the true costs of pollution and water scarcity become increasingly apparent, however, governments and policymakers are also becoming increasingly willing to address water problems (IPCC 2007). In 2007, Algeria, Egypt and Morocco spent 20 and 30 percent of their budgets on water. Bucknall's, 'Making the Most of Scarcity: Accountability for Better Water Management in the Middle East and North Africa' (Hulme *et.al*; 2001) assesses that by 2050, MENA governments will most likely begin to employ water for enterprises that generate the highest amount of money and employment and begin to import more hydro-intensive crops such as wheat. The report estimates that the cost of water-related environmental problems is between 0.5 and 2.5 percent of GDP for most countries. Given that the volume of water available for food production has not been sufficient to satisfy increasing demand (Gibelin *et.al*; 2003). Wichelns describes the role of virtual water as a method by which North African countries have coped with water scarcity in the past. Such was the case during

the boom of the 1970s, when higher incomes and increasing populations created a greater demand for food that could only be generated by increasing food imports.

CHAPTER FIVE

CONCLUSION

After the completion of my research I have come to the conclusion that over the centuries, people in the North Africa have responded deftly to climate change, however, with modern life and economic progress their capacity to cope with climate variations has declined. The situation in the region is further compounded by the fact that North Africa has a low capacity to adopt, both technologically and financially. The impact of climate change on agriculture and poor groups livelihoods are one of the greatest potential threats to development and a key challenge in climate change agenda. The North Africa region is particularly vulnerable to climate change due to geographic and ecological features. The situation is aggravated by the interaction of multiple economic and social sources of stress and further compounded by low adaptive capacity. The interaction between climate change, economic development, and social stability in the North African region are all interlinked and is of great importance (Drine 2010). The climate change will further exacerbate the situation in the region through reduced employment and higher food prices. Indeed, North Africa is one of the most disadvantaged regions of the world with regard to food self-sufficiency diminishing water resources for agriculture and inefficient management of water resources will limit the capacity to feed the region's own population and put more pressure on food prices. Food deficit is increasing and the reliance on external food sources has become a real constraint for development in most countries in the region. Consequently, any variations in agriculture production and food prices will have impact, with possible social ramifications. Limited opportunities for financing and lending as well as misguided agricultural policies have limited adaptation in agriculture sector and resulted in declining farm output. Harsh living conditions in rural areas, due to the paucity of agricultural and rural development will trigger massive rural–urban migration. Droughts in rural areas associated with water scarcity will influence migration into cities, increasing urbanization and stressing the socio-economic conditions. Besides, the Sahara desert is continuously expanding to the north and according to UN conference on desertification held in Tunisia in 2006, by 2020 up to 60 million people could migrate from Sub-Saharan Africa to North Africa and Europe. Furthermore, some experts confirm that diseases from Central Africa like Malaria, yellow fever and dengue fever could extend their endemic areas to North Africa in response to climate change.

It is true that as the North African region which is covered by desert determines the geopolitics of the area which has direct impact on the lives of the people. Global climate change has caused socio-economic and political impact in the North African region. To deal with the issue of climate change several global negotiations have taken place where the North African countries have shown their keen interest. But it is also true that the problem of climate change has only been discussed in the organisations and when it comes on the ground of implementing the measures it has not been put to real practice. But the role and efforts of Maghreb Union, African Union and United Nation cannot be ignored. There are several measures taken by different North African countries but still lot has to be done.

Climate change in the region is more than an issue of environment. It is indeed a matter of development; ‘unsustainable development is the underlying cause of climate change and development pathways will determine the degree to which social systems are vulnerable to climate change’ (Huq *et al*; 2006:4). Climate scientists now feel more confident that the scientific evidence supports the assertion that climate change is likely to occur. They conclude that the current global warming is the result of emission of greenhouse gases through burning fossil fuel, deforestation, and growing population. The effects of climate change so far include rising temperatures, higher sea levels and more frequent extreme weather events like floods, droughts, and storms. Because of climate change, droughts in many arid and semi-arid regions are likely to be more frequent and agriculture will be severely hit by global warming, climate disruption, and extreme weather events (IPCC 2007). The negative effects of climate change on agriculture include increased insect infections, crop damage from extreme heat, planning problems due to less reliable forecasts (uncertainty), increased soil erosion, increased weed growth and disease, decreased herbicide and pesticide efficacy, increased moisture stress, and severe storms and floods. Seasonal changes in rainfall and temperature could alter growing seasons, planting and harvesting calendars. In addition, water availability for irrigation and drinking will be less predictable because rainfall will be more variable. It is possible that salt from rising sea levels may contaminate the underground fresh water supplies in coastal areas. Therefore, agriculture in many countries will be under significant pressure to meet the demand from rising population, which exacerbates food security problem. The IPCC assessment report 2007 states confidently that North Africa (Algeria, Morocco, Libya,

and Tunisia) is extremely vulnerable to climate variations. The severity of climate change impacts on North African countries is related to the geographic and ecological particularity of the region. Moreover, historical data confirm that the annual rainfall in the region has declined since the early 20th century while annual mean temperature has increased. The frequency and severity of floods and heat waves in addition to years of recurring drought combined with the expansion of the Sahara desert into farmlands, confirm that climate change has already begun to affect the region.

However, despite the fact that the impacts of climate change on North Africa are likely to be more severe compared to other regions of the world (taking into account biophysical and socio-economic conditions of the region) there remains a considerable effort to understand the magnitude of the challenge facing the region and the region's capacity to cope.

“...no concerted data gathering and research efforts could be traced regarding the impacts of climate change on health, infrastructure, biodiversity, tourism, water and food production. The economic impact seems to be totally ignored. Reliable records on climate patterns in the region barely exist” (AFED Report 2009).

. Transportation systems, water supply and waste water networks are generally vulnerable to projected increase in intensity and frequency of heat waves, storms and sea level rise. Huge floods in Algeria in 2001, Morocco in 2002 and in Tunis in 2003, confirm that a lot of work needed to be carried out to make the infrastructure in the region more resilient to climate change. Moreover, over reliance on state and underdeveloped civil society are among the main bottlenecks handicapping the region's capacity to cope with the climate change. Climate change now and for many years to come is foremost among the concerns of the North African countries, as these are extremely vulnerable to climate variations. Extreme events associated with climate change, like floods and droughts, will probably set economic development back many years. In other side, approaches to climate change adaptation are not usually aligned with development issues. Climate change mitigation will divert resources from programs to address poverty, unemployment and poor-living

conditions and threats the sustainability of development process. Therefore, conflicting interests between the development and climate change agendas need to be identified and addressed. Identifying a win-win strategy that succeeds to address climate change risks without jeopardizing economic development is top priority for the governments in the region. Moreover, governments in the region need to shift from risk management to risk preparedness. In other words adaptation to climate change should be considered by countries of the region in development programmes. In additions, given that climate change will not be uniform across the country, a climate vulnerability map is needed to identify zones at risk and better targeting interventions. Governments in the region should take steps to reduce the vulnerability and enhance adaptive capacity of the most exposed populations. Finally, limited resources hinder the ability of Morocco and Tunisia to mitigate the impacts of climate change; a regional and international supports for the two countries will be more than necessary to cope with climate change challenge.

Only a few systematic modeling studies of the effects of climate change on agriculture in North Africa are available, possibly due to the fact that most of the region has an arid and semiarid climate and they receive very low level of rainfall. Temporal and spatial irregularity in precipitation makes it difficult to predict the impacts of climate change on agriculture in particular and the economy in general. However, as one of the world's most water-scarce regions with a high dependency on climate-sensitive agriculture, the economic and social conditions in North Africa are likely to deteriorate in the future. Higher temperature in the region will increase evaporation and cause the loss of surface water. In addition, in the quasi-totality of the aquifers ground water level reached alarming values and water quality is at the lower limit of standard. Changes in extremes including floods and droughts are also projected to affect water quality. Sea level rise is projected to extend areas of salinisation of ground water resulting in a decrease of freshwater availability for human and ecosystem in coastal areas (IPCC 2007). According to many experts because of more frequent drought periods, agriculture performance is projected to drop in the future. The adverse impacts of climate change include reduced crop yield due to drought and reduced water availability. Increasing temperature trend will make crops fail to reach mature due to lack of enough moisture in the soil. In the other side warmer climate will probably increase crop losses caused by weeds and diseases.

Climate change in the region will also result in a reduction of the growing period of crops, a reduction of crops cycle, and an increase in the risk of dry period during the course of crop cycles. The 2009 Report by the World Bank, the Food and Agriculture Organization of the United Nations (FAO) and the International Fund for Agriculture Development (IFAD) confirms the average yearly rainfall in the region could decrease by 10% in the next 50 years. Moreover, because of more frequent drought and heat waves rain-fed crop yields are expected to fluctuate increasingly and decrease by almost 40% in Algeria and Morocco (Darin 2010).

North African leaders are aware of the continent's vulnerability. They have long supported international efforts to combat global warming. But because Africa has few industries and produces relatively few greenhouse gases, reducing emissions has not been the top priority. Instead African governments, civil society and their development partners have focused on finding ways to deal with the coming shocks and on assisting vulnerable communities to adapt. Africa's development agenda includes projects to strengthen the ability of communities to cope with climate change. Irrigation schemes are vital for food security and are also an important defense against climate change. As seasonal rains become more erratic irrigation will help farmers keep their livelihoods, increase the food supply and remain on the land. The problem, said by a scientist Ogunlade Davidson, is money. North Africa is receiving some assistance through funds operated by the Global Environment Facility (GEF) established in 1991 to assist developing countries finance environmental protection projects. The Least Developed Countries Fund is only for those countries classified as LDCs, while the Special Climate Change Fund supports climate-related projects in all developing countries. That is one reason why a global commitment to combat climate change is important, he noted, "because it is the international community that can come up with the means. If we put up bureaucratic obstacles on it, African countries will not be able to access those funds and the problem will persist." The time for studies and pilot projects is over, he asserted and he said that now is time to act. "Climate change will have a major impact," he noted. "Africa will have to change its agricultural systems. But if it doesn't have enough money, it can't." Irrigation, fertilizers, and better seeds all require funds. "North Africa never enjoyed the benefits of putting up the greenhouse gases so it never accumulated the wealth to bear the shocks." Now Africans have to cope with a situation they did not create, with

resources they do not have. Global warming is “a double loser for countries in North Africa,” he added (Fleshman 2002).

The potential security consequences of climate change advocates for more aggressive action on climate change have seized on the security connection to draw attention to their cause. In an effort to demonstrate the importance of their concerns, there is a risk of speaking beyond the available evidence to sell the threat. North African region has investigated a range of security consequences conflict, migration, terrorism, and disaster relief to determine what role climate change might play in relation to them. The policy community needs to continually engage academics on the state of their findings and commit to policies that will be beneficial to countries, even if the worst security consequences of climate change do not come to pass. These include early warning systems, disaster preparedness, weather station monitoring, reforestation, better building codes, and drought-resistant agriculture. We observed that North African countries along the Mediterranean tend to be physically exposed to climate hazards but that this vulnerability is offset by better education and health indicators and superior governance at the national level. Countries like Morocco and Tunisia, despite facing higher physical exposure to climate change, are likely to be better equipped to handle the problem. While the precise connections and security consequences remain uncertain, our vulnerability assessments can help policymakers to prioritize resources. Preventive action and measures to address the most vulnerable areas and countries should be more cost-effective than responding to weather emergencies after the fact. At the same time, such investments should mostly involve development assistance rather than hard power, though some investments in training local militaries in disaster response will be a priority. Beyond general support to improve the overall effectiveness of weak governments throughout the region, more targeted funds for adaptation of drought-resistant agriculture, early warning systems, improved flood control, and investments in meteorological stations are particularly important.

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